

**ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT STUDY REPORT FOR**  
**THE PROPOSED WORLD TRADE CENTRE NAIROBI - HOSPITAL ON PLOT**  
**L.R. NO. 24861/1 (NAIROBI BLOCK 149/1351) WITHIN THE NAIROBI BUSINESS**  
**PARK ALONG NGONG' ROAD, NAIROBI COUNTY**



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**AUGUST 2023**



**SUBMISSION**

This Environmental and Social Impact Assessment (ESIA) Study Report has been prepared by Green By Choice Limited, a NEMA certified EIA/EA firm of experts. We, the undersigned, wish to certify that the particulars in this report are correct and true to the best of our knowledge.

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We are indebted to the community members and stakeholders for accepting to participate in the public baraza/ meetings and providing their views, comments and concerns in respect to the proposed project.



## **EXECUTIVE SUMMARY**

NBP Holdings Limited contracted Green by Choice Limited in May 2023 to prepare an Environmental and Social Impact Assessment (ESIA) Study report for the proposed World Trade Centre Hospital on plot L.R. No. 24861/1 (Nairobi Block 149/1351) within the Nairobi Business Park along Ngong' Road, Nairobi County. The proposed project will involve demolition of the existing infrastructure and construction of the multi-speciality hospital with a bed capacity of 150. It will feature two basement floors, ground and five floors. The ESIA is prepared pursuant to Section 58 of the Environmental Management and Coordination Act Cap. 387 of the Laws of Kenya. Urban development including establishment of hospitals are categorised as high risk projects under the Second Schedule (3e) of the Environmental Management and Coordination Act Cap. 387 of the Laws of Kenya and should undergo an ESIA Study process.

The methods used in the preparing the ESIA study report were guided by the Third Schedule of the Environmental Management and Coordination (Impact Assessment and Audit) Regulations, 2003. Site visits were undertaken in June 2023 for purposes of reconnaissance, assessing the baseline and environmental risks associated with the proposed project as well as applicable environmental safeguards and standards. Environmental screening criteria was informed by the Second Schedule of the Environmental Management and Coordination (Impact Assessment and Audit) Regulations, 2003. As per this Schedule the issues considered by the experts were ecological and socio-economic issues, landscape changes, land use character and water. Data collection methods included literature review, observations during site visits and photography. The stakeholder engagement strategy included a community consultative meeting and administration of questionnaires to the neighbours.

The assessment showed that the proposed project will have both positive and negative environmental and social impacts. The positive impacts include provision of high quality and reliable health care services, contribution of the project towards attainment of Vision 2030, creation of employment opportunities, a market for local goods and services, transfer of skills and a source of income to the proponent, County and National Government.

The negative environmental and social impacts will arise throughout the project cycle i.e. demolition phase, construction phase, operation phase and possible decommissioning phase. During the demolition phase, the main environmental concerns will include the solid wastes which will comprise of rubble and assorted derelict items, wood, steel among others. Prior to demolition, the proponent will obtain a demolition permit from the County Government of Nairobi and seek approval from NEMA and implement the recommended mitigation measures.

Construction activities will involve clearing of vegetation and civil works which will impact negatively on the biodiversity and the existing vegetation cover. The proponent should retain vegetation cover in areas that will not be excavated as far as practicable, compact loose soil within the project sites, use the overburden generated during construction activity to backfill



the adjacent eroded areas and replant indigenous trees in the section of the property that will not be developed to compensate for loss at construction phase.

Site preparatory and construction activities will generate significant quantities of solid waste in form of biomass, overburden, domestic waste such as plastic containers and construction materials such as wood, building blocks, metal cuttings and wrappings among others. The proponent will procure the services of a NEMA licensed waste handler to dispose the solid waste and ensure compliance with the provisions of the Environmental Management and Coordination (Waste Management) Regulations, 2006.

Increased water demand and effluent generation during construction phase will be mitigated by procuring temporary toilets for use by the workers, sensitizing workers on need to conserve available water resources, acquiring a Water Resources Authority (WRA) permit to abstract water from the existing borehole and ensuring compliance with the provisions of Environmental Management and Coordination (Water Quality) Regulations, 2006.

Air pollution during the construction phase will be in form of dust and particulate matter generated during excavations, concrete mixing activities and exhaust fumes from machinery use and Heavy Commercial Vehicles (HCVs) delivering construction materials to the site. The proponent should mitigate this impact by ensuring dust screens are installed around the project site, water sprinkled to suppress dust, stock piles of construction materials covered, adequate dust masks provided and enforcing their use as well as monitoring fugitive emissions to ensure compliance with limits set under the First Schedule of the Environmental Management and Coordination (Air Quality) Regulations, 2014.

Noise pollution during the construction phase will emanate from machinery operations and vehicles delivering materials to the site. The noise levels produced may be above the stipulated Environmental and Management Co-ordination Act (EMCA) limits and are a health hazard. The proposed mitigation measures include delivery of raw materials, excavation and construction work be limited to day time hours only between 8am to 5pm, locate machinery that are likely to produce noise as far as practical from neighbouring properties, procure, provide and enforce the use of earmuffs, sensitize truck drivers to avoid unnecessary hooting and running of vehicle engines and ensure compliance with provisions of the Environmental Management and Coordination (Noise and Excessive Vibration Pollution) (Control) Regulations, 2009.

The workforce, visitors and neighbours to the proposed project site will be exposed to potential safety and health risks during construction activities. The potential safety risks will be from the use of machinery, falling objects or even falls. These risks have a potential to cause disturbances, injuries, permanent disability or even death. The proponent should register the site as a workplace with the Directorate of Occupational Safety and Health Services (DOSHS), obtain insurance cover for the workforce, provide and enforce the use of Personal Protective Equipment (PPE), provide the correct equipment for the jobs assigned and train the employees on their use, provide first aid services and emergency vehicle at the site, regulate the entry of visitors to the construction site by deploying adequate security



measures and comply with the provisions of the Occupational Safety and Health Act (OSHA), 2007.

There is potential for leakage and spillage during fueling, servicing and maintenance of machinery and vehicles. This increases the chances of soil and water contamination. The proponent and contractor should properly store, handle and dispose new oil and used oil waste, procure and train workers on the use of oil spill containment kits and contract a NEMA licensed waste oil handler to manage the waste oil from the construction site.

Heavy Commercial Vehicles delivering construction materials to the proposed project site will interfere with the normal traffic flow along Ngong' Road especially in cases of stalling and breakdowns. The proponent should prepare and implement a Traffic Management Plan, ensure delivery of construction materials are not undertaken during peak hours, displaying signage and warnings on the road to forewarn other road users on the use of the road by HCVs and adhering to the Nairobi County Government Traffic By-Laws and Kenya Traffic Laws.

During the operational phase, the significant environmental and social impacts will include: waste generation and management, increased waste water, increased water demand, occupational safety and health risks, fire risks and emergency preparedness, increased energy demand, increased storm water and traffic volume. A summary of the recommended mitigation measures for this phase is as shown on Table 1 below.

**Table 1: Summary of potential environmental impacts and proposed mitigation measures during the operational phase.**

<b>Potential environmental impact</b>	<b>Proposed mitigation measures</b>
Waste generation and management	<ul style="list-style-type: none"><li>✓ Segregate waste at their point of generation</li><li>✓ Infectious and/ or hazardous wastes should be identified and segregated according to its category using a color-coded system</li><li>✓ Train staff on the storage, management and disposal of radioactive wastes in accordance to national and international standards</li><li>✓ Prepare a Health Care Solid Waste Management and Disposal plan</li><li>✓ Procure the services of a NEMA licensed biomedical waste handler to dispose the waste</li><li>✓ Biomedical wastes should be incinerated at site or disposed of by licensed waste handler</li><li>✓ The radioactive waste management should be in line with the Nuclear Regulatory Act, 2019</li><li>✓ Comply with the Waste Management Regulations, 2006</li></ul>
Occupational Safety and health risks	<ul style="list-style-type: none"><li>✓ Conduct occupational training programs and specialty courses, to ensure that workers are oriented to the specific</li></ul>



## ESIA Study for the Proposed World Trade Centre Nairobi Hospital

Potential environmental impact	Proposed mitigation measures
	<ul style="list-style-type: none"><li>hazards of individual work assignments</li><li>✓ Conduct risk assessment and Occupational Safety and Health audits annually</li><li>✓ Keep an accident and/ incident register</li><li>✓ Display precautionary and informative signage at strategic areas</li><li>✓ Ensure compliance with the provisions of the OSHA, 2007</li></ul>
Increased traffic volume	<ul style="list-style-type: none"><li>✓ Implement the Traffic Management Plan</li><li>✓ Designate vehicle registration and checkpoints inside the premises to avert unnecessary traffic snarl up along adjacent roads caused by vehicles waiting to access the hospital.</li><li>✓ Provide ample parking space within the hospital</li><li>✓ Provide dedicated exits and entries for the hospital</li></ul>

A decommissioning phase is possible in the event of end of project life, closure by government agencies due to non-compliance with environmental and health regulations, an order by a court of law due to non-compliance with the existing regulations, natural calamities and change of user of land. The proponent should prepare and submit a due diligence decommissioning audit report to NEMA for approval at least three (3) months in advance.

In conclusion, this study has found out that the proposed project will be viable with minimal adverse impacts. The ESIA study proposes a suite of Environmental and Social Management and Monitoring Plans to address the anticipated negative impacts during the project cycle and improving the environmental performance of the proposed project. On the basis of a commitment by the proponent to implement the proposed mitigation measures and the Environmental Management Plans, we recommend the issuance of an EIA License as per the Environmental Management and Coordination Act Cap. 387 of the Laws of Kenya.



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**ACRONYMS**

<b>BAT</b>	Best Available Technology
<b>BEP</b>	Best Environmental Practice
<b>CIDP</b>	County Integrated Development Plan
<b>CSR</b>	Corporate Social Responsibility
<b>DOSHS</b>	Directorate of Occupational Safety and Health Services
<b>EA</b>	Environmental Audit
<b>EDL</b>	Effluent Discharge License
<b>EIA</b>	Environmental Impact Assessment
<b>EMCA</b>	Environmental Management and Coordination Act
<b>EPRA</b>	Energy and Petroleum Regulatory Authority
<b>ESIA</b>	Environmental and Social Impact Assessment
<b>ESMP</b>	Environmental and Social Management Plan
<b>GOK</b>	Government of Kenya
<b>HCV</b>	Heavy Commercial Vehicle
<b>HCWM</b>	Health Care Waste Management
<b>ITCZ</b>	Inter-Tropical Convergence Zone
<b>KEBS</b>	Kenya Bureau of Standards
<b>L.R.</b>	Land Reference
<b>NCA</b>	National Construction Authority
<b>NCCAP</b>	National Climate Change Action Plan
<b>NCWSC</b>	Nairobi City Water and Sewerage Company
<b>NEMA</b>	National Environment Management Authority
<b>OSHA</b>	Occupational Safety and Health Act
<b>PPE</b>	Personal Protective Equipment
<b>PPP</b>	Public-Private Partnership
<b>SDG</b>	Sustainable Development Goal
<b>SQM</b>	Square meter
<b>TOR</b>	Terms of Reference
<b>VAT</b>	Value Added Tax
<b>VOC</b>	Volatile Organic Carbon
<b>WRA</b>	Water Resources Authority
<b>WRUA</b>	Water Resources Users Association
<b>WSP</b>	Water Services Provider
<b>WSTF</b>	Water Sector Trust Fund



## **1 INTRODUCTION**

### **1.1 Background information**

The private health sector is increasingly viewed as critical to meeting the growing demand for financing and delivery of health care services in the country. The private health market has dramatically grown over the last two decades and is an important source for care across various segments of the population. In recognition of this important role, the Government of Kenya (GOK) has developed strategies to develop the private health sector in its Vision 2030 plan as well as in the strategic plans for 2008-2012 of the Ministry of Medical Services and Ministry of Public Health and Sanitation. Some of the key features of those plans include social health insurance to increase access to health care, a reduced role for the Ministry of Health in service delivery, more delegation of authority to provincial and district level, and promoting more public-private partnerships (PPPs). The country intends to become a regional provider of choice for highly-specialised health care, thus opening the country to health tourism as an income generating activity.

The proponent, NBP Holdings Limited, proposes to set up a multi-specialty hospital on an approximately 2.5 acres piece of land on Plot L.R. No. 24861/1 (Nairobi Block 149/1351) within the Nairobi Business Park along Ngong' Road, Nairobi County. Urban development including establishment of hospitals are categorised as high risk projects under the Second Schedule (3e) of the Environmental Management and Coordination Act Cap. 387 of the Laws of Kenya and should undergo an Environmental and Social Impact Assessment (ESIA) Study process. To fulfil this legal requirement, ensure sustainability of the development activities and improve its environmental performance, the proponent contracted Green By Choice Limited to carry out the ESIA Study.

Prior to the commencement of the ESIA study process, the consultant prepared and submitted to National Environment Management Authority (NEMA) a Scoping Report and Terms of Reference (TOR) as per the Environmental Management and Coordination (Impact Assessment and Audit) Regulations, 2003 which was approved 6<sup>th</sup> June 2023 (Ref. No. NEMA/TOR/5/2/580). The purpose of the TOR was to define the geographical and technical scope to be covered by the ESIA Study as per the following sections.

### **1.2 Objectives of the Study**

The overall objective of the study is to carry out an assessment of the proposed development to determine whether the proposed project will have any adverse impacts on the environment, taking into account biophysical, social, cultural, legal and economic considerations. The specific objectives of the study are to:-

- identify the likely negative impacts of the proposed project
- assist decision makers arrive at a decision whether to grant a license to the proposed project
- verify compliance with environmental laws, policies and regulations as well as industry best practice and standards
- identify and analyze alternatives to the envisaged project
- identify, analyze and propose mitigation measures for negative impacts and



enhancement measures for positive impacts to be undertaken during and after the implementation of the project including recommending cost effective measures to be used to mitigate against the anticipated negative impacts

- seek the views of affected persons in consultation with NEMA
- prepare an Environmental and Social Management Plan (ESMP) report compliant with the Environmental Management and Coordination Act Cap. 387 of the Laws of Kenya.

### **1.3 Terms of Reference**

The Terms of Reference for the study of the proposed project are to:-

- provide a detailed description of the proposed project in terms of location, objectives, design, activities, material inputs, outputs, products and waste
- provide a detailed description of the baseline environmental and socioeconomic conditions of the proposed project area
- review the relevant legal, policy and institutional framework applicable in the implementation of the proposed project
- provide a detailed description of the potentially affected environment
- identify, predict and analyze the environmental and social impacts of the proposed project, including seeking neighbours and public views and concerns
- provide an analysis of project alternatives in terms of site, design and implementation technologies and provide reasons for preferred options
- provide a detailed Environmental and Social Management Plan (ESMP) proposing measures for mitigating negative environmental and social impacts, including the responsibility, timeframe and cost to implement the measures.

### **1.4 Study approach and methodology**

#### **1.4.1 Introduction**

The ESIA study report methods were guided by the Third Schedule of the Environmental Management and Coordination (Impact Assessment and Audit) Regulations, 2003. The consultants prepared a scoping report and Terms of Reference (TOR) as required under Regulation 11 of the Environmental Management and Coordination (Impact Assessment and Audit) Regulations, 2003 and submitted them to NEMA for consideration for approval. The scoping report and TOR were approved on 6<sup>th</sup> June, 2023 and the consultants began preparation of the ESIA study report.

#### **1.4.2 Data collection**

The methods for carrying out the study included site visits and observations, literature review and holding consultative meetings with stakeholders. Site visits were carried out in May 2023 for purposes of area reconnaissance, assessing the baseline environmental conditions of the proposed project site and screening of environmental risks associated with the proposed development as well as the applicable environmental safeguards and standards. Environmental screening criteria was informed by the Second Schedule of the Environmental Management and Coordination (Impact Assessment and Audit) Regulations, 2003. As per



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this schedule, the issues considered by the experts included ecological impacts, socio-economic issues, landscape changes, land use character and water (Table 2).

**Table 2: Summary of the results from the screening and scoping exercise.**

Criteria	Results
Ecological impacts	<ul style="list-style-type: none"><li>– Excavation will occur</li><li>– Proposed project site neighbours the Ngong’ Forest</li><li>– There are indigenous tree species on site</li><li>– No endangered species of trees or plants found at the site</li></ul>
Social-economic considerations	<ul style="list-style-type: none"><li>– Contribution of the project towards attainment of Kenya Vision 2030</li><li>– Provision of quality and affordable healthcare services</li><li>– Creation of employment opportunities</li><li>– Optimal use of land</li><li>– Income to the proponent</li><li>– Revenue to the government through taxes &amp; licenses</li><li>– Workers and neighbours during construction and operational phases will be exposed to safety and health risks</li><li>– No cultural or heritage issues at the site</li></ul>
Landscape impacts	<ul style="list-style-type: none"><li>– The landscape of the area will be altered and new views created</li></ul>
Land uses	<ul style="list-style-type: none"><li>– The project neighbourhood features mixed land use</li></ul>
Water	<ul style="list-style-type: none"><li>– The construction and subsequent operations of the proposed project will increase water demand and impact on water resources</li></ul>

### 1.4.3 Stakeholder engagement strategy

#### 1.4.3.1 Introduction

Public and stakeholder participation in the ESIA process was conducted pursuant to the following International and National legal instruments;

A. International Legal Instruments that make Stakeholder Consultation and Public participation during Environmental Impact Assessment process mandatory

1. Aarhus Convention
2. United Nations Conference on Environment and Development
3. Convention on Environmental Impact Assessment in a Trans-boundary Context
4. Principle 17 of the 1992 Rio Declaration on Environment and Development
5. Agenda 21

B. National Legal instruments that make Stakeholder Consultation and Public participation during Environmental Impact Assessment process mandatory

1. Constitution of Kenya 2010 Article 69 (1) (d)
2. Section 59 of the Environmental Management and Coordination Act (EMCA), 1999
3. Regulation 35 of the Environmental (Impact Assessment and Audit) Regulations, 2003



### **1.4.3.2 Methodology used in the Consultation and Public Participation**

#### **1.4.3.2.1 Stakeholder Mapping**

Prior to commencement of the ESIA process, the consultants conducted a stakeholder mapping and analysis to determine the individual, groups and institutions that will be affected by and have an interest in the project in consultation with the proponent, the County Government and the Ministry of Interior and Coordination of National Government. The consultants then prepared a comprehensive list of all the stakeholders in consultation with the proponent and categorized them based on the following:

- Low interest, low influence – those to keep informed
- High interest, low influence – those to involve and consult with
- Low interest, high influence – powerful stakeholders to engage
- High interest, high influence – partners to collaborate with

Nine key stakeholder categories are envisioned. These are;

1. County and National Government Representation
2. Lead Agencies and community organizations operating directly under them
3. Civil Society
4. Conservation Organizations
5. Local Community and Residents' Associations
6. Opinion leaders including political leaders
7. Faith Based Institutions
8. Special Interest Groups
9. Media

The consultant then identified the key contact persons within the stakeholder categories who will be engaged throughout the ESIA study process. The identification of the key contact persons was done in consultation with the proponent, lead agencies, the County Government of Nairobi, Ministry of Interior Coordination of National Government, Residents Associations, Community Groups, Non-Governmental Organizations and Conservation groups.

Further, the consultant identified other stakeholders who may not be apparent but needed to be consulted and analyzing the role of each stakeholder in the ESIA study process as well as project implementation. Finally, the consultant determined the tools for engaging with each stakeholder including language of communication and allocation of resources to ensure meaningful participation of the stakeholders in the ESIA process.

#### **1.4.3.2.2 Administration of questionnaires**

Questionnaires were administered to the different target groups and local community members in the vicinity of the proposed project site. Oral interviews and administering of questionnaires was undertaken. Door to door public consultations were conducted for the stakeholders neighbouring the proposed project site. This was conducted to solicit the opinion of the neighbouring community and also ensure comprehensiveness in the ESIA study report as stipulated in the Environmental Management and Co-ordination Act Cap. 387 of the Laws



of Kenya. It is also a way of informing the community of proposed future developments in their neighbourhood.

**1.4.3.2.3 Public baraza**

A public baraza was held where various concerns and proposed mitigation measures were suggested by the general public and other stakeholders. These have been integrated in this study report.



## 2 DESCRIPTION OF THE PROPOSED PROJECT

### 2.1 Proposed project location

The proposed project will be located on plot L.R.No. 24861/1 (Nairobi Block 149/1351) within the Nairobi Business Park along Ngong' Road, Nairobi County (Figure 1). It is georeferenced at Latitude 1°18'26"S and Longitude 36°44'24"E and 1820m above sea level. The proposed site neighbours the Ngong' Race Course and Golf Park, Ngong' Road Forest Sanctuary and Nairobi War Cemetery to the South East, residential buildings to the North and commercial buildings to the West.

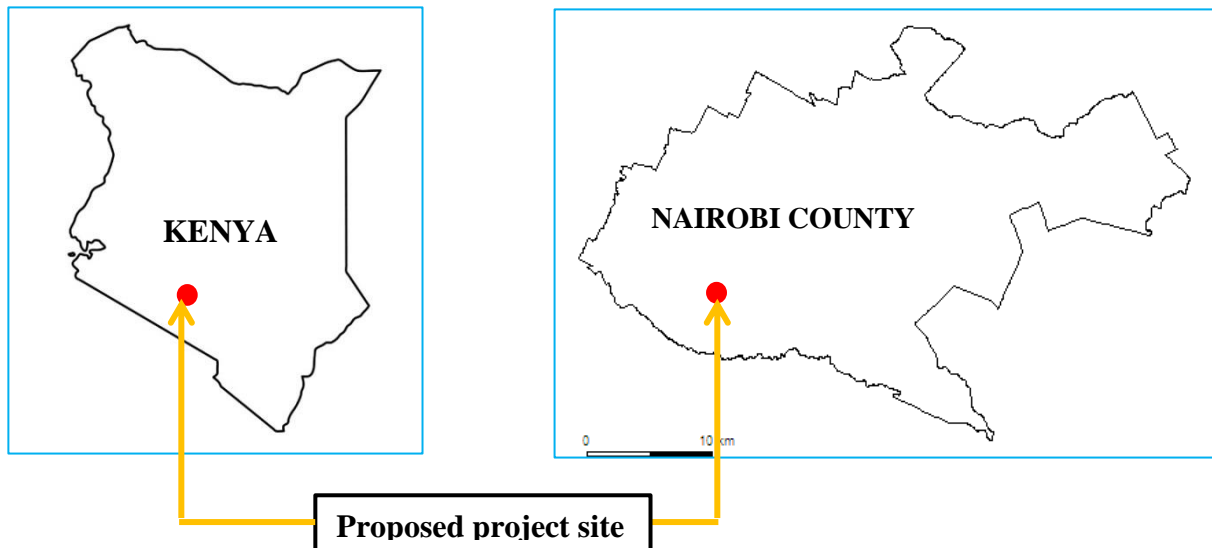


Figure 1: The location of the proposed project site (Source: Google Earth, 2023).



## **2.2 Proposed project description and activities**

The proposed project will involve demolition of the existing infrastructure such as the sewer line, cable line, pump room, water tanks, power house, Information and Communications Technology (ICT) room, transformer, switch room, generator shed, old office blocks, stores and their associated amenities (Figures 2 - 4) and construction of the multi-speciality hospital with a bed capacity of 150. The proposed hospital will feature two basement floors, ground and five floors as shown in Figure 5 and Table 3 below.



**Figure 2: A section of the trunk sewer line connected to the interceptor within the proposed project site (Source: Site visit, June 2023).**



**Figure 3: The ICT room, transformer, switch room and generator shed at the proposed project site (Source: Site visit, June 2023).**





Figure 4: The water tank and pump house at the proposed project site (Source: Site visit, June 2023).



Figure 5: The general layout of the proposed hospital (Source: Symbion Kenya Limited, July 2023).

Table 3: Development components and features of the proposed development (Source: Summarized from Architects United).

Component/ Floors	Area/Capacity	Main Features
Basement 2	4153.68 SQM	Parking bay (107 cars) Electrical panel room Engineering store Female and male lockers Housekeeping cubicle



## ESIA Study for the Proposed World Trade Centre Nairobi Hospital

Component/ Floors	Area/Capacity	Main Features
		Medical gases Server room Staff lounge
Basement 1	4070.27 SQM	Parking bay (91 cars) Command rooms (2) Electrical panel room General store IT Department Linen store Pharmacy store & cabin Pump room Record room Underground water tank Waste management
Ground floor	2219.10 SQM	Accounts office Billing office Bone Mineral Density Cafeteria Casualty ward Emergency ward Magnetic Resonance Imaging Pharmacy Pulmonary Function Tests Ultrasonography X-ray
First floor	2141.59 SQM	Occupational Therapy (5) Intensive Care Unit (30) Cardiac Catheterization Laboratory Counselling room Equipment bay UPS room Tech room Staff change
Second floor	1640.27 SQM	Nephrology & urology department (10 beds) Oncology & haematology department (10 beds) Endoscopy departments (7 beds) Blood bank Chapel Counselling room Healing garden Laminar room Linen segregation Mosque



## ESIA Study for the Proposed World Trade Centre Nairobi Hospital

Component/ Floors	Area/Capacity	Main Features
		Outpatient Department Physiotherapy Reverse Osmosis plant Service kitchen Training room
Third floor	1675.45 SQM	Neonatal Intensive Care Unit (8) Paediatric Intensive Care Unit (5) Semi-private room (10) Private rooms (9) Andrology cryo room Consultation room Culture room Feeding room Gas store In vitro fertilization laboratory Intrauterine insemination room Labour operating theatre Labour room Milk store Outpatient Department Pharmacy store Recovery room Semen collection
Fourth floor	1401.83 SQM	General wards (48) Semi-private rooms (16) Administration working area Pantry Printing & storage area
Fifth floor	1283.05 SQM	Private rooms (24) Canteen Pantry Pathology Laboratory Training room

Other installations include washrooms, resident doctors' rooms, stores, lounges, lobbies, lifts, waste segregation, linen segregation, clean and dirty utility rooms, electricity and electrical appliances, water supply systems and plumbing systems among others.

### 2.2.1 Planning, preparation and design activity phase

This phase entails planning, site zoning and preparation of the proposed project taking into consideration type and nature of materials to be used, while bearing in mind the physical conditions of the plot in line with total costs as well as economic value of the proposed project.



### **2.2.2 Excavation and foundation works**

Excavation will be carried out to prepare the site for laying of foundations, pavements and drainage systems. The excavation will involve the use of heavy earthmoving machinery such as tractors and bulldozers.

### **2.2.3 Construction phase**

This phase will involve demolition of the existing infrastructure prior to the excavation and foundation works, setting foundations/slabs for the proposed development, masonry works, roofing, electrical work, plumbing and civil works. During this stage drainage works will also be done.

### **2.2.4 Materials and Equipment during Construction Phase**

The following are the materials and equipment that will be used during the construction of the proposed hospital (Table 4). All materials that will be used shall be as per the Kenya Bureau of Standards (KEBS) specifications, and materials will be sourced from local manufacturers in the surrounding area where possible.

**Table 4: The materials and equipment to be used.**

<b>Materials</b>	<b>Equipment</b>
<ul style="list-style-type: none"><li>• Stones/building blocks</li><li>• Common burnt clay bricks</li><li>• Sand</li><li>• Concrete</li><li>• Steel reinforcement bars</li><li>• Cement</li><li>• Tiles</li><li>• Roofing material</li><li>• Electrical wires etc.</li><li>• Prefabricated steel structures</li></ul>	<ul style="list-style-type: none"><li>• Cranes</li><li>• Excavator</li><li>• Vibrators</li><li>• Welding machines, cranes, wheelbarrows</li><li>• Transportation vehicles</li><li>• Concrete mixer</li><li>• Concrete pumps etc.</li></ul>

### **2.2.5 Operational phase**

Once construction of the proposed hospital is completed, it is anticipated that staff will occupy the premises and undertake typical medical facility activities. There is need to incorporate efficient operational controls together with trained staff, to ensure high level efficiency and environmental performance.

### **2.2.6 Decommissioning Phase**

Upon decommissioning, the project components including the main structure, pavements, drainage systems, parking areas and perimeter fence will be demolished. This will generate a lot of solid waste, which will be recycled or re-used for this or other construction works or if not re-usable, disposed of appropriately by a licensed waste disposal company.

All equipment including electrical installations, production equipment among others will be dismantled and removed from the site on decommissioning of the project. Priority will be



given to reuse of this equipment in other projects. Once all the waste resulting from demolition and dismantling works is removed from the site, the site will be restored through replenishment of the top soil and re-vegetation using indigenous plant species.

### **2.3 Project budget**

The total estimated cost of the proposed project is KES 3,240,136,736 inclusive of 16% Value Added Tax (VAT).



### 3 BASELINE CONDITIONS OF THE PROPOSED PROJECT SITE

#### 3.1 Introduction

Baseline conditions of the proposed project site were assessed and documented for the purposes of determining the future impacts of the proposed project on the environment and livelihoods of the local community. The baseline survey was done through literature review and site visits. This section details on the findings of the survey which will form a basis for impact monitoring plans and improvement of the environmental and social performance of the proposed project during implementation.

#### 3.2 Climate and rainfall conditions

The climate of Nairobi is predominantly equatorial and is influenced by the movement of the overhead sun and altitude. Physical features of Nairobi are diverse with a rugged topography characterized by different relief aspects which affect the climate and vegetation of the area. Rainfall pattern in Nairobi is bimodal alternating with dry seasons as it is associated with the Inter-Tropical Convergence Zone (ITCZ). The ITCZ is connected to the passage of the overhead sun and lags by few weeks twice a year resulting in the long rains (April) and short rains (November). The mean annual rainfall in Nairobi is about 900mm with the two maxima. The annual range of temperature in Nairobi is small while the diurnal range is large for all the months of the year. This is attributed to the strong isolation during the day resulting in large values of maximum temperature while during the night, the strong radiative cooling results in low minimum temperatures. The warmest period in Nairobi is from December to April with average minimum and maximum temperatures of 11.5°C and 22°C respectively (Figure 6).

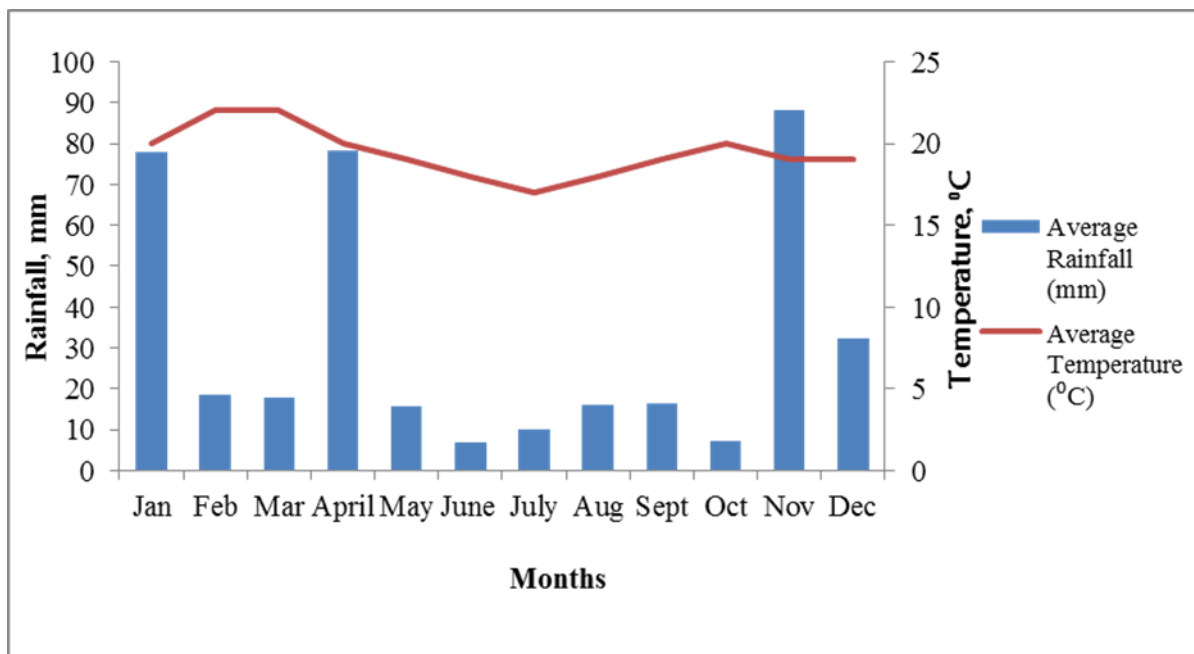


Figure 6: Average rainfall and temperature distribution for Nairobi City County (Source: World Weather Online, processed from 2022 data).

#### 3.3 Physical and topographic features

The terrain in the Eastern side of the County is gently rolling but divided by steep valleys towards the City boundaries. To the North, there is the Karura Forest which is characterized



by steep sided valleys. The Karen-Lang'ata area is characterized by plains surrounded by Nairobi National Park on the East and Ngong' Forest on the South.

Several streams with steep-sided valleys covered with vegetation are a dominant landscape feature of the County. The main rivers in the County are Nairobi River, Ngong' River and Kabuthi River. These rivers are highly polluted by effluent from open sewers and industrial waste. Nairobi dam, which is along the Ngong' River, and Jamhuri Dam are the main water reservoirs in the County. The main types of soils are black cotton and red soils that form patches in different parts of the County. There are three forests in the County, namely Ngong' Forest to the South, Karura Forest to the North and the Nairobi Arboretum. The three forests have a total coverage of 23.19 Km<sup>2</sup>.

### **3.4 Soil formation**

According to the Geotechnical report, the soil on the proposed site is a 1m to 3m thick layer clay of intermediate to high plasticity with sand and gravel inclusions. Underlying the soil is rock, tuffs, cemented volcanic ashes down to 20m or so overlying trachyte, a hard lava. The rock strength varies in depth from "weak" to "strong" as defined by BS5930: Code of Practice for Site Investigations; the strength corresponding with the two types of rock. The soils, very weak and mobile under change in moisture content, are unsuitable as a foundation. The rock below, with an allowable bearing pressure of 400kPa, will be an excellent foundation.

### **3.5 Land use/cover**

Land uses in Nairobi have evolved over the decades as a result of planning attempts in solving the urban problems. There are seven distinct land uses in the city namely, residential, commercial, industrial, institutional, recreational, transportation and agricultural (which has persisted in peri-urban neighborhoods). The county is endowed with some permanent rivers. However, the aquatic ecosystems are largely choked by the effects of pollution from different sources. Currently, efforts are underway to ensure a sustainable clean Nairobi River Basin. In addition, the city has witnessed major extensions and currently the total area occupied by industrial activities is 2,370 hectares. However, the policy on location of small-scale industrial sites has not been sufficiently implemented triggering acute shortage of serviced open-air industrial workplaces. Rangelands, agricultural, secondary growth and riparian vegetation have declined which is attributed to the population growth in the peri-urban areas which has led to land fragmentations to acreages which are not agriculturally viable. Thus the city experiences increased land consumption rate and absorption coefficient i.e. the city's growth has been characterized by urban sprawl. The proposed project is located within a mixed-use zone.

### **3.6 Biodiversity**

The proposed project site neighbours the Ngong' Sanctuary Forest. It is the only indigenous forest that is located within Nairobi county, it is rich in biodiversity as it is home to over 175 bird species, over 35 mammals and numerous insects, reptiles, amphibians and fish. One of the important bird species that inhabits the forest, which serves as an indicator of ecosystem



health, is the African Crested Eagle (Wainaina, 2014). The flora identified at the proposed project site include the African tulip (*Spathodea campanulata*) (Figure 7), Locust trees spp. (Figure 8), Eucalyptus spp. (Figure 8), blackjack, lantana camara among others.



**Figure 7: The African tulip at the proposed project site (Source: Site visit, June 2023).**



**Figure 8: Some eucalyptus trees observed adjacent to the proposed project site (Source: Site visit, June 2023).**

### **3.7 Water resources and sanitation**

Water and sanitation in Nairobi face problem common to many cities of the developing world which grow too fast. The water supply is unable to meet the fast growing demand. Water is unreliable even to the small majorities who have direct connection to tapped water. For those who cannot get enough, reliance on alternative unregulated service suppliers is a necessity, but these practice prices which are much higher than the legal rate. For those with the means, investment in storage tanks helps harvesting more water at the expense of everyone else in the community. This situation translates into unequal and inequitable consumption of the



available water. The Nairobi water utility; Nairobi City Water and Sewerage Company (NCWSC), relies almost exclusively on surface water to satisfy the growing city's water needs. The city's major water service provider suffers from poor water quality and intermittent water shortages. In addition, erosion in the Aberdare Range from deforestation is causing siltation in the company's reservoirs, resulting in a loss of storage capacity. Moreover, due to high leakage, frequent pipe bursts in the network and intermittent supply treated water is sometimes contaminated before it reaches the tap. This further increases the water-borne disease fatalities especially in the informal settlement. The proposed project area sources its water from an existing borehole.

The existing sewer network has a total length of about 163Km and covers an area of about 208Km<sup>2</sup> which is less than 30% of the 696Km<sup>2</sup> area of the City. There are two wastewater treatment plants in Nairobi: the Dandora stabilization ponds (with a capacity of 80,000m<sup>3</sup> per day which treats industrial and domestic sewage) and the Kariobangi wastewater treatment plant (with a capacity of 32,000m<sup>3</sup> per day which uses the trickling filter technology). The wastewater from both plants discharge into the Nairobi River. Currently, the Dandora stabilization ponds treat only half of their capacity while the Kariobangi wastewater treatment plant has stopped functioning thus wastewater bypasses the system and discharges into the Nairobi River. The proposed project site is connected to the sewer line.

### **3.8 Demographic characteristics**

According to the 2019 Population and Housing Census, Nairobi City County has a total population of 4,397,073 people with a population density of 6,247 people per squared kilometers. However, the population densities vary widely within the city with high-income zone's average densities being as low as 911/Km<sup>2</sup> while low-income areas experience densities as high as 68,940/Km<sup>2</sup>. Nairobi is a culturally diverse city and all the major Kenyan ethnic groups are represented in the city. Lang'ata Sub-County, where the proposed project lies, has a population of 197,489 people.

### **3.9 Infrastructure**

There is heavy congestion on most of the City's roads especially during the morning and evening peak hours. The total road network covers 3,602 Km out of which 1,735 Km are tarmac while 1867 Km are earth roads. The current poor state of the road network is a great impediment to socio-economic growth leading to high production costs and low productivity. The completion of Thika Super Highway, by-passes and missing links within the County has helped to reduce traffic congestion. The proposed project area is served by Ngong' Road which is tarmacked.

The main sources of energy in Nairobi City County are electricity, solar, Liquefied Petroleum Gas (LPG), biogas, paraffin, charcoal and firewood. Lack of access to clean sources of energy is a major impediment to development due to health related complications such as increased respiratory infections and air pollution. The type of cooking fuel used by households is related to their socioeconomic status. High level energy sources are cleaner but cost more and are used by households with higher levels of income compared to simpler



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sources of fuel, mainly firewood, which are mainly used by households with a lower socio-economic profile. The sources of energy at the proposed project include the National energy grid and back-up generator.



## **4 LEGISLATIVE POLICY AND INSTITUTIONAL FRAMEWORK**

### **4.1 Introduction**

The Third Schedule of the Environmental Management and Coordination (Impact Assessment and Audit) Regulations, 2003 requires that environmental guidelines and standards which include the Kenyan government policies and strategies, National legislation and associated institutions should be incorporated in an ESIA report. The legal and institutional frameworks provide important safeguards for protection and conservation of fragile environments and vulnerable communities and enhance the implementation of the Environmental and Social Management Plans. Under this section, the ESIA will therefore review the applicable sets of laws and institutions which are tasked with the protection and conservation of the environment at the proposed project site.

### **4.2 Policy Framework**

#### **4.2.1 The National Environment Policy, 2013**

The National Policy aims to provide a framework for an integrated approach to sustainable management of Kenya's environment and natural resources. In particular, it proposes to strengthen:-

- Legal and institutional framework for good governance
- Integration of environmental management with economic growth, poverty reduction and improving livelihoods
- Research and capacity development
- Promotion of new environment management tools
- Promotion of collaboration and cooperation and partnerships in environment management
- Promotion of domestication, co-ordination and maximization of benefit from Strategic Multilateral Environment Agreements

#### **4.2.2 The National Health Policy 2014 - 2030**

The goal of the policy is to attain the highest possible standard of health in a responsive manner. The health sector aims to achieve this goal by supporting equitable, affordable, and high-quality health and related services at the highest attainable standards for all Kenyans. This policy has six objectives which include:

- eliminating communicable conditions,
- halting and reversing the rising burden of non-communicable conditions and mental disorders,
- reducing the burden of violence and injuries,
- providing essential healthcare,
- minimizing exposure to health risk factors, and
- strengthening collaboration with private and other sectors that have an impact on health.

This policy takes into account the functional responsibilities between the two levels of government (county and national) with their respective accountability, reporting and



management lines. It proposes a comprehensive and innovative approach to harness and synergise health services delivery at all levels.

#### **4.2.3 The Health Care Waste Management Plan 2016 –2021**

The aim of the plan is to strengthen the Health Care Waste Management (HCWM) systems in Kenya through the protection of patients, health workforce, the public and the environment from the hazards associated with health care risk waste. The plan provides direction of reinforcing the capacity of the Ministry in its central policy support role and strengthening county health institutions health facility specific HCWM services focusing on Best Available Technologies (BAT) and Best Environmental Practices (BEP). The plan is a major input in ensuring the delivery of quality health services which will eventually contribute to the achievement of the Sustainable Development Goals (SDGs) number 3 (Good health and well-being) and 12 (Responsible consumption and production). All efforts to improve health sector performance, irrespective of which approved provider runs it, are ultimately geared towards improving peoples' health and safeguarding the environment.

#### **4.2.4 The National Land Policy, 2009**

The National Land Policy guides the country towards efficient, sustainable and equitable use of land for prosperity and posterity. The policy aims at promoting positive land reforms for the improvement of the livelihoods of Kenyans through establishment of accountable and transparent laws, institutions and systems dealing with land. The overall objective of the policy is to secure rights over land and provide for sustainable growth, investment and the reduction of poverty in line with the Government's overall development objectives. Specifically, the policy offers a framework of policies and laws designed to ensure the maintenance of a system of land administration and management that will provide: a) All citizens with the opportunity to access and beneficially occupy and use land; b) Economically viable, socially equitable and environmentally sustainable allocation and use of land; c) Efficient, effective and economical operation of land markets; d) Efficient and effective utilization of land and land-based resources; and e) Efficient and transparent land dispute resolution mechanisms.

#### **4.2.5 The National Energy and Petroleum Policy, 2018**

This policy aims to ensure sustainable, adequate, affordable, competitive, secure and reliable supply of energy at the least cost geared to meet national and county needs while protecting and conserving the environment. It has twenty objectives that include but not limited to providing an environment conducive for the development and provision of energy services and ensuring that prudent environmental, social, health and safety considerations, as well as issues of climate change are factored in energy and petroleum sector developments.

#### **4.2.6 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. The overall objective of the policy is to provide a framework that is dynamic, innovative, and effective for re-engineering the water sector. The water policy proposes to mitigate the challenges and threats facing the



water sector by ensuring that coordination and accelerated partnerships are mainstreamed in the management and provision of water resources. It also sets the goal of enhancing protection of watersheds and other catchment areas in the country.

#### **4.2.7 The National Climate Change Action Plan 2018–2022**

This plan aims to strengthen the country's path towards sustainable, climate-resilient development while achieving low carbon climate resilient development. The National Climate Change Action Plan (NCCAP) states that sustainable human settlements and sanitation services are essential for human health, which is a pillar of the Government's Big Four Agenda. It therefore proposes an integrated approach to climate actions that addresses sustainable human settlements and health, and sanitation services by reducing incidences of malaria and other diseases and encourage climate-resilient solid waste management, buildings and settlements.

#### **4.2.8 The Kenya Vision 2030**

Kenya Vision 2030 is a long-term development blueprint that aims to transform Kenya into a newly industrializing, middle-income country providing a high quality of life to all its citizens by the year 2030. The Government of Kenya has developed strategies to develop the private health sector in its Vision 2030 plan as well as in the strategic plans. Some of the key features of those plans include social health insurance to increase access to health care, a reduced role for the Ministry of Health in service delivery, more delegation of authority to County and Sub-county level and promoting more Public Private Partnerships (PPPs).

#### **4.2.9 The Nairobi City County Integrated Development Plan 2018-2022**

The overall aim of the County Integrated Development Plan (CIDP) is to increase and expand sustainable development opportunities and build people's capacities to enable them create wealth and transform their lives for growth and prosperity in line with the Kenya's Vision 2030, Big Four Agenda and the Sustainable Development Goals. The County intends to strengthen health initiatives to enhance sustainability of community health services and promote a healthy and productive population. This will be achieved through integrating health care services, improving accessibility and improve service delivery in health facilities.

### **4.3 Legal framework**

#### **4.3.1 The Constitution of Kenya, 2010**

The Constitution of Kenya 2010 is the supreme law of the land. Under Chapter IV, Article 42 provides for the right to a clean and healthy environment for all. Further, Chapter V of the Constitution deals with Land and Environment. Specifically, Part 2 elaborates on the obligations of the proponent in respect to protection of the environment and enforcement of environmental rights.

#### **Relevance to the proposed project**

- The proponent should ensure that the project's operations do not infringe on the right to a clean and healthy environment for all.



- The proponent must ensure that the operations are carried out in an ecologically, economically and socially sustainable manner.
- The proponent is entitled to a fair administrative decision-making process from NEMA and other State organs.

#### **4.3.2 The Environmental Management and Co-ordination Act Cap. 387 of the Laws of Kenya**

This Act is the framework environmental law and aims to improve the legal and administrative co-ordination of the diverse sectoral initiatives in the field of environment so as to enhance the national capacity for its effective management. The Act harmonizes the sector specific legislations touching on the environment in a manner designed to ensure greater protection of the environment in line with the National Environment Policy, 2013.

##### **Relevance to the proposed project**

Section 58 of the Act requires proponents of a development likely to have deleterious effects on the environment to prepare and submit ESIA Study report to NEMA for consideration and decision making. This study report is prepared to comply with the provisions of this Section. In addition, several Regulations have been enacted by the line Ministry to operationalize the Act as discussed below.

##### **1. The Environmental Management and Coordination (Impact Assessment and Audit) Regulations, 2003**

It describes how experts should conduct the ESIA process including guidelines and standards to be met by reports. The regulations were amended in 2019 to address challenges that have been reported since they were gazetted. This report complies with the provisions of these Regulations.

##### **2. The Environmental Management and Coordination (Noise and Excessive Vibration Pollution) (Control) Regulations, 2009**

These Regulations were gazetted to manage noise levels to levels that do not cause a disturbance to the public. The operations at the proposed project site can potentially generate noise above the acceptable limits within the neighbourhood. Appropriate Personal Protective Equipment (PPE) should be provided for employees engaged in activities that may produce noise above the acceptable limits within the proposed site.

##### **3. The Environmental Management and Coordination (Air Quality) Regulations, 2014**

These regulations were aimed at controlling, preventing and abating air pollution to ensure clean and healthy ambient air. The activities of the proposed project will have a potential to pollute the air from construction works, dust emissions and exhaust fumes from machinery at the facility and vehicles. The proponent should undertake quarterly air quality monitoring and implement the recommendations.



#### **4. The Environmental Management and Coordination (Waste Management) Regulations, 2006**

The Regulations focus on management of solid wastes, industrial wastes, hazardous wastes, pesticides and toxic substances, radioactive substances and biomedical wastes. The regulations are aimed at addressing the impact of pollution from solid wastes on the environment which become important sources of disease causing pathogens. Part VI (Biomedical Wastes) Section 40 requires any person who generates biomedical waste to treat or cause to be treated all biomedical wastes in the manner prescribed in the Ninth Schedule of the regulations. The proponent will ensure proper waste disposal throughout the project cycle, procure the services of a NEMA licensed contractor for solid waste management and incinerators and comply with these regulations.

#### **5. The Environmental Management and Coordination (Water Quality) Regulations, 2006**

These Regulations address the challenges of pollution of water resources and conservation. It consists of VI parts and eleven schedules dealing with protection of sources of water for domestic use to miscellaneous provisions. For the proposed development, the proponent and contractor should implement measures to prevent water pollution from construction activities and effluent discharge at operational phase. Once the facility is operational, the proponent should apply for and obtain an Effluent Discharge Licence from NEMA.

#### **4.3.3 The Physical and Land Use Planning Act, 2012**

The Act provides for the planning, use, regulation and development of land and for connected purposes. It was enacted to ensure that every person engaged in physical and land use planning shall promote sustainable use of land and liveable communities which integrates human needs in any locality. The Act allows the County Government to prepare a local physical and land use development plan in respect of a County, Sub-County, or unclassified urban area.

#### **Relevance to the proposed project**

The proponent has obtained a Change of Use from commercial cum residential to mixed use for the proposed hospital from the County Government of Nairobi.

#### **4.3.4 The Occupiers' liability Act, 2012**

It is an Act of Parliament to amend the law as to the liability of occupiers and others for injury or damage resulting to persons or goods lawfully on any land or other property from dangers due to the state of the property or to things done or omitted to be done in situ.

#### **Relevance to the proposed project**

The proponent is mandated to warn visitors of the likelihood of dangers within the premises to enable the visitors to be reasonably safe.



#### **4.3.5 The National Construction Authority Act, 2011**

The National Construction Authority (NCA) was established through an Act of Parliament with the role to oversee the construction industry and coordinate its development. The Authority accredits and registers contractors as well as certifies skilled construction workers and site supervisors and regulates their professional undertakings. The Authority promotes and ensures quality assurance in the construction industry through standardization and improvement techniques and materials.

##### **Relevance to the proposed project**

The proponent will ensure compliance with the provisions of the Act throughout the construction process.

#### **4.3.6 The Occupational Safety and Health Act, 2007**

It is an Act of Parliament to provide for the safety, health and welfare of workers and all persons lawfully present at workplaces. Although the Occupational Safety and Health Act (OSHA), 2007 repealed the Factories and Other Places of Work Act Cap. 514 of the Laws of Kenya, it inherited all the subsidiary legislation issued under Cap. 514. Examples of subsidiary legislation inherited include:-

- Eyes Protection Rules L.N. 44 of 1978
- Building Operations and Works of Engineering Construction Rules L.N. 40 of 1984
- Electric Power Special Rules L.N. 340 of 1979
- First Aid Rules L.N. 87 Of 1964
- Cellulose Solutions Rule L.N. 87 of 1964
- Health and Safety Committee Rules L.N. 31 of 2004
- Medical Examination Rules L.N. 24 of 2005
- Noise Prevention and Control Rules L.N. 25 Of 2005
- Fire Risk Reduction Rules L.N. 59 Of 2007
- Hazardous Substances Rules L.N. 60 of 2007

##### **Relevance to the proposed project**

Under OSHA, the proponent should register the site as a workplace with the Directorate of Occupational Safety and Health Services (DOSHS) and ensure timely renewal of the same. In addition, the proponent should provide the workers with adequate and appropriate PPE and enforce their use at work, and carry out occupational safety and health audit annually.

#### **4.3.7 The Public Health Act, 2012**

The Public Health Act borrows heavily from the common law doctrine of nuisance. It makes it an offence for a property owner to allow nuisance or any other condition liable to be injurious or dangerous to health to prevail on the property. What constitutes nuisance is broadly described to include any obstruction, smell, accumulation of wastes or refuse, smoky chimneys, dirty dwellings or premises used without proper sanitation, smoke emissions and improperly crowded areas so long as it can be demonstrated that the situation endangers or is liable to endangering health. A medical officer of health may issue orders requiring the owner



of the property to remove the nuisance to enhance health conditions at the premises. It then becomes the responsibility of the property owner to maintain clean and healthy conditions.

**Relevance to the proposed project**

The proponent should ensure compliance with the Act by providing a clean, healthy and safe environment during construction and subsequent operation of the facility.

**4.3.8 The Work Injury Compensation Benefit Act, 2007**

Part III of the Act stipulates the right to compensation to employees who get injured, diseased or die at the work place. All accidents should be reported by the employer to the relevant authorities. Occupational diseases are defined and compensation criteria described under the Act. The Act includes compulsory insurance for employees. Part VII gives details on medical aid to injured or diseased workers.

**Relevance to the proposed project**

- All workers contracted during the project implementation phase are entitled to medical and life insurance as required by the Act.
- Accidents occurring at the work place should be reported to the DOSHS as the Act stipulates.
- Appropriate medical aid should be given to those injured at site at prescribed medical facilities.

**4.3.9 The Pharmacy and Poisons Act, 2019**

The Act makes provision for the control of pharmaceuticals and the trade in drugs and poisons.

**Relevance to the proposed project**

The proponent should ensure that medical drugs and substances are sourced from registered sources and operations not to contravene the provisions of this Act.

**4.3.10 The Medical Practitioners and Dentists Act, 2019**

This Act consolidated and amended the law to make provision for the registration of medical practitioners and dentists and for purposes connected therewith and incidental thereto. The Act contains the Medical Practitioners and Dentists rules among other subsidiary legislation on code of conduct.

**Relevance to the proposed project**

Under these Act, medical facilities are licensed to operate after meeting the following conditions:

- The County Medical health officer submits a satisfactory report on the premises to the Medical Practitioners and Dentists Board.
- The medical practitioners offering a service at the institution is/are duly registered by the Medical practitioner's board as required.



- The quality of health to be provided at the institution shall be such as to comply with the standards acceptable by the Board.

#### **4.3.11 The Nurses and Midwives Act, 2019**

The Act makes provision for the training, registration, enrolment and licensing of nurses, to regulate their conduct and to ensure their maximum participation in the health care of the community and for connected purposes.

##### **Relevance to the proposed project**

The proponent should ensure that the nurses and midwives operate within the requirements of this Act which include ensuring that the nurses are not only registered but also licensed to practice as such.

#### **4.3.12 The Clinical Officers (Training, Registration, and Licensing) Act, 2017**

This is an Act of Parliament to make provision for the training, registration and licensing of clinical officers; to regulate their practice and for connected purposes.

##### **Relevance to the proposed project**

The proponent should adhere to the provisions of this Act.

#### **4.3.13 The Medical Laboratory Technicians and Technologists Act, 2000**

It is an Act of Parliament to provide for the training, registration and licensing of medical laboratory technicians and technologists, to provide for the establishment, powers and functions of the Kenya Medical Laboratory Technicians and Technologists Board, and for connected purposes.

##### **Relevance to the proposed project**

The proponent should ensure that the Laboratory Technicians and Technologists operate within the requirements of this Act.

#### **4.3.14 The Sustainable Waste Management Act, 2022**

The Act was established to provide a legal and institutional framework for sustainable waste management and among its objectives is to; promote sustainable waste management and procurement services as well as establish environmentally sound infrastructure for sustainable waste management in addition to creating an enabling environment for employment in green economy, waste management, recycling and recovery industry. Furthermore, the Act was established to promote and ensure effective delivery of waste services.

##### **Relevance to the proposed project**

The proponent should establish infrastructure for waste management in line with the Act.

#### **4.3.15 The Climate Change Act, 2016**

The Climate Change Act provides a regulatory framework for the development, management, implementation and regulation of mechanisms to enhance climate change resilience and low



carbon development for the sustainable development of Kenya. It provides for mainstreaming of climate change responses into development planning, decision making and implementation as well as resilience and adaptation in all governance sectors.

### **Relevance to the proposed project**

- The proponent should develop a Climate Change Action Plan and implement measures to ensure low carbon footprint at the project area through incorporating low carbon technologies in order to reduce emission intensity.
- The proponent should install renewable energy infrastructure for lighting, energy efficient machines and ensure compliance with the Environmental Management and Coordination (Air Quality) Regulations, 2014.
- The proponent should support the local communities in climate change adaptation measures through investments in capacity building in agriculture, forestry and conservation among others as part of Corporate Social Responsibility (CSR).

### **4.3.16 The Water Act, 2016**

The Constitution acknowledges access to clean and safe water as a basic human right and assigns the responsibility for water supply and sanitation service provision to the 47 established counties. The purpose of the 2016 Water Act is to align the water sector with the Constitution's primary objective of devolution. The Act establishes several organs to ensure development and sustainable use of water resources. These include the Water Resources Authority (WRA), the Water Sector Trust Fund (WSTF), Water Resources Users Associations (WRUAs), Water Services Providers (WSPs) and Water Works Development Agencies among others.

### **Relevance to the proposed project**

The Water Act provides for the management, conservation, use and control of water resources and for the acquisition and regulation of rights to use water, to provide for the regulation and management of water supply and sewerage services.

### **4.3.17 The Energy Act, 2019**

The Act stipulates the electrical supply requirements one has to meet and offenses related to supply and use of electricity.

### **Relevance to the proposed project**

The proponent is required to ensure that the energy supplied is consumed in accordance to the provisions of the Act and energy audits carried out after every three years.

### **4.3.18 The County Government Act, 2012**

The new constitution grants County Governments the powers to grant or to renew business licenses or to refuse the same. To ensure implementation of the provisions of the new constitution, the County Governments are empowered to make by-laws in respect of all such matters as are necessary or desirable for the maintenance of health, safety and well-being of the general public.



**Relevance to the proposed project**

The Act gives the right to access all property at all times by the County Government officers and servants for inspection purposes. The proponent will be under obligation to allow County officers and inspectors at the premises and comply with the by-laws of the County.

**4.3.19 The Nairobi City County Community and Neighbourhood Associations Engagement Act, 2016**

It is an Act of the Nairobi City County Assembly to give statutory recognition to community and neighbourhood initiatives in complementing county government service delivery; to enable structured co-operation between the county government, residents and businesses, and to generally regulate and facilitate the activities of the associations and to give further effect to Article 10 of the Constitution as regards the principle of participation of the people and for connected purposes.

**Relevance to the proposed project**

- The proposed project site is located within the Karen and Lang'ata District Association.
- The proponent should ensure compliance with the Act.

**4.4 Institutional arrangements to implement the legal framework**

To implement the above legal framework, the government has established a number of institutions with varying mandates of implementation as shown in Table 5.

**Table 5: Institutions and their legislative mandate as it applies to the proposed project.**

<b>Institution</b>	<b>Legislative mandate</b>
National Environment Management Authority	To implement the Environmental Management and Coordination Act and Associated Regulations and Sustainable Waste Management, Act, 2022
County Government of Nairobi	To implement the County Government Act, 2012, its by-laws, the Public Health Act, 2012, the Physical and Land Use Planning Act, 2019 and the Occupiers Liability Act, 2012 and the Nairobi City County Community and Neighbourhood Associations Engagement Act, 2016
Ministry of Health	To implement the Pharmacy and Poisons Act, 2019, Medical Practitioners and Dentists Act, 2019, Nurses and Midwives Act, 2019, Clinical Officers (Training, Registration, and Licensing) Act, 2017, Medical Laboratory Technicians and Technologists Act, 2000
Directorate of Occupational Safety and Health Services	To implement the Occupational Safety and Health Act, 2007 alongside the subsidiary legislation
Water Resources Authority	To implement the Water Act, 2016
Energy and Petroleum Regulatory Authority (EPRA)	To implement the Energy Act, 2019



## 5 CONSULTATION AND PUBLIC PARTICIPATION

### 5.1 Introduction

Public and stakeholders participation in the ESIA process is a legislative requirement under Part 2, Section 69 (1d) of the Constitution of Kenya 2010 and Regulation 17 of the Environmental Management and Coordination (Impact Assessment and Audit) Regulations, 2003. The aim of public and stakeholders consultations was to obtain and document comments, views and concerns that the neighbours and stakeholders have regarding the proposed project. For the proposed project, public and stakeholders consultations were undertaken using two strategies i.e. administration of questionnaires and public baraza/meeting.

Public notices to inform the public were posted along Ngong' Road and its surroundings sixteen (16) days prior to the date of the public baraza (Figure 10). Other key stakeholders received individual invitation letters to the meeting. There was good representation among those who attended the meeting, with government representatives, elected leaders, residential neighbours, business neighbours and the proponent. The proposed project was presented to the stakeholders. Thereafter, the plenary session was opened. A wide range of views, concerns and suggestions were expressed which reflected different interests and positions in the community. (*The minutes of the meeting are appended to this report*).

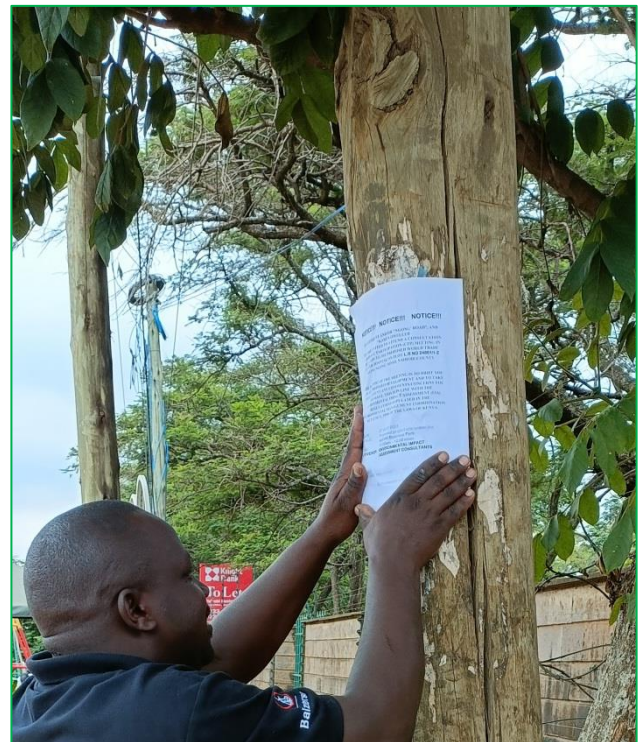
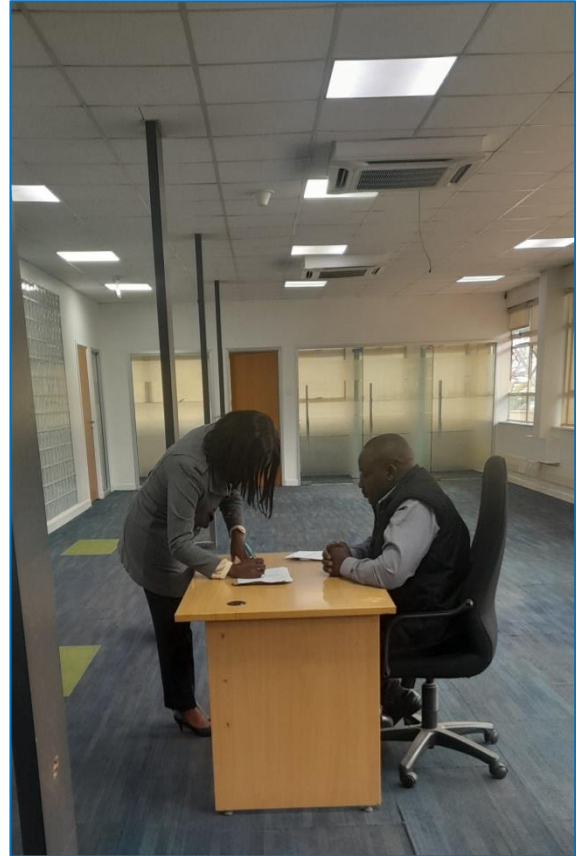


Figure 9: Public notices along Ngong' Road (Source: Fieldwork, June 2023).





**Figure 10: Registration of stakeholders during the public baraza (Source: Public baraza, July 2023).**



## ESIA Study for the Proposed World Trade Centre Nairobi Hospital



**Figure 11: The stakeholders during the public baraza (Source: Public baraza, July 2023).**



### **5.1.1 Issues raised by the affected community**

The public baraza was held on 6<sup>th</sup> July 2023 at the Nairobi Business Park. Table 6 summarizes the issues raised by the stakeholders and their recommended mitigation measures.

**Table 6: Issues raised by the local community and their recommended mitigation measures.**

<b>Issues raised</b>	<b>Recommended mitigation measures</b>
Creation of employment opportunities	• Prioritizing employment opportunities to the local community members
Corporate Social Responsibility (CSR)	• Initiate CSR projects such as constructing a Police Post, support local schools etc.
Traffic snarl-ups	• Provide an access road directly from the Ngong' Road instead of using the main entrance to the Nairobi Business Park
Insecurity	• Increase the number of security personnel
Noise pollution	• Implement measures to prevent noise pollution
Air pollution	• Implement measures to prevent air pollution

Generally, all stakeholders consulted had no objections to the proposed project. They however requested the proponent to implement the recommended mitigation measures outlined in the ESIA Study report to minimize the negative impacts of the proposed project.

## **5.2 Grievances Redress Mechanism**

The affected persons by the proposed project may raise their grievances and dissatisfactions about actual or perceived impacts in order to find a satisfactory solution. These grievances, influenced by their physical, situational and/or social losses, can emerge at the different stages of the project cycle. Not only should the affected persons be able to raise their grievances and be given an adequate hearing, but also satisfactory solutions should be found that mutually benefit both the affected persons and the project. It is equally important that the affected persons have access to legitimate, reliable, transparent and efficient institutional mechanisms that are responsive to their complaints.

### **5.2.1 Grievances prevention**

Grievances cannot be avoided entirely, but much can be done to reduce them to manageable numbers and reduce their impacts. This will be achieved by;

1. Providing sufficient and timely information to communities. Many grievances arise because of misunderstandings; lack of information; or delayed, inconsistent or insufficient information. Accurate and adequate information about a project and its activities, plus an approximate implementation schedule, should be communicated to the communities, especially affected parties, regularly.
2. Conduct meaningful community consultations. The project proponent should continue the process of consultation and dialogue throughout the implementation of the project. Sharing information, reporting on project progress, providing community members with an opportunity to express their concerns, clarifying and responding to their

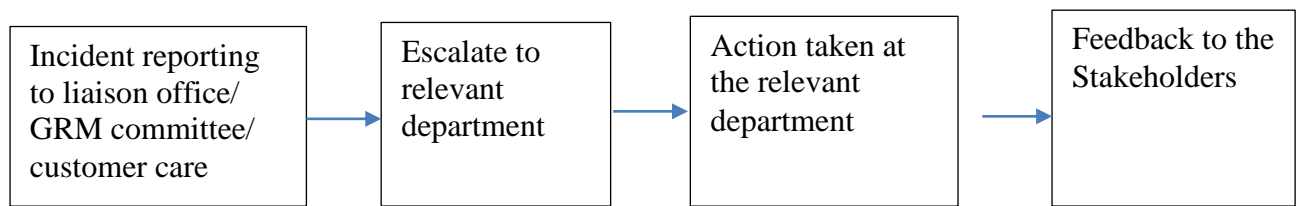


issues, eliciting communities' views, and receiving feedback on interventions will benefit the communities and the project management.

3. Overall good management of the facility will ensure a reduction in potential conflicts with the local community and other stakeholders.

### **5.2.2 Grievances Redress Mechanism Tool**

The proposed project will have a more prompt and efficient resolution on individual and collective complaint and provision of feedback on any grievances and dissatisfaction from stakeholders during operations. The flow chart below (Figure 13) shows a complaint and proposal consideration mechanism for the proposed project that provides an accessible channel for submission of complaints and feedback to stakeholders.



**Figure 12: Grievances Redress Mechanism Tool flow chart**



## **6 ENVIRONMENTAL AND SOCIAL IMPACTS AND MITIGATION MEASURES**

### **6.1 Introduction**

The proposed project will have both socio-economic benefits and attendant negative environmental and social impacts. One of the key objectives of the ESIA process is to systematically assess the value of the benefits against the environmental and social concerns and provide measures to avoid, prevent or reduce the magnitude of the impacts. The following section identifies, predicts and analyses these impacts and proposes mitigation measures to address them. The mitigation measures are based several EIA principles such as the entitlement to a clean and healthy environment and duty to enhance and safeguard the environment, polluter pays principle, precautionary approach and stakeholder involvement in addressing environmental and social challenges of the proposed development.

### **6.2 Positive impacts of the proposed project**

The project's direct benefits include but are not limited to the following;

#### **1. Provision of quality, reliable and affordable health care services**

The upcoming development will ease access to specialized services for almost all health conditions as it will help to enhance access to diagnostic services for specialized services and improve capacity to serve many people.

#### **2. Contribution of the project towards attainment of Vision 2030**

Through encouragement to the private sector, Kenya intends to become the regional provider of choice for highly-specialized health care, thus opening Kenya to health tourism as an income-generating activity. The proposed hospital aims to provide an efficient and high quality health care system in line with the Social Pillar of the Vision 2030.

#### **3. Creation of employment opportunities**

The proposed project will provide approximately 400 employment opportunities to both skilled and unskilled personnel throughout its life cycle. Already the proponent has employed various consultants to develop the hospital and preparation of the ESIA study report. This will in turn improve the local economy and livelihoods.

#### **4. A market for local goods and services**

The proposed project will be a market base for various goods and services required to run its operations such as cement, sand and aggregate, medicines, laboratory reagents and apparatus, surgical equipment, telecommunication and energy supply among others.

#### **5. Transfer of skills**

The proposed project will facilitate the transfer of skills and technology to the local community. During construction and operation of the proposed project, several people from within and outside the county will be employed to provide different services. As such, the local people will learn new skills and technology from the civil engineers, welders, masons and other experts that will be deployed.

#### **6. Income to the proponent**

The facility through its operations will accrue income to the proponent thus enabling expansion of business and creating more employment opportunities to the locals.



## **7. Revenue to the government**

The proposed project will generate revenue to the government through taxes, licences and fees levied on goods/ services. Through the revenues generated, the government will be capable of financing its obligations to the country.

## **6.3 Anticipated negative and social impacts**

Against the background of positive impacts, the proposed project is expected to result in a number of negative environmental and social impacts at the various stages of implementation as discussed below.

### **6.3.1 Negative impacts at the demolition phase of the proposed project**

The main environmental concerns at demolition phase include the solid wastes which will comprise of rubble and assorted derelict items, wood, steel among others.

#### **Recommended mitigation measures at demolition phase**

1. Prior to demolition, the proponent will obtain a demolition permit from the County Government of Nairobi and seek approval from NEMA.
2. Provide the workforce with Personal Protective Equipment
3. Recyclable materials such as steel and re-usable ones such as timber should be sold to licensed recycling companies and re-used for the new development respectively.
4. The other solid wastes and rubble should be disposed by a NEMA Licensed contractor
5. Use low sound emission machinery during demolition.
6. Secure the site using dust screens, sprinkling the rubble with water and contain all debris on site.

### **6.3.2 Negative impacts at the construction phase of the proposed project**

#### **6.3.2.1 Change in land use**

The current land use is commercial cum residential. However, the proponent proposes to set up a hospital which is inconsistent with the current land use.

#### **Recommended mitigation measure**

1. The proponent has obtained a change of user from commercial cum residential to mixed use from the County Government of Nairobi

#### **6.3.2.2 Environmental risks of obtaining raw materials**

Construction activities will require raw materials such as steel bars, sand, cement and building blocks, among others. These materials will be sourced from the environment and will have a negative impact at their points of origin.

#### **Recommended mitigation measures**

1. Source raw materials from sites that are licensed as per the Environmental Management and Coordination Act Cap. 387 of the Laws of Kenya



2. Have a procurement plan based on the Bill of Quantities prepared by a Quantity Surveyor to avoid potential oversupply of materials and wastage
3. Re-use construction materials such as wood and metal cuttings which can be salvaged

#### **6.3.2.3 Destruction of the physical environment**

Site preparation will involve clearing of vegetation and civil works which will impact negatively on the biodiversity and the existing vegetation cover. Vegetation covers plays an important role in preventing soil erosion and are habitat for other organisms among others. Therefore, clearance of the vegetation would lead to the loss of these benefits.

#### **Recommended mitigation measures**

1. Ensure proper demarcation and delineation of the proposed project area to be affected by civil works
2. Retain vegetation cover in areas that will not be developed as far as practicable

#### **6.3.2.4 Solid waste generation and management**

Site preparatory and construction activities will generate significant quantities of solid waste in form of biomass, overburden, domestic waste such as plastic containers and construction materials such as wood, building blocks, metal cuttings and wrappings among others. These will need to be disposed appropriately as poor solid waste management can create breeding grounds for disease causing pathogens as well as pollute soil and groundwater.

#### **Recommended mitigation measures**

1. Procure and strategically place adequate solid waste collection bins with a capacity for segregation within the construction site
2. Sensitize construction workers on the process of solid waste collection, segregation and proper disposal
3. Recycle and reuse waste construction materials
4. Procure the services of a NEMA licensed waste handler to dispose the solid waste
5. Comply with the provisions of the Environmental Management and Coordination (Waste Management) Regulations, 2006

#### **6.3.2.5 Water demand and effluent generation**

Construction projects utilize significant quantities of water for drinking, concrete mixing, cleaning, curing of concrete works, dust management and sanitation purposes which will lead to an increased demand for water and subsequently generate effluent which will need to be managed efficiently. It should be noted that water for the proposed project site will be sourced from the existing borehole, and the site also has access to the sewer line. A hydrogeological survey has been undertaken at the proposed site and the report is attached.

#### **Recommended mitigation measures**

1. Procure and deliver to the site temporary toilets for use by the workers during the construction phase
2. Sensitize the workers on the need to conserve available water resources



3. Acquire a Water Resources Authority (WRA) permit to abstract water from the borehole
4. Comply with the provisions of the Environmental Management and Coordination (Water Quality) Regulations, 2006

#### **6.3.2.6 Air pollution**

Air pollution during the construction phase will be in form of dust generated during excavations, concrete mixing activities and exhaust fumes from machinery use and Heavy Commercial Vehicles (HCVs) delivering construction materials to the site. The most relevant pollutant considered is particulate matter because of its potentially significant increase during the construction phase. Respirable particulate matter may present respiratory diseases, cause eye irritation and visual intrusion to workers, visitors to the project site and the neighbors if it is in excess of  $100 \mu\text{g}/\text{Nm}^3$  as per the First Schedule of the Environmental Management and Coordination (Air Quality) Regulations, 2014.

#### **Recommended mitigation measures**

1. Procure, provide and enforce the use of dust masks to workers and visitors to the project site
2. Install dust screens around the project site during construction
3. Cover stock piles of construction materials to reduce dust emissions especially during windy conditions
4. Sprinkle water at the excavation areas to suppress dust
5. Use of serviceable machinery/equipment and trucks
6. Monitor fugitive emissions to ensure compliance with the limits set under the First Schedule of the Environmental Management and Coordination (Air Quality) Regulations, 2014
7. Comply with the provisions of the Environmental Management and Coordination (Air Quality) Regulations, 2014

#### **6.3.2.7 Noise pollution**

The construction works, delivery of building materials by HCVs and the use of machinery including concrete mixers and metal grinders among others may lead to high levels of noise and vibration within the proposed project site and the surrounding area. The noise levels produced may be above the stipulated EMCA limits and may lead to hearing impairments to the workers, visitors to the site and the neighbors. Construction sites can only emit noise levels of up to 75 dB(A) during the day and 65dB (A) at night as per the Second Schedule of the Environmental Management and Coordination (Noise and Excessive Vibration Pollution) (Control) Regulations, 2009.

#### **Recommended mitigation measures**

1. Delivery of raw materials, excavation and construction work should be limited to day time hours only between 8am to 5pm
2. Fit the drill rig mast with a muffler



3. Locate machinery that are likely to produce noise as far as practical from neighboring properties
4. Procure, provide and enforce the use of earmuffs to staff who will work within peak noise producing areas and visitors accessing the same areas
5. Service machinery and equipment regularly to ensure that they are in good condition
6. Sensitize truck drivers to avoid unnecessary hooting and running of vehicle engines
7. Comply with the Environmental Management and Coordination (Noise and Excessive Vibration Pollution) (Control) Regulations, 2009

#### **6.3.2.8 Occupational safety and health risks**

Workers undertaking construction activities, visitors to the project site and neighboring properties will be exposed to potential safety and health risks during construction activities. The potential safety risks will be from the use of machinery, risks from moving machinery, falling objects or even falls, air and noise pollution among others. These risks have a potential to cause disturbances, injuries, permanent disability or even death.

#### **Recommended mitigation measures**

1. Register the site as a workplace with the Directorate of Occupational Safety and Health Services (DOSHS)
2. Designate a fire assembly point within the proposed site
3. Obtain insurance cover for the workers at the site
4. Provide adequate and appropriate Personal Protective Equipment (PPE) to workers and visitors to the site and enforce on their use
5. Provide employees with correct tools and equipment for the jobs assigned and train on their use
6. Ensure that the contact details of the fire brigade and ambulance services are available on site
7. Regulate the entry of visitors to the construction site by deploying adequate security measures
8. Comply with the provisions of the Occupational Safety and Health Act, 2007

#### **6.3.2.9 Soil and surface water contamination**

Machinery used for construction activities and vehicles delivering construction materials to the site will need petroleum products such as fuel, oils, lubricants etc. There is potential for leakage and spillage during fueling, servicing and maintenance of machinery and vehicles. This increases the chances of soil and water contamination.

#### **Recommended mitigation measures**

1. Properly storing, handling and disposing of new oil and used oil waste
2. Procure and train workers on the use of oil spill containment kits
3. Oil products and materials should be stored in site stores
4. Contract a NEMA licensed waste oil handler to manage the waste oil from the construction site



#### **6.3.2.10 Traffic snarl up**

Heavy Commercial Vehicles delivering construction materials to the proposed project site will interfere with the normal traffic flow along Ngong' Road especially in cases of stalling and breakdowns.

#### **Recommended mitigation measures**

1. Prepare and implement a Traffic Management Plan
2. Delivery of construction materials should not be undertaken during peak hours
3. Display signage and warnings on the road to forewarn other road users on the use of the road by Heavy Commercial Vehicles
4. Offload construction materials on the site and not on the road reserves
5. Adhere to the Nairobi County Government Traffic By-Laws and Kenya Traffic Laws

### **6.3.3 Negative impacts during the operational phase of the proposed project**

#### **6.3.3.1 Waste generation and management**

The proposed hospital will generate different types of waste such as general waste, pharmaceuticals waste, cytotoxic, chemical waste, pathological waste, radioactive waste etc. These wastes can be hazardous, toxic and even lethal owing to their high potential for diseases transmission. Medical waste generation from the facility is of paramount significance and should be managed according to industry standards.

#### **Recommended mitigation measures**

1. Segregate waste at their point of generation
2. Infectious and/ or hazardous wastes should be identified and segregated according to its category using a color-coded system as stipulated in the eighth schedule of the Waste management Regulations, 2006
3. Train staff on the storage, management and disposal of radioactive wastes in accordance to national and international standards
4. Prepare a Health Care Solid Waste Management and Disposal plan
5. Procure the services of a NEMA licensed biomedical waste handler to dispose the waste
6. Biomedical wastes should be incinerated at site or disposed of by licensed waste handler
7. The radioactive waste management should be in line with the Nuclear Regulatory Act, 2019
8. Comply with the provisions of the Environmental Management and Coordination (Waste Management) Regulations, 2006

#### **6.3.3.2 Increased waste water**

Liquid waste will emanate from washrooms and washing operations. During operation, the waste water generated will be channelled to the public sewer line. Regular maintenance of the sewer line at the premises will be carried out by the proponent.



**Recommended mitigation measures**

1. Provide a separate holding tank and drainage system leading to the sewer line for process waste water
2. Process waste water must be treated with chemical disinfectants, neutralized and then flushed into the sewage system.
3. The treated effluent being discharged to the sewer line should conform to the limits as provided for on the fifth schedule of the Water Quality Regulations, 2006.
4. Apply for and obtain an Effluent Discharge License (EDL) from NEMA
5. Waste water from the health care facility should never be used for agricultural, aquacultural, drinking water, or recreational purposes.
6. Undertake quarterly water quality monitoring of the process water
7. Conduct routine maintenance on the sewerage discharge pipes
8. Comply with the provisions of the Environmental Management and Coordination (Water Management) Regulations, 2006

**6.3.3.3 Increased water demand**

Water will be required for domestic use in sanitation, drinking, cleaning, in the kitchen area and other medical uses. Increased water usage is anticipated during the operational phase of the proposed project and it's therefore important to adopt water conservation best practices.

**Recommended mitigation measures**

1. Install water saving devices for domestic water use e.g. dual flush toilets, automatic shut-off taps, etc.
2. Conduct regular audits of water systems to identify and rectify any possible water leakages
3. Install a water meter to monitor the water usage in order to enable proper performance review and management
4. Create awareness on water conservation among the staff, patients and visitors through water conservation posters within the premises

**6.3.3.4 Occupational Safety and health risks**

Health service workers, patients and visitors are engaged in different areas or activities are exposed to different types of risk from infection. Risk areas include but are not limited to operating theatres, acute medicine, Intensive care units, emergency and ambulance services, dialysis, laboratories, especially where there is exposure to blood and blood products, potentially, hazardous devices and instruments, or handling of aggressive patients and pathology. Other potential sources of safety and health risks include exposure to radiation, trip hazards, electrical hazards, falling objects and fire risks.

**Recommended mitigation measures**

1. Conduct occupational training programs and specialty courses, to ensure that workers are oriented to the specific hazards of individual work assignments
2. Conduct risk assessment and Occupational Safety and Health audits annually
3. Keep an accident and/ incident register



4. Display precautionary and informative signage at strategic areas
5. Ensure compliance with the provisions of the OSHA, 2007

#### **6.3.3.5 Fire risks and emergency preparedness**

Fire risks and emergencies at the proposed facility can occur due to operational negligence, electrical faults and spillage of flammable materials. This can result to injuries, loss of lives and property. The proponent needs to put in place measures to prevent the fire incidences.

#### **Recommended mitigation measures**

1. Formulate a fire and emergency response action plan and communicate it to the facility users
2. Provide suitable and adequate fire-fighting equipment such as fire extinguishers, fire hose reels, smoke detectors, fire alarms and fire hydrants at appropriate locations within the proposed development
3. Fire-fighting equipment should be serviced quarterly by fire service providers
4. Provide fire exits within the proposed development
5. Designate a fire assembly point within the facility
6. Conduct fire drills biannually to ensure workers remain alert on what to do in the unfortunate incidences of fire outbreaks
7. Conduct inspection of electrical installations and maintain records of such inspections, faults detected and action taken
8. Conduct fire safety audits and train the staff on fire safety annually
9. Comply with the provisions of the Occupational Safety and Health Act, 2007

#### **6.3.3.6 Increased energy demand**

The operation of the facility will increase the demand on energy for running the machinery and equipment and for lighting and powering of electrical appliances. Energy supply for the proposed development will be obtained from the national grid and supplemented by a standby generator.

#### **Recommended mitigation measures**

1. Display energy saving conservation tips
2. Maintain machinery and equipment in a serviceable and good working order to maximize its efficiency on fuel consumption
3. Harness solar energy
4. Conduct energy audits after every three years and implement the corrective measures

#### **6.3.3.7 Increased storm water**

The surface runoff from the building roof and paved ground will lead to increased volume and velocity of storm water or run-off flowing from the proposed project site. This will in turn lead to increased amounts of storm water entering the drainage system potentially resulting to additional flow.



**Recommended mitigation measures**

1. Ensure that no surface wastewater is directed into the sewer system to avoid overloading the sewerage system
2. Harvest rainwater from roof for non-potable uses e.g. cleaning and watering plants.

**6.3.3.8 Increased traffic volume**

During operation, the hospital will experience an upsurge in clients and visitors. This means an increased number of vehicles accessing the facility. This in turn may have undesirable effect on traffic flow within the area.

**Recommended mitigation measures**

1. Implement the Traffic Management Plan
2. Designate vehicle registration and checkpoints inside the premises to avert unnecessary traffic snarl up along adjacent roads caused by vehicles waiting to access the hospital.
3. Provide ample parking space within the hospital
4. Provide dedicated exits and entries for the hospital

**6.3.4 Decommissioning phase impacts**

A decommissioning phase is possible in the event of end of project life, closure by government agencies due to non-compliance with environmental and health regulations, an order by a court of law due to non-compliance with existing regulations, natural calamities and change of use of land. The proponent should prepare and submit a due diligence decommissioning audit report to NEMA for approval at least three (3) months in advance and apply for a demolition permit. The following environmental and social concerns will manifest at this phase:-

1. Economic decline
2. Displacement of patients and workers
3. Waste generation and management
4. Safety and health risks
5. Insecurity

**6.3.4.1 Economic decline**

In the event of decommissioning of the proposed development, the proponent will incur huge financial losses and the employees will also lose their livelihoods. In addition, the government will lose revenue earned from the operations of the hospital leading to economic decline.

**Recommended mitigation measures**

1. Train employees on alternative livelihoods prior to decommissioning
2. Prepare and issue recommendation letters to employees to seek alternative employment opportunities
3. Review potential job opportunities in other ongoing contracts by the proponent and recommend the employees who qualify



4. Comply with the provisions of labor laws by paying employees their terminal dues

#### **6.3.4.2 Displacement of patients and workers**

The decommissioning of the proposed hospital will result into displacement of the tenants, patients, students, workers and persons making business out the health care facility.

#### **Recommended mitigation measures**

1. Notify all Interested and Affected Parties on the impending decommissioning to enable them make alternative arrangements.

#### **6.3.4.3 Waste generation**

Demolition activities will result in generation of both solid waste and effluent. The waste will include materials such as concrete, metal, wood, adhesives, sealants and fasteners. Although demolition waste is generally considered as less harmful to the environment since it is composed of inert materials, there is growing evidence that large quantities of such waste may lead to release of certain hazardous chemicals into the environment. The debris and other solid waste have a potential to pollute the environment and lower water quality of ground and surface water. Effluent from the workers will also need to be disposed of appropriately.

#### **Recommended mitigation measures**

1. Recover re-usable materials for sale or use in other project sites
2. Contract a NEMA licensed waste contractor to handle and dispose both solid waste and effluent generated from the demolition activities

#### **6.3.4.4 Safety and health risks**

Safety and health risks during demolition are likely to emanate from accidental falls and cuts, injuries from demolition tools and machinery use. Noise and air pollution from demolition works could pose safety and health risks to workers, neighbours and visitors to the site.

#### **Recommended mitigation measures**

1. Display signage to forewarn people on ongoing demolition activities
2. Provide and enforce the use of PPE throughout the demolition works
3. Avail first aid kits on site throughout the entire period
4. Ensure workers are given the correct hand tools and equipment for the jobs assigned

#### **6.3.4.5 Insecurity**

Insecurity will result from the site when it's abandoned after decommissioning. Unoccupied structures within the site will act as criminal dens and the security boost that had been provided by the hospital to the local community would be lost.

#### **Recommended mitigation measure**

1. The proponent should extend the tenure of contracted security firm during the decommissioning phase of the facility.



#### 6.4 Impact analysis

Potential project impacts are predicted and quantified to the extent possible. The magnitude of impacts on resources such as water and air or receptors such as people, communities, wildlife species and habitats is defined. Magnitude is a function of the following impact characteristics;

1. Type of impact (direct, indirect, induced)
2. Size, scale or intensity of impact
3. Nature of the change compared to baseline conditions (what is affected and how)
4. Geographical extent and distribution (e.g. local, regional, international)
5. Duration and/or frequency (e.g. temporary, short-term, long term, permanent)

Magnitude describes the actual change that is predicted to occur in the resource or receptor. It takes into account all the various impact characteristics in order to determine whether an impact is negligible or significant. Some impacts can result in changes to the environment that may be immeasurable, undetectable or within the range of normal natural variation. Such changes can be regarded as essentially having no impact and are characterized as having a negligible magnitude (Table 7).

1. **Negligible impact (very low)** - Where a resource or receptor would not be affected by a particular activity or the predicted effect is deemed to be imperceptible or is indistinguishable from natural background variations.
2. **Less than significant impact (Low)** - Is a minor impact where a resource or receptor would experience a noticeable effect but the impact magnitude is sufficiently low (with or without mitigation) and /or the resource or receptor is of low sensitivity. In either case, a less than significant impact must be sufficiently below applicable standard threshold limits.
3. **Potentially significant impact (moderate)** - A moderate impact that meets applicable standards but comes near the threshold limit. The emphasis for such moderate impacts is to demonstrate that the impact has been reduced to a level that is as minor as reasonably practicable so that the impact does not exceed standard threshold limits.
4. **Significant impact (high)** - One where an applicable standard threshold limit would or could be exceeded or if a highly valued or very scarce resource would be substantially affected.

**Table 7: Risk and impact significance matrix for the proposed project.**

Environmental impact	Magnitude of impact		
	Construction phase	Operational phase	Decommissioning phase
Change in land use	2	0	0
Environmental risks of obtaining raw materials	2	0	0
Destruction of the physical environment	3	0	0



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Solid waste generation	2	2	2
Water demand	2	2	2
Effluent generation	2	2	2
Air pollution	2	3	2
Noise and excessive vibration pollution	2	3	2
Occupational safety and health risks	3	3	3
Soil and surface water contamination	2	0	0
Groundwater pollution	2	0	0
Traffic snarl up	2	2	1
Fire risks and emergency preparedness	1	2	1
Energy demand	2	3	2
Increased storm water	2	2	2
Economic decline	0	0	3
Insecurity	0	1	2

### Legend

Magnitude	Impact score
Negligible	0
Low	1
Moderate	2
High	3



## **7 ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN FOR THE PROPOSED PROJECT**

### **7.1 Introduction**

The preceding section identified and analyzed the potential environmental and social impacts of the proposed project and proposed mitigation measures to address the impacts. Under this section, four Environmental and Social Management Plans (ESMPs) are proposed to guide the proponent in implementing the mitigation measures throughout the project cycle. Each of the ESMP is organized into five sections comprising of the impact, the recommended mitigation measures, responsibility, timeframe and budget (Tables 8 - 11). The strategies for mitigation include preventing the impact from occurring in the first place, minimizing the impact, taking corrective action where impact occurs among others.



**Table 8: Environmental Management Plan for the demolition phase of the proposed project**

<b>Impact</b>	<b>Mitigation measures</b>	<b>Responsibility</b>	<b>Timeframe</b>	<b>Cost estimates (Ksh.)</b>
Impact of demolition	<ul style="list-style-type: none"> <li>❖ Prior to demolition, the proponent will obtain demolition permit</li> <li>❖ Provide the workforce with PPE</li> <li>❖ Contract a NEMA Licensed contractor to dispose the other solid waste</li> <li>❖ Use low sound emission machinery during demolition</li> <li>❖ Secure the site using dust screens, sprinkling the rubble with water and contain all debris on site</li> </ul>	<ul style="list-style-type: none"> <li>❖ Contractor</li> <li>❖ Proponent</li> </ul>	Prior to commencement	20,000 for demolition permit

**Table 9: Environmental Management Plan for the construction phase of the proposed project**

<b>Impact</b>	<b>Mitigation measures</b>	<b>Responsibility</b>	<b>Timeframe</b>	<b>Cost estimates (Ksh.)</b>
Environmental risks of obtaining raw materials	<ul style="list-style-type: none"> <li>❖ Source raw materials from sites that are licensed</li> <li>❖ Have a procurement plan based on the Bill of Quantities to avoid potential oversupply of materials and wastage</li> <li>❖ Re-use construction materials</li> </ul>	<ul style="list-style-type: none"> <li>❖ Contractor</li> <li>❖ Project manager</li> </ul>	Prior to commencement	Nil
Destruction of the physical environment	<ul style="list-style-type: none"> <li>❖ Ensure proper demarcation and delineation of the proposed project area to be affected by civil works</li> <li>❖ Retain vegetation cover in areas that will not be developed</li> </ul>	<ul style="list-style-type: none"> <li>❖ Contractor</li> <li>❖ Project manager</li> </ul>	Prior to commencement	Cost factored
Solid waste generation and management	<ul style="list-style-type: none"> <li>❖ Procure and strategically place adequate solid waste collection bins with a capacity for segregation within the construction site</li> <li>❖ Sensitize construction workers on the process of solid waste collection, segregation and proper disposal</li> <li>❖ Recycle and reuse waste construction materials</li> </ul>	<ul style="list-style-type: none"> <li>❖ Contractor</li> <li>❖ Project manager</li> </ul>	During the construction phase	300,000



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Impact	Mitigation measures	Responsibility	Timeframe	Cost estimates (Ksh.)
	<ul style="list-style-type: none"> <li>❖ Procure the services of a NEMA licensed waste handler to dispose the solid waste</li> <li>❖ Comply with the Waste Management Regulations, 2006</li> </ul>			
Water demand and effluent generation	<ul style="list-style-type: none"> <li>❖ Procure and deliver to the site temporary toilets for use by the workers during the construction phase</li> <li>❖ Sensitize the workers on the need to conserve available water resources</li> <li>❖ Acquire a WRA permit to abstract water from the borehole</li> <li>❖ Comply with the Water Quality Regulations, 2006</li> </ul>	<ul style="list-style-type: none"> <li>❖ Contractor</li> <li>❖ Project manager</li> </ul>	During the construction phase	200,000
Air pollution	<ul style="list-style-type: none"> <li>❖ Procure, provide and enforce the use of dust masks to workers and visitors to the project site</li> <li>❖ Install dust screens around the project site during construction</li> <li>❖ Cover stock piles of construction materials to reduce dust emissions especially during windy conditions</li> <li>❖ Sprinkle water at the excavation areas to suppress dust</li> <li>❖ Use of serviceable machinery/equipment and trucks</li> <li>❖ Monitor fugitive emissions</li> <li>❖ Comply with the Air Quality Regulations, 2014</li> </ul>	<ul style="list-style-type: none"> <li>❖ Contractor</li> <li>❖ Project manager</li> </ul>	During the construction phase	300,000
Noise pollution	<ul style="list-style-type: none"> <li>❖ Delivery of raw materials, excavation and construction work should be limited to day time hours only between 8am to 5pm</li> <li>❖ Fit the drill rig mast with a muffler</li> <li>❖ Locate machinery that are likely to produce noise as far as practical from neighboring properties</li> <li>❖ Procure, provide and enforce the use of earmuffs to staff who will work within peak noise producing areas and visitors</li> </ul>	<ul style="list-style-type: none"> <li>❖ Contractor</li> <li>❖ Project manager</li> </ul>	During the construction phase	Cost factored



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Impact	Mitigation measures	Responsibility	Timeframe	Cost estimates (Ksh.)
	accessing the same areas ❖ Service machinery and equipment regularly to ensure that they are in good condition ❖ Sensitize truck drivers to avoid unnecessary hooting and running of vehicle engines ❖ Comply with the Noise and Excessive Vibration Pollution (Control) Regulations, 2009			
Occupational safety and health risks	❖ Register the site as a workplace with DOSHS ❖ Designate a fire assembly point within the proposed site ❖ Obtain insurance cover for the workers at the site ❖ Provide adequate and appropriate PPE to workers and visitors to the site and enforce on their use ❖ Provide employees with correct tools and equipment for the jobs assigned and train on their use ❖ Ensure that the contact details of the fire brigade and ambulance services are available on site ❖ Regulate the entry of visitors to the construction site by deploying adequate security measures ❖ Comply with the Occupational Safety and Health Act, 2007	❖ Contractor ❖ Project manager	During the construction phase	500,000
Soil and surface water contamination	❖ Properly storing, handling and disposing of new oil and used oil waste ❖ Procure and train workers on the use of oil spill containment kits ❖ Oil products and materials should be stored in site stores ❖ Contract a NEMA licensed waste oil handler to manage the	❖ Contractor ❖ Project manager	During the construction phase	400,000



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Impact	Mitigation measures	Responsibility	Timeframe	Cost estimates (Ksh.)
	waste oil from the construction site			
Traffic snarl up	<ul style="list-style-type: none"> <li>❖ Prepare and implement a Traffic Management Plan</li> <li>❖ Delivery of construction materials should not be undertaken during peak hours</li> <li>❖ Display signage and warnings on the road to forewarn other road users on the use of the road by Heavy Commercial Vehicles</li> <li>❖ Offload construction materials on the site and not on the road reserves</li> <li>❖ Adhere to the Nairobi County Government Traffic By-Laws and Kenya Traffic Laws</li> </ul>	<ul style="list-style-type: none"> <li>❖ Contractor</li> <li>❖ Project manager</li> </ul>	During the construction phase	200,000

**Table 10: Environmental Management Plan for the operational phase of the proposed project**

Impact	Mitigation measures	Responsibility	Timeframe	Cost estimates (Ksh.)
Waste generation and management	<ul style="list-style-type: none"> <li>❖ Segregate waste at their point of generation</li> <li>❖ Infectious and/ or hazardous wastes should be identified and segregated according to its category using a color-coded system as stipulated in the eighth schedule of the Waste management Regulations, 2006</li> <li>❖ Train staff on the storage, management and disposal of radioactive wastes in accordance to national and international standards</li> <li>❖ Prepare a Health Care Solid Waste Management and Disposal</li> </ul>	<ul style="list-style-type: none"> <li>❖ Proponent</li> </ul>	Throughout operations	Quotation



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Impact	Mitigation measures	Responsibility	Timeframe	Cost estimates (Ksh.)
	<ul style="list-style-type: none"> <li>plan</li> <li>❖ Procure the services of a NEMA licensed biomedical waste handler to dispose the waste</li> <li>❖ Biomedical wastes should be incinerated at site or disposed of by licensed waste handler</li> <li>❖ The radioactive waste management should be in line with the Nuclear Regulatory Act, 2019</li> <li>❖ Comply with the Waste Management Regulations, 2006</li> </ul>			
Increased waste water	<ul style="list-style-type: none"> <li>❖ Provide a separate holding tank and drainage system leading to the sewer line for process waste water</li> <li>❖ Process waste water must be treated with chemical disinfectants, neutralized and then flushed into the sewage system</li> <li>❖ The treated effluent being discharged to the sewer line should conform to the limits as provided for on the fifth schedule of the Water Quality Regulations, 2006</li> <li>❖ Apply for and obtain an EDL from NEMA</li> <li>❖ Waste water from the health care facility should never be used for agricultural, aqua-cultural, drinking water, or recreational purposes</li> <li>❖ Undertake quarterly water quality monitoring of the process water</li> <li>❖ Conduct routine maintenance on the sewerage discharge pipes</li> <li>❖ Comply with the Water Management Regulations, 2006</li> </ul>	❖ Proponent	Throughout operations	<ul style="list-style-type: none"> <li>• 5,000 application fees for EDL</li> <li>• Quotation</li> </ul>
Increased water	<ul style="list-style-type: none"> <li>❖ Install water saving devices for domestic water use</li> </ul>	❖ Proponent	Throughout	<ul style="list-style-type: none"> <li>• 5,000</li> </ul>



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Impact	Mitigation measures	Responsibility	Timeframe	Cost estimates (Ksh.)
demand	<ul style="list-style-type: none"> <li>❖ Conduct regular audits of water systems to identify and rectify any possible water leakages</li> <li>❖ Install a water meter to monitor the water usage in order to enable proper performance review and management</li> <li>❖ Create awareness on water conservation</li> </ul>		operations	application for Water abstraction permit • Quotation
Occupational Safety and health risks	<ul style="list-style-type: none"> <li>❖ Conduct occupational training programs and specialty courses, to ensure that workers are oriented to the specific hazards of individual work assignments</li> <li>❖ Conduct risk assessment and Occupational Safety and Health audits annually</li> <li>❖ Keep an accident and/ incident register</li> <li>❖ Display precautionary and informative signage at strategic areas</li> <li>❖ Ensure compliance with the provisions of the OSHA, 2007</li> </ul>	❖ Proponent	Throughout operations	500,000
Fire risks and emergency preparedness	<ul style="list-style-type: none"> <li>❖ Formulate a fire and emergency response action plan and communicate it to the facility users</li> <li>❖ Provide suitable and adequate fire-fighting equipment at appropriate locations within the proposed development</li> <li>❖ Fire-fighting equipment should be serviced quarterly by fire service providers</li> <li>❖ Provide fire exits within the proposed development</li> <li>❖ Designate a fire assembly point within the facility</li> <li>❖ Conduct fire drills biannually</li> <li>❖ Conduct inspection of electrical installations and maintain records of such inspections, faults detected and action taken</li> </ul>	❖ Proponent	Throughout operations	1,000,000



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Impact	Mitigation measures	Responsibility	Timeframe	Cost estimates (Ksh.)
	<ul style="list-style-type: none"> <li>❖ Conduct fire safety audits and train the staff on fire safety annually</li> <li>❖ Comply with the provisions of the OSHA, 2007</li> </ul>			
Increased energy demand	<ul style="list-style-type: none"> <li>❖ Display energy saving conservation tips</li> <li>❖ Maintain machinery and equipment in a serviceable and good working order to maximize its efficiency on fuel consumption</li> <li>❖ Harness solar energy</li> <li>❖ Conduct energy audits after every three years and implement the corrective measures</li> </ul>	❖ Proponent	Throughout operations	500,000
Increased storm water	<ul style="list-style-type: none"> <li>❖ Ensure that no surface wastewater is directed into the sewer system to avoid overloading the sewerage system</li> <li>❖ Harvest rainwater from roof for non-potable uses e.g. cleaning and watering plants</li> </ul>	❖ Proponent	Throughout operations	Cost factored
Increased traffic volume	<ul style="list-style-type: none"> <li>❖ Implement the Traffic Management Plan</li> <li>❖ Designate vehicle registration and checkpoints inside the premises to avert unnecessary traffic snarl up along adjacent roads caused by vehicles waiting to access the hospital.</li> <li>❖ Provide ample parking space within the hospital</li> <li>❖ Provide dedicated exits and entries for the hospital</li> </ul>	❖ Proponent	Throughout operations	Cost factored

**Table 11: Environmental Management Plan for the decommissioning phase of the proposed project**

Impact	Mitigation measures	Responsibility	Timeframe	Cost estimates (Ksh.)
Economic decline	❖ Train employees on alternative livelihoods prior to	❖ Proponent	Prior to	Nil



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Impact	Mitigation measures	Responsibility	Timeframe	Cost estimates (Ksh.)
	decommissioning ❖ Prepare and issue recommendation letters to employees to seek alternative employment opportunities ❖ Review potential job opportunities in other ongoing contracts by the proponent and recommend the employees who qualify ❖ Comply with the provisions of labor laws by paying employees their terminal dues		decommissioning	
Displacement of patients and workers	❖ Notify all Interested and Affected Parties on the impending decommissioning to enable them make alternative arrangements	❖ Proponent	Prior to decommissioning	Nil
Waste generation	❖ Recover re-usable materials for sale or use in other project sites ❖ Contract a NEMA licensed waste contractor to handle and dispose both solid waste and effluent generated from the demolition activities	❖ Proponent ❖ Contractor	During decommissioning	To be determined
Safety and health risks	❖ Display signage to forewarn people on ongoing demolition activities ❖ Provide and enforce the use of PPE throughout the demolition works ❖ Avail first aid kits on site throughout the entire period ❖ Ensure workers are given the correct hand tools and equipment for the jobs assigned	❖ Proponent ❖ Contractor	During decommissioning	300,000
Insecurity	❖ The proponent should extend the tenure of contracted security firm during the decommissioning phase of the facility	❖ Proponent	During decommissioning	Quotation



## 7.2 Health, Safety and Accident Prevention Plan

In order to ensure public health and safety, and to prevent accidents or emergency situations at construction, operation or decommissioning phases, the following action plan shall be incorporated in the project cycle (Table 12).

**Table 12: Health, Safety and Accident Prevention Action Plan.**

Issue	Specific measures	Responsibility	Timing
Project design	<ul style="list-style-type: none"> <li>Incorporation of health and safety measures in project design</li> </ul>	<ul style="list-style-type: none"> <li>Project architect</li> <li>Structural and civil engineers</li> </ul>	Design stage
Site organization and cleanliness	<ul style="list-style-type: none"> <li>Keep construction materials in correct place</li> <li>Maintain cleanliness at the construction site</li> </ul>	<ul style="list-style-type: none"> <li>Contractor</li> <li>Proponent</li> </ul>	Construction stage
Fire safety	<ul style="list-style-type: none"> <li>No storage of inflammables</li> <li>Fire safety awareness</li> <li>Keep fire-fighting facilities at the site</li> <li>Safe handling of fire</li> <li>No smoking on site</li> </ul>	<ul style="list-style-type: none"> <li>Contractor</li> <li>Proponent</li> <li>Visitors</li> </ul>	Throughout the project cycle
Accident prevention	<ul style="list-style-type: none"> <li>Safe handling of tools and machinery</li> <li>Use of appropriate personal protection equipment</li> <li>Engagement of qualified personnel</li> <li>Controlling visitor entry onto the site</li> </ul>	<ul style="list-style-type: none"> <li>Contractor</li> <li>Proponent</li> <li>Visitors</li> <li>Security company</li> </ul>	Construction stage
Waste disposal	<ul style="list-style-type: none"> <li>Provision of adequate waste disposal facilities at the site</li> <li>Engagement of licensed waste company</li> <li>Recycle and reuse materials as far as practical</li> </ul>	<ul style="list-style-type: none"> <li>Contractor</li> <li>Contracted waste disposal company</li> <li>Building occupants</li> </ul>	Throughout the project cycle
Tools and machinery safety	<ul style="list-style-type: none"> <li>Use of tools and machines for designated job</li> <li>Regular servicing of machinery</li> <li>Proper storage of tools</li> </ul>	<ul style="list-style-type: none"> <li>Contractor</li> </ul>	Construction stage



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Issue	Specific measures	Responsibility	Timing
Emergency preparedness	<ul style="list-style-type: none"><li>• Keeping passages clear</li><li>• Marking emergency exits</li><li>• Training staff in emergency preparedness and response</li><li>• Keeping a well-equipped first aid kit on site</li></ul>	<ul style="list-style-type: none"><li>• Contractor</li><li>• Proponent</li></ul>	Throughout the project cycle
Insurance	<ul style="list-style-type: none"><li>• Insuring all workers on the construction site</li></ul>	<ul style="list-style-type: none"><li>• Contractor</li></ul>	Construction stage
Site security	<ul style="list-style-type: none"><li>• 24-hour security on site</li><li>• Control of visitor entry onto site</li></ul>	<ul style="list-style-type: none"><li>• Contractor</li><li>• Security company</li></ul>	Construction and operation stage



## **8 ANALYSIS OF ALTERNATIVES**

### **8.1 Introduction**

Analyzing project alternatives is important as it allows the proponent to evaluate possible project options that could mitigate the environmental risks identified during the EIA process through prevention, elimination of the risks altogether or reduction of the severity of an impact. The analysis will also assist NEMA and lead agencies in decision making by either approving the project as proposed or advising the proponent on the need for a particular alternative such as an alternative site or technological and design changes. In the current proposal, the alternatives identified are discussed in detail below.

### **8.2 The ‘No Project’ alternative**

The ‘No Project’ alternative has the advantage of retaining the status quo, meaning that the predicted environmental and social impacts will not occur and is ideally the best-case scenario for mitigation. In addition to denying people specialized healthcare services, will also deny the government revenue from the tax obtained from materials, deny the proponent, contractors and skilled and unskilled workers a reliable income. This alternative is therefore not viable.

### **8.3 The “Yes Project” alternative**

This option envisages that the proposed project will be implemented thus was considered as the most viable because of the following reasons;

1. Provision of high quality and reliable health care services
2. Contribution of the project towards attainment of Vision 2030
3. Provision of employment opportunities for both skilled and unskilled personnel
4. A market for local goods and services
5. Income to the proponent
6. Revenue to the government in form of taxes levied on goods and /services undertaken by the proposed hospital

### **8.4 Alternative project site**

Pursuing an alternative project site would require that the project be implemented at another site other than the proposed site. Currently, there is no other alternative site available to the proponent for the proposed development. Relocation would necessitate the proponent's search for alternative land or potentially diminish their aspirations of making a meaningful contribution to the economy. Looking for alternative land to accommodate the proposed project of this character and the completion of official transactions on it may take a long period. In addition, it is not guaranteed that such land would be available.

### **8.5 Alternative Construction materials and technology**

The proposed project will be constructed using modern, locally and internationally accepted materials to achieve public health, safety, security and environmental aesthetic requirements. Equipment that saves energy and water will be given first priority without compromising on cost or availability factors. The columns and wall will be made using locally sourced stones, cement, sand (washed and clean); metal bars that meet the Kenya Bureau of Standards



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requirements. Heavy use of timber during construction is discouraged because of destruction of forests. Exotic species would be preferred to indigenous species in the construction where need will arise.



## 9 ENVIRONMENTAL AND SOCIAL MONITORING PLANS

### 9.1 Introduction

An Environmental and Social Monitoring Plan is proposed to assist the proponent in mitigating possible adverse impacts arising from the proposed project and enhance the positive benefits arising from the project through implementation of the recommended mitigation measures. The purpose of the monitoring plan is to ensure that the impacts do not exceed legal standards specified under the different legislations. Implementation of the monitoring plans will ensure that the negative impacts of the project are lessened throughout the project cycle. For the proposed project, the following monitoring plans are proposed.

### 9.2 Air quality monitoring plan

#### 9.2.1 Introduction

Potential sources of air pollution at the proposed project site are dust during construction activities, emissions from machinery/ equipment and vehicular. Air pollution above acceptable limits is toxic to ecological systems and to human health. The purpose of the air quality monitoring plan is to ensure that the concentrations of air pollutants are within the standards prescribed under the Environmental Management and Coordination (Air Quality) Regulations, 2014. In addition, the results will be used to evaluate if the adopted air pollution controls and management are effective.

#### 9.2.2 Monitoring parameters

The monitoring parameters and the specified target values are stipulated under the First Schedule of the Environmental Management and coordination (Air Quality) Regulations, 2014 (Table 13).

**Table 13: Ambient air quality tolerance limits as per the First Schedule of the Environmental Management and Coordination (Air Quality) Regulations, 2014.**

Pollutant	Limits as per Air Quality Regulations, 2014
Sulphur Oxides (SO <sub>x</sub> )	80 µg/m <sup>3</sup>
Nitrogen Dioxide	150 µg/m <sup>3</sup>
Suspended Particulate Matter (SPM)	360 µg/m <sup>3</sup>
Respirable Particulate matter (<10µm)	70 µg/m <sup>3</sup>
PM <sub>2.5</sub>	35 µg/m <sup>3</sup>
Non methane hydrocarbons	700ppb
Total VOC	600 µg/m <sup>3</sup>
Oxides of Nitrogen	80 µg/m <sup>3</sup>
Carbon monoxide/ carbon dioxide	10 mg/m <sup>3</sup>

#### 9.2.3 Monitoring location

Air quality monitoring should be carried out within the proposed project site during the construction phase.

#### 9.2.4 Monitoring frequency

Air quality monitoring should be done on a quarterly basis in collaboration with a



NEMA designated laboratory.

### **9.3 Noise monitoring plan**

#### **9.3.1 Introduction**

Potential sources of noise pollution will emanate during construction activities and operation of equipment. Noise levels above the stipulated EMCA limits may lead to hearing impairments which may reduce the workmanship of the employees. The purpose of noise monitoring plan is to therefore ascertain the extent of the impact due to the construction activities and subsequent operation of the facility in compliance with the First and Second Schedule of the Environmental Management and Coordination (Noise and Excessive Vibrations pollution) (Control) Regulations, 2009.

#### **9.3.2 Monitoring parameters**

The monitoring parameters and standard specified target values for the purpose of environmental monitoring and protection are stipulated in the Second Schedule of the Environmental Management and Coordination (Noise and Excessive Vibrations pollution) (control) Regulations, 2009 (Table 14).

**Table 14: Maximum permissible levels for construction sites as stipulated under the Second Schedule of Environmental Management and Coordination (Noise and Excessive Vibration Pollution) (Control) Regulations, 2009.**

Zone		Maximum Noise Level Permitted (Leq) in db(A)	
		Day	Night
(i)	Health facilities, educational institutions, homes for disabled etc.	60	35
(ii)	Residential	60	35
(iii)	Areas other than those prescribed in (i) and (ii)	75	65

#### **9.3.3 Monitoring location**

Noise monitoring should be carried out within the proposed project site during the construction phase and peak noise producing sections of the facility during operations.

#### **9.3.4 Monitoring frequency**

Noise monitoring should be done on a quarterly basis in collaboration with a NEMA designated laboratory.

#### **9.3.5 Waste monitoring plan**

##### **9.3.5.1 Introduction**

Solid waste will emanate from construction activities and during the operational phase of the proposed development. Poor disposal of solid waste causes environmental pollution and therefore poses a health risk to the workers, visitors to the facility, patients and neighbours.



The purpose of the monitoring plan is to ensure both the general and biomedical waste is managed in such a way that it protects both the public health and the environment.

### 9.3.5.2 Monitoring strategy

The waste monitoring plan will document the collection, storage and disposal of solid waste from the proposed development. There is need to code each of the collection points, note the capacity and critical levels, frequency of disposal and the personnel and contractor responsible. In addition, it will be important to characterize the waste streams at the collection points to inform investments in segregation infrastructure.

### 9.3.5.3 Monitoring frequency

The frequency of waste monitoring differs from the collection to the disposal stage/incineration to ensure reduced odour, potential contamination and accumulated heaps of waste. Table 15 describes the outline for which the activity should be monitored but can be adjusted depending on the amount generated.

**Table 15: Sample outline for solid waste monitoring plan.**

Activity	Frequency	Critical levels (kgs)	Target	Responsibility
Collection	Daily			
Storage	Daily			
Management	Daily			
Disposal (general waste)	Weekly			
Incineration (biomedical waste)	Thrice per week			

### 9.3.5.4 Indicators of success

Indicators of success will include timely collection and disposal of solid waste by the contractors, acquiring a waste disposal tracking documents and timely incineration of biomedical waste.

## 9.3.6 Safety and health monitoring plan

### 9.3.6.1 Introduction

Potential safety and health risks at the proposed project site include exposure to radiation, trip hazards, electrical hazards, falling objects and fire risks among others with a potential to cause permanent disability or even death to workers, visitors and patients. The purpose of safety and health monitoring plan is to assess existing controls alongside potential health and safety risks in order to develop an effective plan of action and to ensure compliance with OSHA, 2007.

### 9.3.6.2 Monitoring strategy

The monitoring schedule regarding occupational safety and health will basically involve:

- Conducting occupational safety and health reviews and reports.
- Hazard identification by analyzing activities that can be an immediate threat or



cause harm over a period of time.

- Ensuring that all accidents and incidents occurring at the proposed project site are promptly reported and investigated.
- Keeping statistics of accidents, incidents and dangerous occurrences and ensuring that reportable cases are filed with the health, safety and environment officer.
- Routine inspections of the proposed facility and equipment.
- Visual inspection as well as interviewing key personnel to identify areas of improvement.
- Undertaking and reviewing of fire, energy and risk assessment reports
- Review of safety awareness, fire drills and fire safety training requirements.
- Evaluation of the effectiveness of health and safety training to the workforce.
- Action plans related to significant findings of the risk assessment.
- Having emergency evacuation plans and emergency routes and safety signage among others.

The responsibility for implementing this monitoring plan will be vested in the Department of Occupational Safety and Health.

#### **9.3.6.3 Indicator of success**

The ideal indicators of success will include zero accidents and fatalities and reduction of the number of incidents and accidents at the proposed project site.

### **9.3.7 Water quality monitoring plan**

#### **9.3.7.1 Introduction**

The potential sources of water quality degradation at proposed project site will include poor disposal of effluent from the sanitation facilities. Poor water quality has potential to affect ground water aquifers. The proponent should put in place a consistent water quality monitoring plan targeting the quality of effluent discharging into the public sewer. The objective of the monitoring plan will be to provide data and information to improve water quality and management of the wastewater by assessing the variation of water quality parameters to comply with the standards prescribed by the Fifth Schedule of the Environmental Management and Coordination (Water Quality) Regulations, 2006. Apart from implementing measures to meet the legal standards, obtaining an Effluent Discharge License from NEMA will also form part of the indicators of success of the wastewater quality monitoring plan.

#### **9.3.7.2 Monitoring parameters**

The water parameters and the specified target values to be monitored at the proposed project site will be based on the Fifth Schedule of the Environmental Management and Coordination (Water Quality) Regulations, 2006 as shown in Table 16 below.



**Table 16: Water quality monitoring parameters and the standards prescribed under the Fifth Schedule of the Environmental Management and Coordination (Water Quality) Regulations, 2006.**

Parameters	Maximum levels permissible
Suspended solids (mg/L)	250
Total dissolved solids (mg/L)	2000
Temperature	20-35
pH Value	6-9
Oil and grease (mg/L) - where conventional treatment shall be used	10
Oil and grease (mg/L) - where ponds is a final treatment method	5
Ammonia Nitrogen (mg/L)	20
Substances with an obnoxious smell	Shall not be discharged into the sewer
Biological Oxygen Demand at 20°C (mg/L)	500
Chemical Oxygen Demand (mg/L)	1000
Arsenic (mg/L)	0.02
Mercury (mg/L)	0.05
Lead (mg/L)	1.0
Cadmium (mg/L)	0.5
Chromium VI (mg/L)	0.05
Chromium(Total) (mg/L)	0.2
Copper (mg/L)	1.0
Zinc (mg/L)	5.0
Selenium (mg/L)	0.2
Nickel (mg/L)	3.0
Nitrates (mg/L)	20
Phosphates (mg/L)	30
Cyanide Total (mg/L)	2
Sulphide (mg/L)	2
Phenols (mg/L)	10
Detergents (mg/L)	15
Colour	Less than 40 Hazen units
Alkyl Mercury	Not detectable (nd)
Free and saline Ammonia as N (mg/L)	4.0
Calcium Carbide	Nil
Chloroform	Nil
Inflammable solvents	Nil
Radioactive residues	Nil
Degreasing solvents of mono-di-trichloroethylene type	Nil



**9.3.7.3 Monitoring location**

Water quality sampling for analysis should be conducted at the trunk line joining the sewer line.

**9.3.7.4 Monitoring frequency**

Water quality sampling and analysis should be undertaken quarterly in collaboration with a NEMA accredited laboratory.

**9.3.8 Domestic water quality monitoring plan****9.3.8.1 Introduction**

Water for domestic water use will be sourced from the borehole within the proposed project site. Borehole water may contain chemical and microbial pollutants that are not fit for human consumption. The purpose of the monitoring plan is to ensure the quality of water from the boreholes is fit for domestic purposes including drinking water as stipulated under the First Schedule of the Environmental Management and Coordination (Water Quality) Regulations, 2006.

**9.3.8.2 Monitoring parameters**

The parameters to be monitored and the corresponding maximum permissible levels prescribed are as shown in Table 17 below.

**Table 17: Water quality monitoring parameters for raw borehole water (Water Works Development Agency).**

Parameters	Units	Results	WHO Standards
<b>Chemical water analysis</b>			
pH	pH scale		6.5-9.0
Turbidity	NTU		Max 25
Conductivity	µs/cm		Max 2000
Total hardness	Mg/L		Max 500
Chloride	Mg/L		Max 600
Total alkalinity	Mg/L		Max 500
Magnesium	Mg/L		Max 150
Calcium	Mg/L		Max 250
Total dissolved solids	Mg/L		Max 1000
Salinity	Mg/L		Max 250
Colour	Hazen		Max 15
Others	Smell		Non objectionable
<b>Bacteriological water analysis</b>			
Faecal coliform count	MPN/100 ml		0
<i>Escherichia coli</i>	MPN/100 ml		0

**9.3.8.3 Monitoring location**

Water quality monitoring should be carried out at the existing borehole.



**9.3.8.4 Monitoring frequency**

The frequency of monitoring should be once per month in collaboration with a NEMA designated laboratory.

**9.3.9 Energy monitoring plan**

**9.3.9.1 Introduction**

The operations of the proposed development will require energy in bulk at the different sections. The aim of the monitoring plan is to inform substantial practical guidelines for continuous improvement of consumption efficiency and identifying cost saving opportunities in energy efficiency.

**9.3.9.2 Monitoring strategy**

Energy consumption should be monitored through power bills from Kenya Power, the fuel consumption by the standby generator and other machinery on a monthly basis and conducting energy audits.

**9.3.9.3 Monitoring frequency**

The monitoring frequency should be conducted once every three years by an energy expert certified by EPRA.



## **10 CONCLUSION AND RECOMMENDATIONS**

### **10.1 Conclusion**

The proposed project is considered important and beneficial as it has the advantage of providing quality, reliable and affordable health care services, contribution of the project towards attainment of Vision 2030 and Sustainable Development Goals number three (Good health and well-being) and twelve (Responsible consumption and production), provision of employment opportunities, supporting other local business establishments and a source of income to the County and National government. Besides this, there will be negative environmental and social impacts at all phases of the project cycle. The main concerns include safety and health issues, increased demand for environmental resources, noise and air pollution and waste management. However, this ESIA study report proposes a suite of Environmental and Social Management Plans to address these negative environmental and social impacts.

### **10.2 Recommendations**

The main recommendation of this ESIA study report is the need for concerted implementation of the Environmental and Social Management and Monitoring Plans by the proponent. Others include:-

The proponent and the contractor will also be required to update internal environmental and social policies and plans to ensure all activities associated with this project, including for the construction phase, are included in their existing Environmental and Social Management Systems.

In addition to the study, the proponent is required to meet the following:-

- Regular Environmental Monitoring and Evaluation during the construction phase;
- An annual Environmental Audit (after one year in operation of the proposed hospital and thereafter annually);
- Fire audit, risk assessment and safety and health audit has to be conducted for the site on annual basis.

On the basis of a commitment by the proponent to implement the proposed mitigation measures and the Environmental and Social Management Plan, we recommend the issuance of an EIA License as per the Environmental Management and Coordination Act Cap. 387 of the Laws of Kenya.



## **11 REFERENCES**

1. Documents provided by the proponent.
2. Government of Kenya Policies
  - The Constitution of Kenya, 2010
  - The Health Care Waste Management Plan 2016 –2021
  - The Kenya Vision 2030
  - The Nairobi City County Integrated Development Plan 2018-2022
  - The National Climate Change Action Plan 2018–2022
  - The National Energy and Petroleum Policy, 2018
  - The National Environmental Policy, 2013
  - The National Health Policy 2014 – 2030
  - The National Land Policy, 2009
  - The National Water Policy, 2021
3. Government of Kenya Statutes:
  - The Environmental Management and Coordination (Air Quality) Regulations, 2014
  - The Environmental Management and Coordination (Impact Assessment and Audit) (amendment) Regulations 2019
  - The Environmental Management and Coordination (Noise and Excessive Vibration Pollution) (Control) Regulations, 2009
  - The Environmental Management and Coordination (Waste Management) Regulations, 2006
  - The Environmental Management and Coordination (Water Quality) Regulations, 2006
  - The Environmental Management and Coordination Act Cap 387 of the Laws of Kenya
  - The Climate Change Act, 2016
  - The Clinical Officers (Training, Registration, and Licensing) Act, 2017
  - The Constitution of Kenya, 2010
  - The County Government Act, 2012
  - The Energy Act, 2019
  - The Medical Laboratory Technicians and Technologists Act, 2000
  - The Medical Practitioners and Dentists Act, 2019
  - The Nairobi City County Community and Neighbourhood Associations Engagement Act, 2016
  - The National Construction Authority Act, 2011
  - The Nurses and Midwives Act, 2019
  - The Occupational Safety and Health Act , 2007
  - The Occupiers’ liability Act, 2012
  - The Pharmacy and Poisons Act, 2019
  - The Physical and Land Use Planning Act, 2019
  - The Public Health Act, 2012



## **ESIA Study for the Proposed World Trade Centre Hospital**

- The Sustainable Waste Management Act, 2022
- The Water Act, 2016
- The Work Injury Compensation Benefit Act 2007



## 12 APPENDICES

### Appendix 1: Copy of the title deed

  
REPUBLIC OF KENYA

THE REGISTRATION OF TITLES ACT  
(Chapter 281)

**CERTIFICATE OF TITLE**

Title Number I.R. 134578

Term: 99 1R134578 YEARS FROM 1-12-1999

ANNUAL RENT SHILLINGS: 299,000/=

I HEREBY CERTIFY that NAIROBI BUSINESS PARK LIMITED (Rentable)

of Post Office Box Number 43233 NAIROBI

in the Republic of Kenya ~~has now transferred to~~ is now registered proprietor(s) as Lessee(s)

from the Government of the Republic of Kenya for the term of Ninety Nine

years for the First day of December One ~~Two~~ thousand Five Hundred

and Ninety Nine of ALL that piece of land situate City of Nairobi

in the Nairobi District containing by measurement Four Decimal Five Five Six

hectares, ~~square metres~~ (4.556) Ha.

hectares (square metres) or thereabouts and being Land Reference Number 24861/1

(Original Number

as delineated on Land Survey Plan Number 302693

annexed to the said Transfer hereto

SUMMIT however to the revisable annual rent of Shillings Two Hundred and Ninety Nine Thousand

and to the Act Special Conditions Encumbrances and other matters specified in the Memorandum hereunder written.

In WITNESS whereof I have hereunto set my hand and seal this 30th

day of December Two thousand and Eleven

  
Registrar of Titles  
B. F. Mwangi 2011

MEMORANDUM

(1) The Government Lands Act (Chapter 280).

(2) The Special Conditions contained in a Grant registered as Number I.R. 83514/1

GFR 5406-3a-2009

(3) Subject to Leases Registered as IR.83514/9,20 and 21

(4) Subject to charge & further charge registered as IR.83514/18 & 19

This Certificate of Title is issued under section 70 of RTA and is in part substitution of a Grant Registered as IR. 83514/1

LAND TITLES DEPARTMENT, NAIROBI REGISTER  
REGISTRATION OF TITLE ACT  
REGISTERED PROPRIETOR I.R. 134578/1  
PRESENTED 30th December 2011  
FIND 200115  
Registrar of Titles



1940  
5/17

(2) THE FOLLOWING INSTRUMENT HAS BEEN REGISTERED AGAINST THE TITLE  
Charge to IEM Bank Limited  
For USD 1,000,000.00

Presentation No: 1940 Date of Registration: 22-5-2017  
 Registrar:  
C. N. Kituyi \*215

(3) THE FOLLOWING INSTRUMENT HAS BEEN REGISTERED AGAINST THE TITLE  
Discharge of charge of no 2 above

Presentation No: 262 Date of Registration: 2-8-2022  
 Registrar:  
P. K. Mundia \*224

(4) THE FOLLOWING INSTRUMENT HAS BEEN REGISTERED AGAINST THE TITLE  
Transfer to NBP Holdings Limited  
For Ksh 2,049,000,000

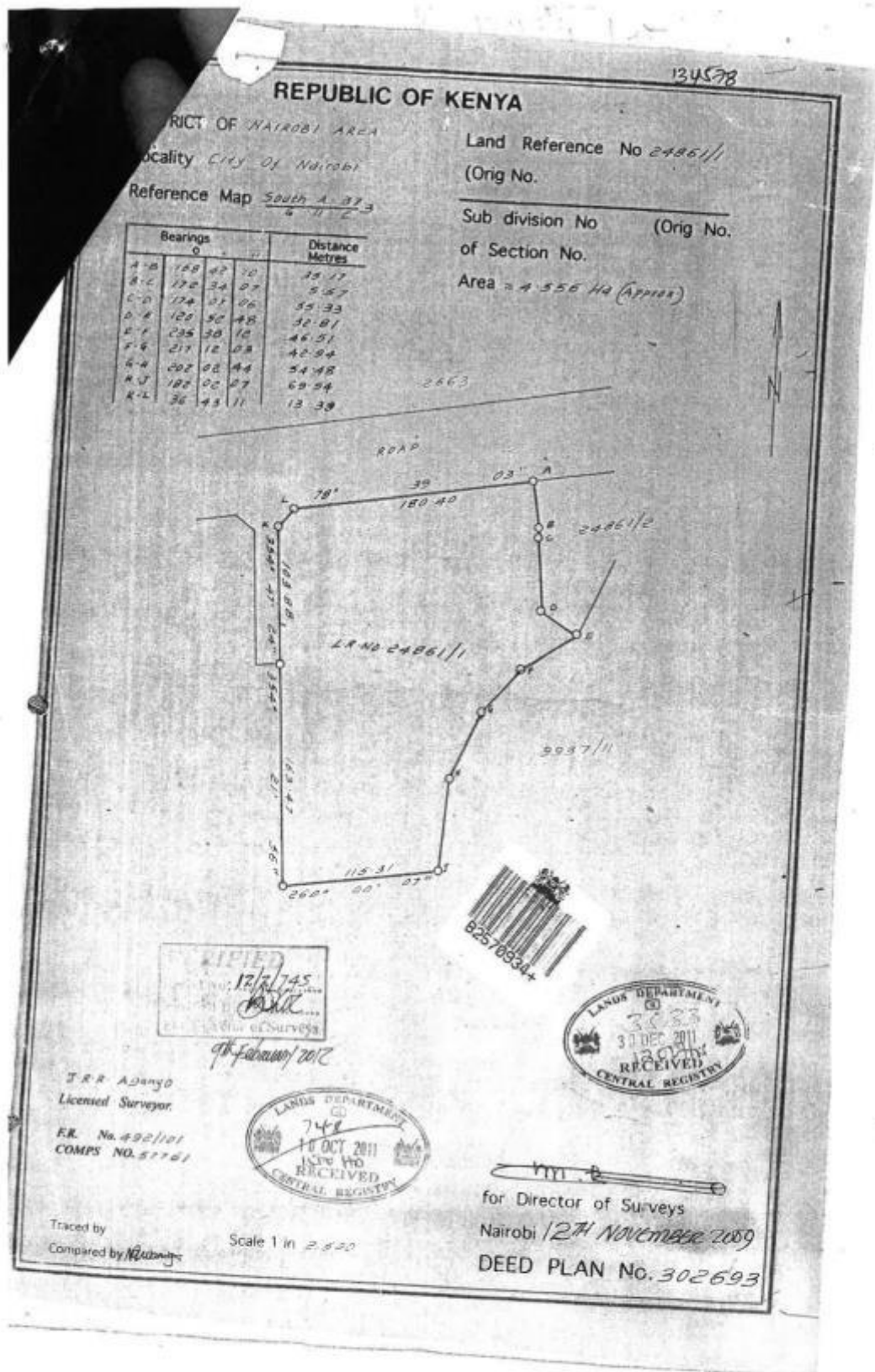
Presentation No: 263 Date of Registration: 2-8-2022  
 Registrar:  
P. K. Mundia \*224

I hereby certify this to be a true copy  
 of the Original.

(1) stamp duty shs.....  
 Copying A/c. shs.....  
 shs.....  
 Date: 01-09-2022

Debm  
P. K. Mundia \*224  
 REGISTRAR OF TITLES







FORM PLUPA/DC/8

SN: SUB-004652

City Hall Way, City Hall  
[www.nairobi.go.ke](http://www.nairobi.go.ke)



P.O.Box 30075-00100  
Nairobi, KENYA

**NAIROBI CITY COUNTY**

**THE PHYSICAL AND LAND USE PLANNING ACT (No. 13 of 2019)**

Registered Number of Application **PLUPA-SUB-000143-N**

**NOTIFICATION OF APPROVAL OF APPLICATION**

TO **NBP HOLDINGS LIMITED**

Through **Solomon Kyeni John**  
**Physical Planner, Reg. No: 0188**

Your application number as above, submitted on **9th, December 2022**

For permission to carry out **Land Subdivision - New of**

L.R. / Parcel No **24861/1 (NAIROBI BLOCK 149/1351)** with Coordinates **-1.3079, 36.7397**

Situated in **Dagoretti-Riruta, Karen** in **Langata** Sub-county

Along **Along Ngong Road** has been **APPROVED** on **20th, January 2023**

By the Urban Planning Technical Committee tabled under Item No 7

For the reasons/subject to the conditions appended overleaf.



Date **20th, January 2023**

**For CECM Built Environment and Urban Planning**

CC:  
The National Land Commission, Nairobi  
The Land Registrar  
The Director General - Physical and Land Use Planning, Nairobi  
The Director of Surveys, Nairobi  
The Secretary, State Department of Lands, Ministry of Lands & Physical Planning



**PLUPA-SUB-000143-N**

**SN: SUB-004652**

**Conditions for approval: -**

- a. Application for water supply to each plot to be made to the Director, Water, Energy, Forestry, Environment & Natural resources and his conditions for such supply to be met.
- b. Construction of any building or boundary wall/hedge should not encroach on to road reserve.
- c. Subject to the plot not constituting part of the disputed land/public utility.
- d. Vehicular plot entrance to and from the 60m wide Ngong road will not be permitted.
- e. Vehicular access to subplot A to be from the existing 18m wide road. Form of application for permission to construct plot access on a public road/street to be obtained from the Director Roads, Transport and Public works.
- f. Vehicular access to subplot B to be via the proposed road easement abutting the plot and as reflected on the approved masterplan.
- g. Subject to submission of building plans of all the existing buildings to the Nairobi City County Government for regularization.
- h. Subject to the structural stability of the existing buildings being verified/ confirmed to the satisfaction of the Director of Public Works, Nairobi City County Government.
- i. All the dilapidated buildings coloured yellow on the deposited plans to be demolished to the satisfaction of the Director - Environment.
- j. The resultant subplots to strictly retain the existing land uses as indicated on the attached / approved masterplan.
- k. Subject to the area coloured Yellow measuring 0.8531ha to be reserved for public purpose (medical facility) as per the approved master plan.






Appendix 2: Change of User approval

Invoice Number: INV-MP-AAA010

PRN: PPA-MP-AAA010



FORM P.P.A. 2

THE PHYSICAL PLANNING ACT (NO. 6 OF 1996)

**NOTIFICATION OF APPROVAL OF DEVELOPMENT PERMISSION**

To: Jane Mwanje Munasseh,  
P.O Box 43657-00100,

Your application, PPA-MP-AAA010, submitted on 12 May 2020

Seeking permission for **Master Plan** from **Commercial cum residential (Flats) to Mixed use** on L.R. Plot no L.R.No. 24861/1 and 24861/2

Situated in Ngong Road, Road Ngong Road

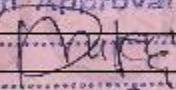
Was approved by the County Planning Committee held on 2020-07-02.

Under **Item 50** Subject to the following/attached conditions:

- i) Payment of revised ground rent as will be determined by the Chairman National Land Commission
- ii) Payment of revised rates as will be determined by the Director Valuation & Property Management - Nairobi City County
- iii) Subject to the plot not constituting part of the disputed public/private utility lands/locations
- iv) Subject to compliance with Sections 36, 41 and 52 of the Physical Planning Act
- v) Subject to compliance with the approved zoning policy
- vi) Subject to provision of appropriate setback(s) as per the rezoning plan
- vii) Subject to provision of adequate and functional on site parking to the satisfaction of Director of Roads, Public Works & Transport

Date of Issue 12 October 2020	Signed
	Name
	For: Chief Officer, Urban Planning
cc:	The Chairman National Land Commission - Nairobi
	The Director of Physical Planning, Nairobi
	The Director of Surveys, Nairobi
	The Secretary, State Department of Lands, Ministry of Lands & Physical Planning
	The Land Registrar


**NAIROBI METROPOLITAN SERVICES**  
**CITY PLANNING DEPARTMENT**  
**Development Application - Policy Plan Approval**


Signature:   
Date: 28/10/2020

**POLICY IMPLEMENTATION SECTION**



Appendix 3: Copy of the certificate of incorporation






No. PVT-AJUBPJ8

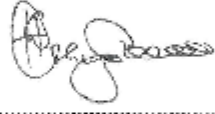
**CERTIFICATE OF INCORPORATION**

I hereby **CERTIFY** that,

**NBP HOLDINGS LIMITED**

is on this date 10 Sep 2018 Incorporated under the Companies Act, 2015 and that the Company is a **PRIVATE LIMITED COMPANY**.






Registrar Of Companies

This is a system generated certificate. To validate this document send the word BBS to 21546



Appendix 4: Copy of Pin certificate



**KENYA REVENUE  
AUTHORITY**

[www.kra.go.ke](http://www.kra.go.ke)

**PIN Certificate**

**For General Tax Questions**  
 Contact KRA Call Centre  
 Tel: +254 (020) 4999 999  
 Cell: +254(0711)099 999  
 Email: [callcentre@kra.go.ke](mailto:callcentre@kra.go.ke)

---

**Certificate Date :** 29/04/2020

**Personal Identification Number**  
P051736990A

---

This is to certify that taxpayer shown herein has been registered with Kenya Revenue Authority

**Taxpayer Information**

<b>Taxpayer Name</b>	NBP HOLDINGS LIMITED
<b>Email Address</b>	NBPHOLDINGSLTD@GMAIL.COM

**Registered Address**

<b>L.R. Number :</b> L.R NO.209/6821	<b>Building</b> ICEA LION CENTRE
<b>Street/Road</b> RIVERSIDE PARK, CHIROMO ROAD	<b>City/Town :</b> NAIROBI
<b>County :</b> Nairobi	<b>District</b> Westlands District
<b>Tax Area</b> Westlands	<b>Station</b> West of Nairobi
<b>P. O. Box</b> 10643	<b>Postal Code</b> 00100

**Tax Obligation(s) Registration**

Sr. No.	Tax Obligation(s)	Effective From Date	Effective Till	Status
1	Income Tax - PAYE	01/04/2020	N.A.	Active
2	Value Added Tax (VAT)	21/04/2020	N.A.	Active
3	Income Tax - Company	10/09/2018	N.A.	Active

The above PIN must appear on all your tax invoices and correspondences with Kenya Revenue Authority. Your accounting end month is December unless a change has been approved by the Commissioner-Domestic Taxes Department. The status of Tax Obligation(s) with 'Dormant' status will automatically change to 'Active' on date mentioned in "Effective Till Date" or any transaction done during the period. This certificate shall remain in force till further updated.

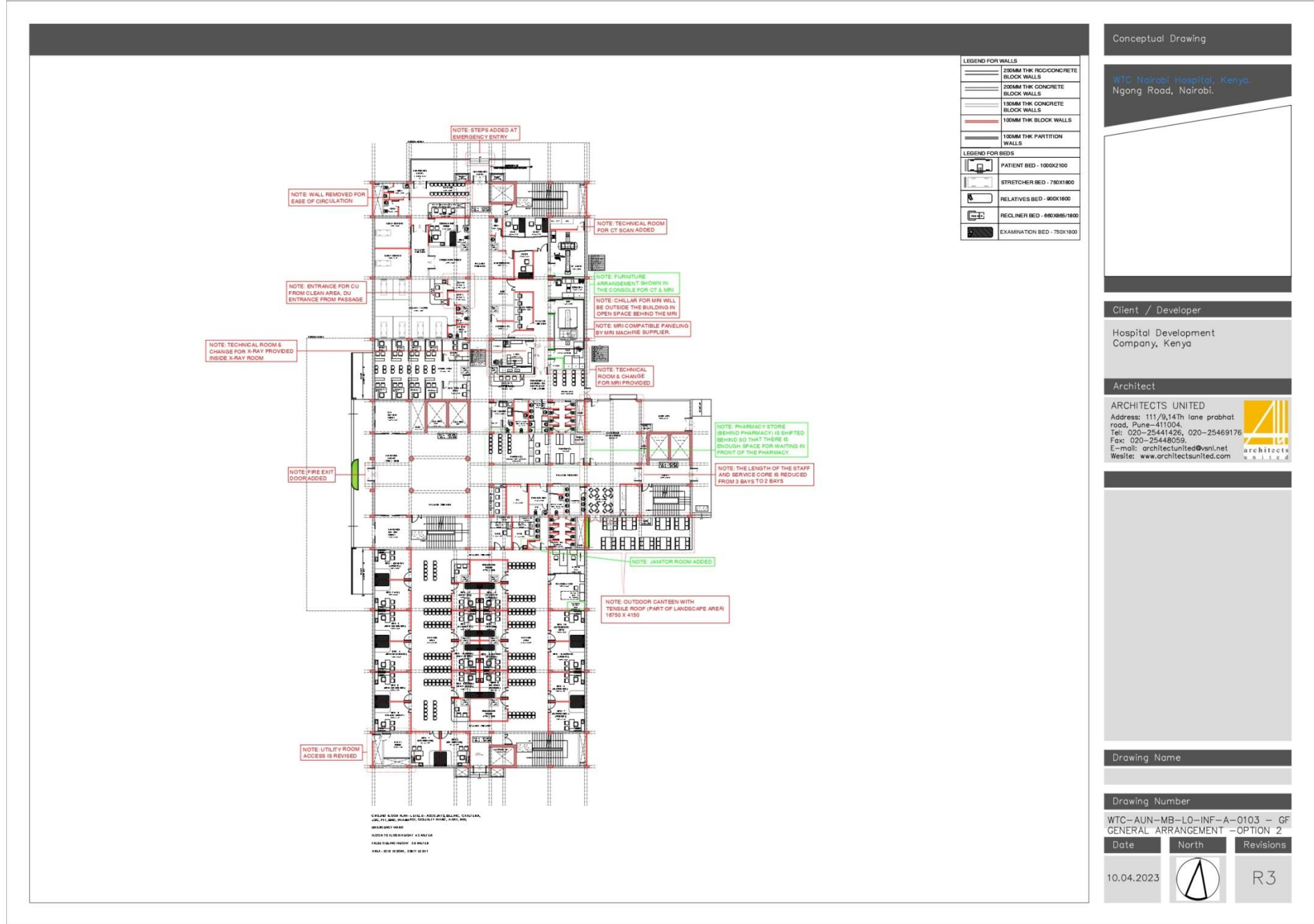
**Disclaimer :** This is a system generated certificate and does not require signature.



## Appendix 5: Project Architectural Drawings



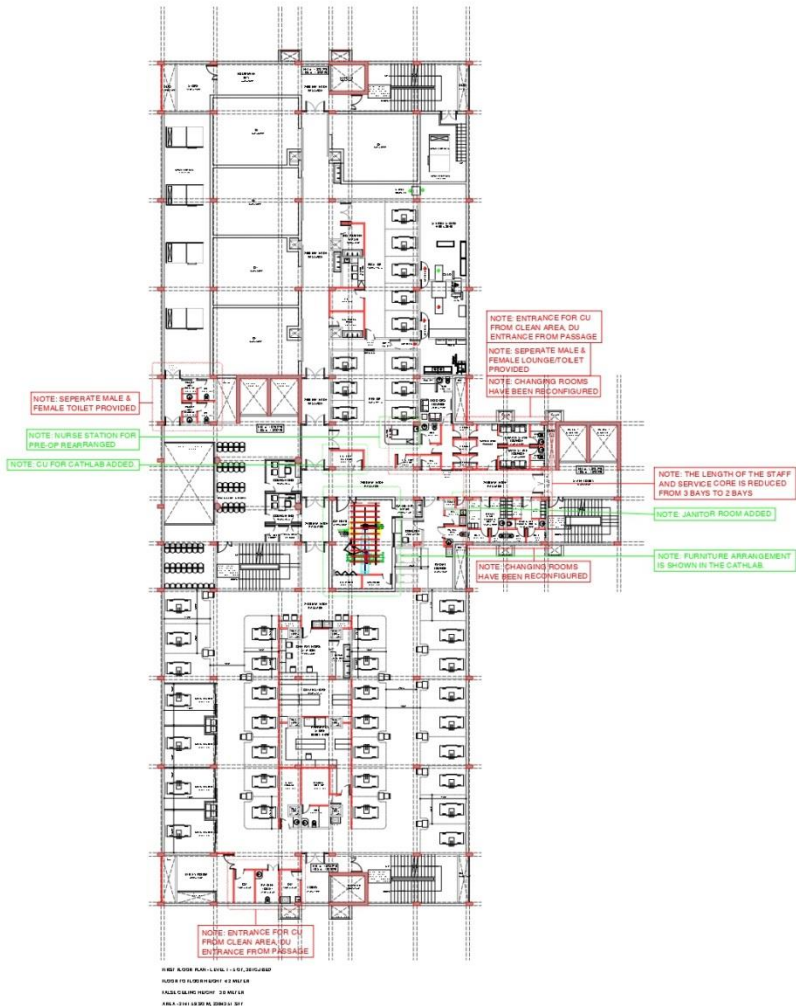
















# ESIA Study for the Proposed World Trade Centre Hospital






### FIRST FLOOR PLAN



LEGEND FOR WALL:

	250MM THK RCC-CONCRETE BLOCK WALLS
	200MM THK CONCRETE BLOCK WALLS
	150MM THK CONCRETE BLOCK WALLS
	100MM THK BLOCK WALLS
	100MM THK PARTITION WALLS
<b>LEGEND FOR BEDS</b>	
	PATIENT BED - 1000X2100
	STRETCHER BED - 760X1800
	RELATIVE'S BED - 900X1800
	RECLINER BED - 680X905/1800
	EXAMINATION BED - 750X1800

LEGEND FOR BEDS

	PATIENT BED - 1000X2100
	STRETCHER BED - 750X1800
	RELATIVES BED - 900X1800
	RECLINER BED - 660X865/1800
	EXAMINATION BED - 750X1800

Client / Developer

Hospital Development  
Company, Kenya

ARCHITECTS UNITED

Address: 111/9,14Th lane prabhat  
road, Pune-411004.  
Tel: 020-25441426, 020-25469176  
Fax: 020-25448059.  
E-mail: [architectunited@vsnl.net](mailto:architectunited@vsnl.net)  
Website: [www.architects united.com](http://www.architects united.com)



Drawing Name

Conceptual First Floor Plan—Level 1

Drawing Number

WTC-AUN-MB-L1-INF-A-0104 - FF  
GENERAL ARRANGEMENT-OPTION 2

10.04.2023

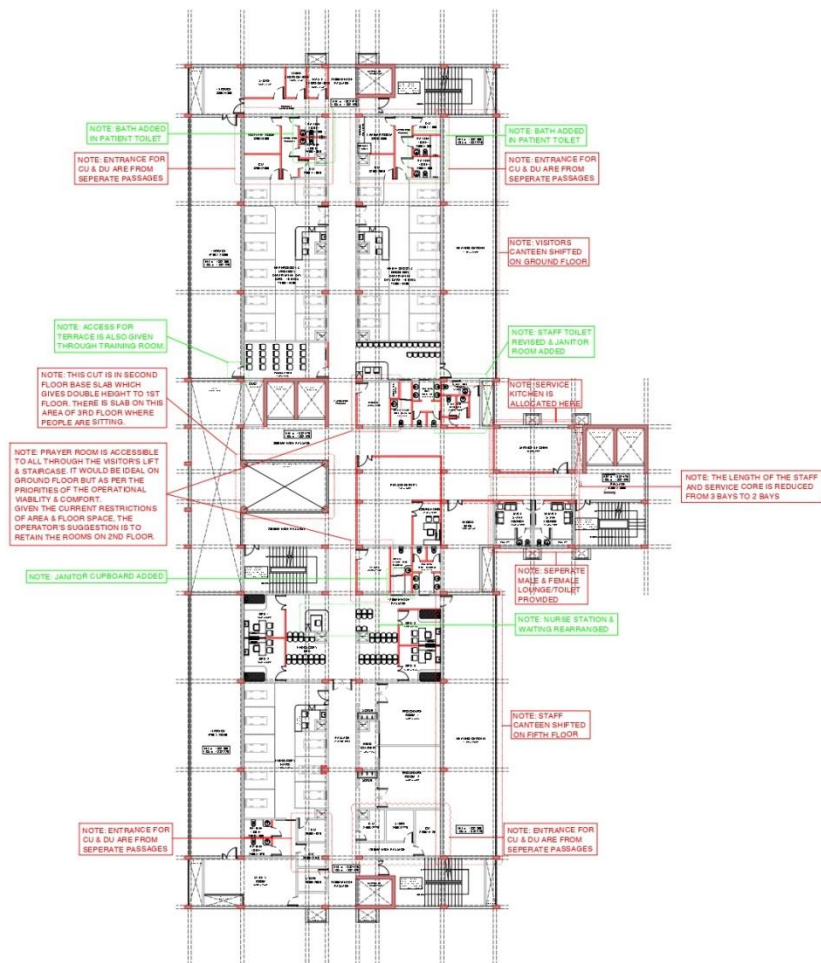


R.3













# ESIA Study for the Proposed World Trade Centre Hospital

## SECOND FLOOR PLAN






SECOND FLOOR PLAN - LEVEL 2 - OFF GASES - HYPOXIC &  
HEMATOCRYT CLARIFICATION - HEMATOLOGY & HEMATOLOGY  
CLARIFICATION - HEMATOLOGY & HEMATOLOGY  
FLOOR TO FLOOR HEIGHT - 10.00 FT  
FLOOR OVERLAP - 10.00 FT  
FLOOR OVERLAP - 10.00 FT  
FLOOR OVERLAP - 10.00 FT

LEGEND FOR WALL:

	250MM THK RCC-CONCRETE BLOCK WALLS
	200MM THK CONCRETE BLOCK WALLS
	150MM THK CONCRETE BLOCK WALLS
	100MM THK BLOCK WALLS
	100MM THK PARTITION WALLS
<b>LEGEND FOR BEDS</b>	
	PATIENT BED - 1000X2100
	STRETCHER BED - 760X1800
	RELATIVE'S BED - 900X1800
	RECLINER BED - 680X905/1800
	EXAMINATION BED - 750X1800

LEGEND FOR BED

	PATIENT BED - 1000X2100
	STRETCHER BED - 750X1800
	RELATIVES BED - 900X1800
	RECLINER BED - 600X865/1800
	EXAMINATION BED - 750X1800

### Conceptual Drawing

WTC Nairobi Hospital, Kenya  
Ngong Road, Nairobi.

Key Plan – 1:5000

Client / Developer

Hospital Development  
Company, Kenya

Architect

ARCHITECTS UNITED

Address: 111/9,14Th lane prabhat  
road, Pune-411004.  
Tel: 020-25441426, 020-25469176  
Fax: 020-25448059.  
E-mail: [architectunited@vsnl.net](mailto:architectunited@vsnl.net)  
Website: [www.architectsunited.com](http://www.architectsunited.com)



Drawing Name

Conceptual Second Floor Plan—Level 2

Drawing Number

WTC-AUN-MB-L2-INF-A-0105 - SF  
GENERAL ARRANGEMENT-OPTION 2

Date \_\_\_\_\_

North

## Revisions

10.04.2023

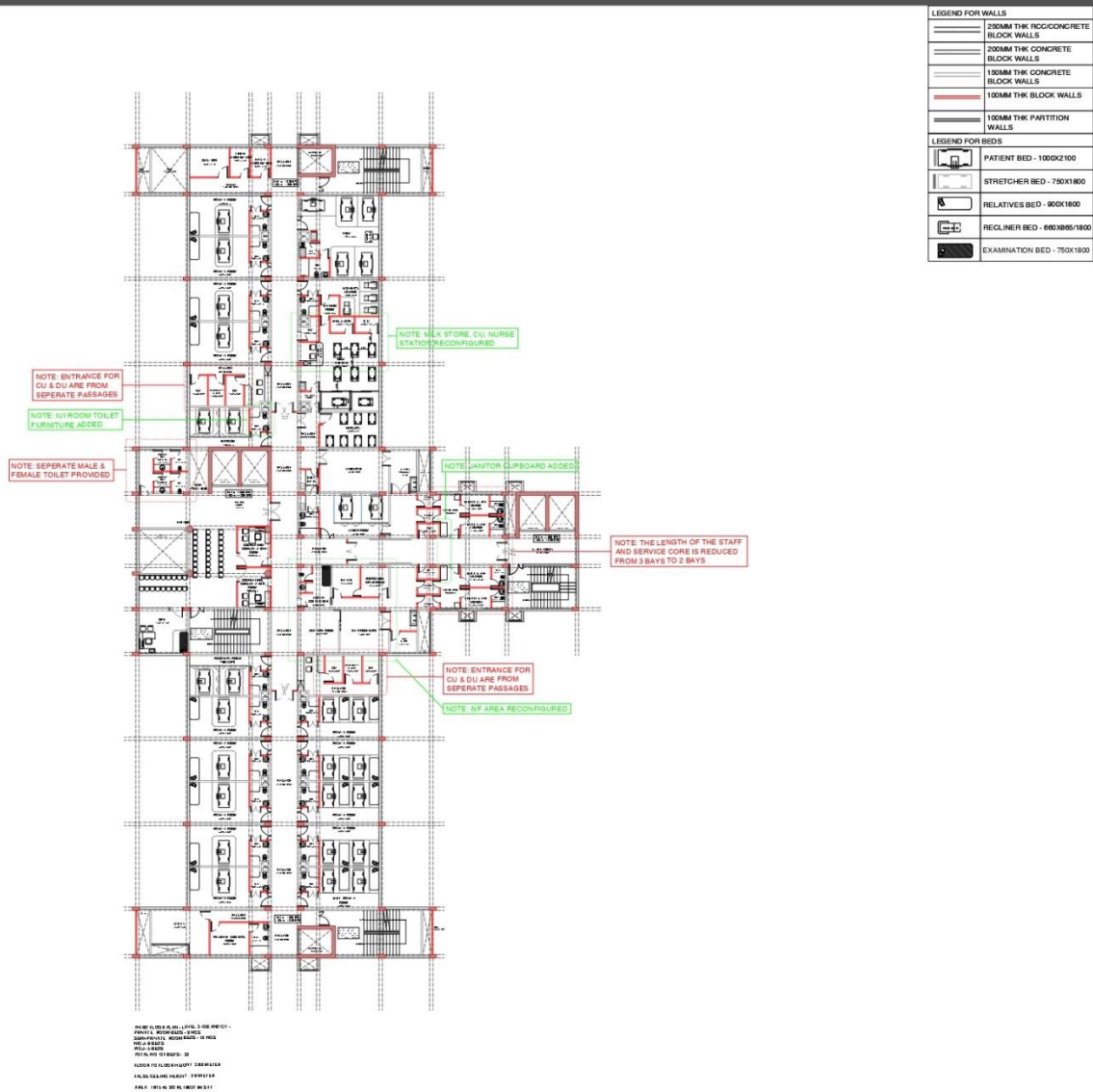


R3



ESIA Study for the Proposed World Trade Centre Hospital

THIRD FLOOR PLAN



Conceptual Drawing

WTC Nairobi Hospital, Kenya.  
Ngong Road, Nairobi.

Key Plan - 1:5000

Client / Developer

Hospital Development  
Company, Kenya

Architect

ARCHITECTS UNITED  
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road, Pune-411004.  
Tel: 020-25441426, 020-25469176  
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Drawing Name

Conceptual Third Floor Plan- Level 3

Drawing Number

WTC-AUN-MB-L3-INF-A-0106 - TF  
GENERAL ARRANGEMENT-OPTION 2

Date

10.04.2023

North



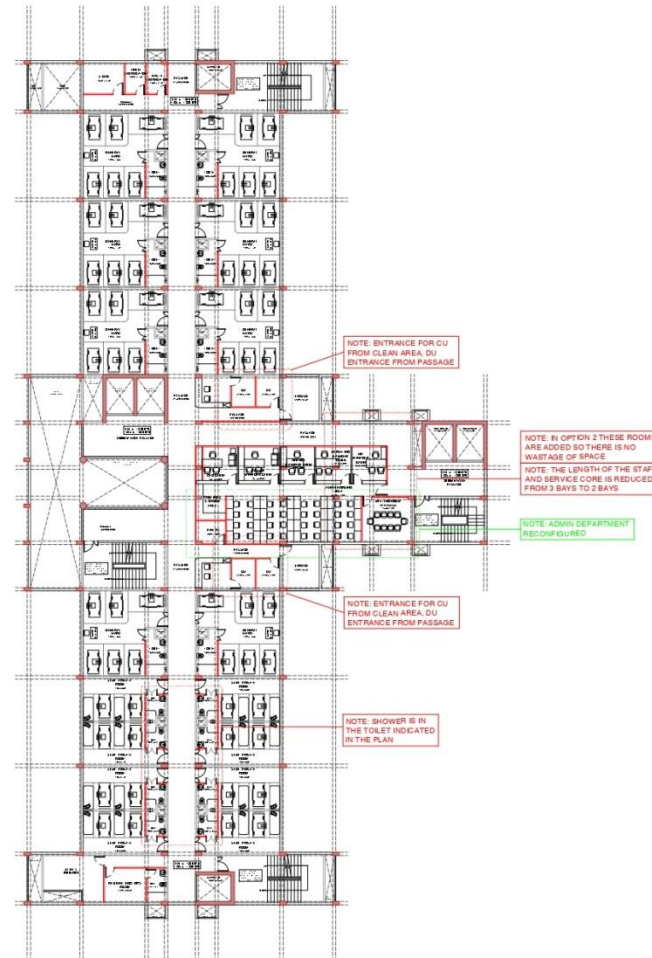
Revisions

R3



# ESIA Study for the Proposed World Trade Centre Hospital

## FOURTH FLOOR PLAN



RELATIVE FLOOR PLAN - LEVEL 4  
GENERAL SCALE: 1:500  
SCALE TO FLOOR PLAN: 1:200  
SCALE TO SECTION: 1:50  
AREA: 1,000 SQ. M. (10,000 SQ. FT.)

LEGEND FOR WALLS	
	250MM THK RCC/CONCRETE BLOCK WALLS
	200MM THK CONCRETE BLOCK WALLS
	150MM THK CONCRETE BLOCK WALLS
	100MM THK BLOCK WALLS
	100MM THK PARTITION WALLS
LEGEND FOR BEDS	
	PATIENT BED - 1000X2100
	STRETCHER BED - 750X1800
	RELATIVES BED - 800X1800
	RECLINER BED - 600X850/1800
	EXAMINATION BED - 750X1800

Conceptual Drawing

WTC Nairobi Hospital, Kenya  
Ngong Road, Nairobi.

Key Plan - 1:5000

Client / Developer

Hospital Development  
Company, Kenya

Architect

ARCHITECTS UNITED  
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Drawing Name

Conceptual Fourth Floor Plan-Level 4

Drawing Number

WTC-AUN-MB-L4-INF-A-0107 - FOF  
GENERAL ARRANGEMENT-OPTION 2

Date

10.04.2023

North



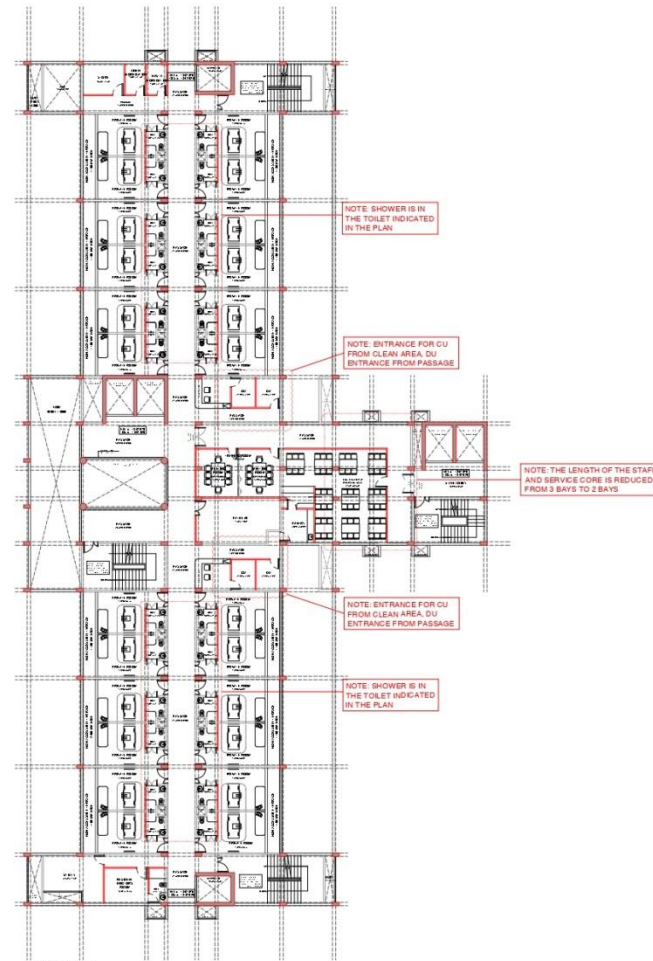
Revisions

R3



# ESIA Study for the Proposed World Trade Centre Hospital

FIFTH FLOOR PLAN



LEGEND FOR WALLS	
	250MM THK RCC/CONCRETE BLOCK WALLS
	200MM THK CONCRETE BLOCK WALLS
	150MM THK CONCRETE BLOCK WALLS
	100MM THK BLOCK WALLS
	100MM THK PARTITION WALLS
LEGEND FOR BEDS	
	PATIENT BED - 1000X2100
	STRETCHER BED - 750X1800
	RELATIVES BED - 800X1800
	RECLINER BED - 600X85/1800
	EXAMINATION BED - 750X1800

NOTE: SHOWER IS IN THE TOILET INDICATED IN THE PLAN

NOTE: ENTRANCE FOR CU FROM CLEAN AREA, DU ENTRANCE FROM PASSAGE

NOTE: THE LENGTH OF THE STAFF AND SERVICE CORE IS REDUCED FROM 3 BAYS TO 2 BAYS

NOTE: ENTRANCE FOR CU FROM CLEAN AREA, DU ENTRANCE FROM PASSAGE

NOTE: SHOWER IS IN THE TOILET INDICATED IN THE PLAN

DATE: 10.04.2023  
DRAWN: 10.04.2023  
CHECKED: 10.04.2023  
APPROVED: 10.04.2023

Conceptual Drawing

WTC Nairobi Hospital, Kenya  
Ngong Road, Nairobi.

Key Plan - 1:5000

Client / Developer

Hospital Development  
Company, Kenya

Architect

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Drawing Name

Conceptual Fifth Floor Plan- Level 5

Drawing Number

WTC-AUN-MB-L5-INF-A-0108 - FIF  
GENERAL ARRANGEMENT-OPTION 2

Date

10.04.2023

North



Revisions

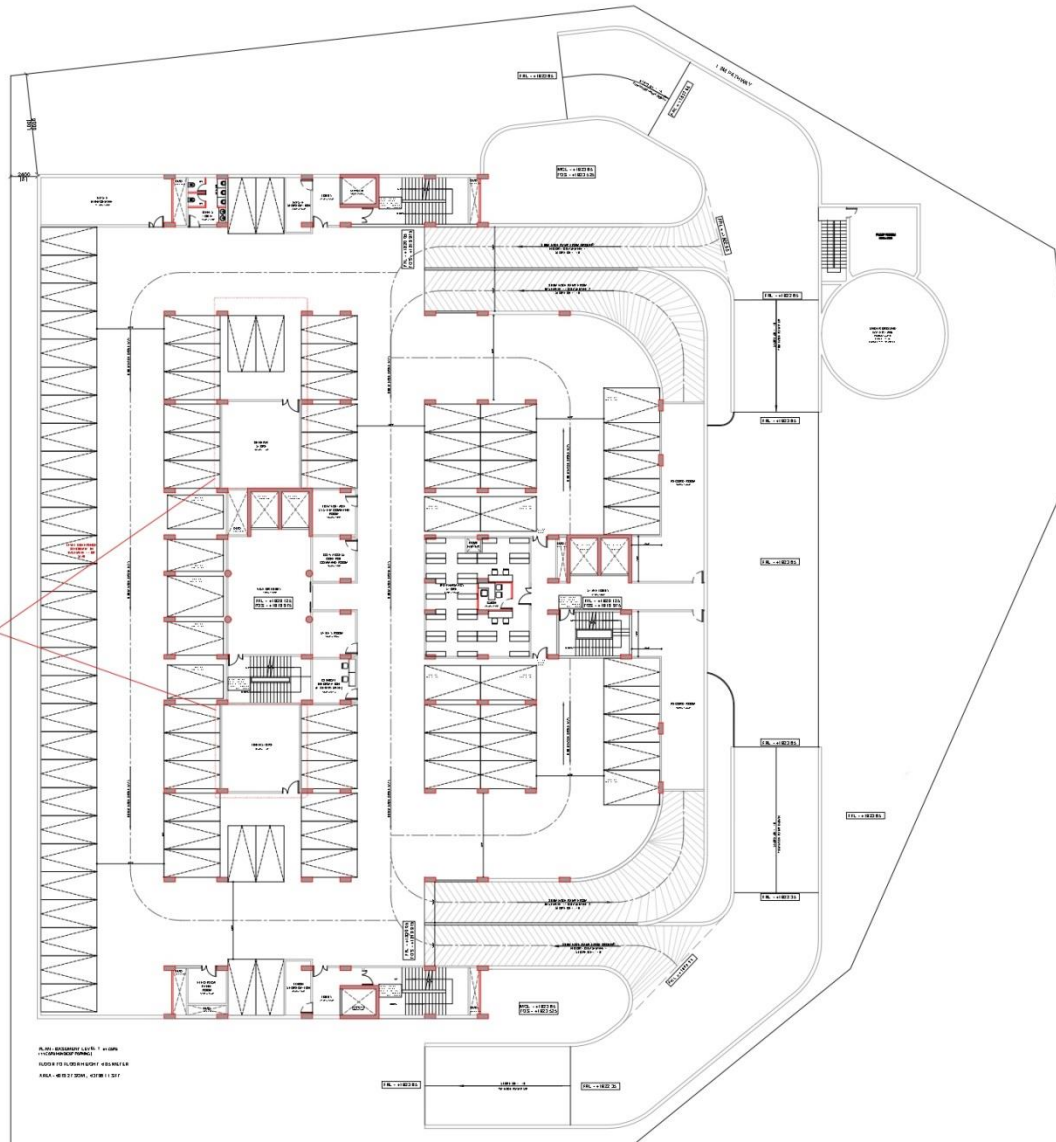
R3



# ESIA Study for the Proposed World Trade Centre Hospital

BASEMENT 1

NOTE: TANDEM PARKING  
REMOVED AS THIS  
BASEMENT WILL BE  
ALLOCATED FOR  
VISITORS PARKING



LEGEND FOR WALLS	
	230MM THK RCC/CONCRETE BLOCK WALLS
	230MM THK CONCRETE BLOCK WALLS
	150MM THK CONCRETE BLOCK WALLS
	100MM THK BLOCK WALLS
	100MM THK PARTITION WALLS

Conceptual Drawing

WTC Nairobi Hospital, Kenya.  
Ngong Road, Nairobi.

Key Plan — 1:5000

Client / Developer

Hospital Development  
Company, Kenya

Architect

ARCHITECTS UNITED  
Address: 111/9,14th lane prabhat  
road, Pune-411004.  
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Drawing Name

Conceptual Basement Level 1 Plan

Drawing Number

WTC-AUN-MB-B1-INF-A-0102 — B1  
GENERAL ARRANGEMENT — OPTION 2

Date

06.04.2023

North



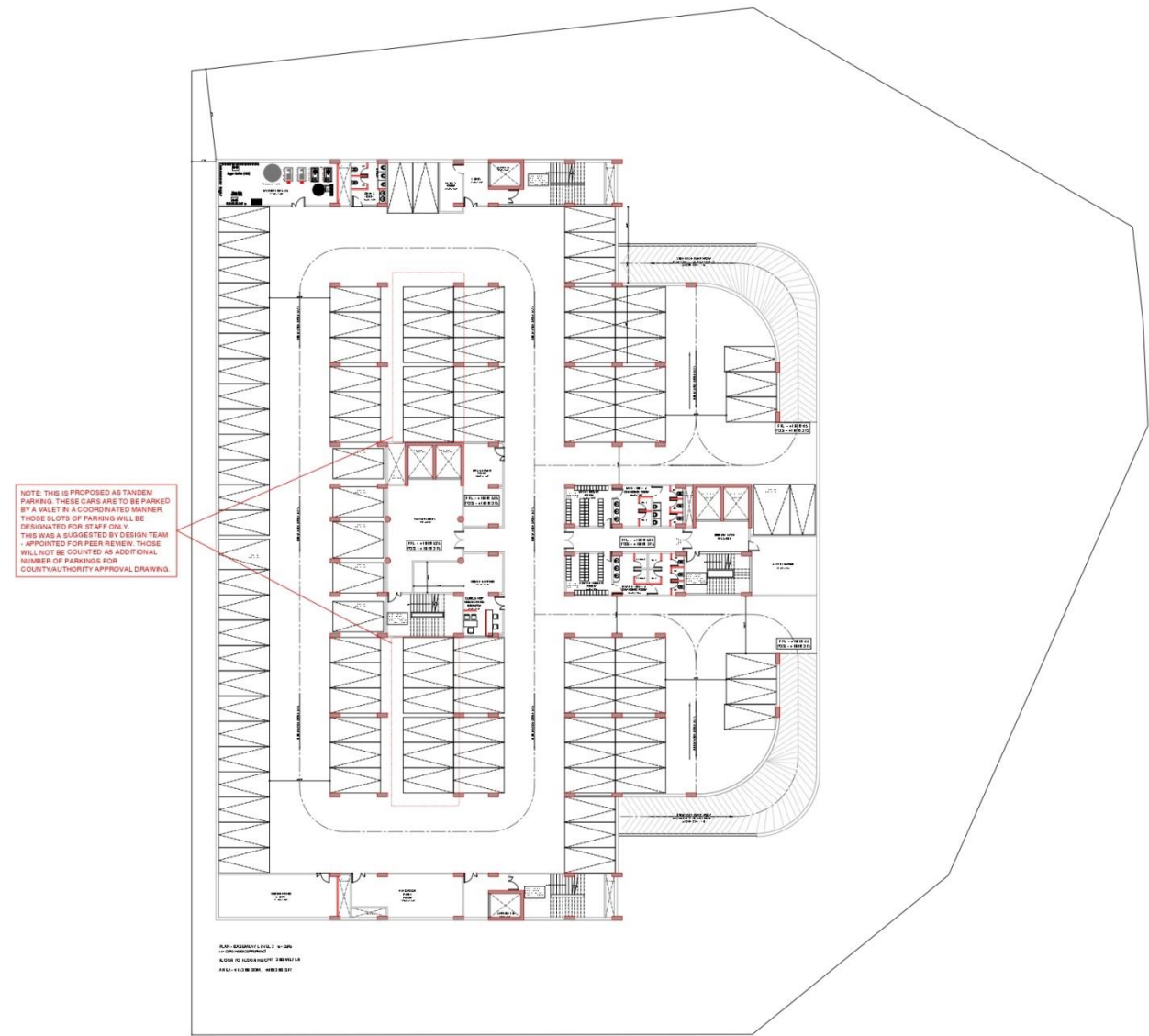
Revisions

R3



ESIA Study for the Proposed World Trade Centre Hospital

BASEMENT 2



NOTE: THIS IS PROPOSED AS TANDEM PARKING. THESE CARS ARE TO BE PARKED BY A VALET IN A COORDINATED MANNER. THOSE SLOTS OF PARKING WILL BE DESIGNATED FOR STAFF ONLY. THIS WAS A SUGGESTION BY DESIGN TEAM - APPOINTED FOR PEER REVIEW. THOSE WILL NOT BE COUNTED AS ADDITIONAL NUMBER OF PARKINGS FOR COUNTRY AUTHORITY APPROVAL DRAWING.

LEGEND FOR WALLS	
	200MM THK. RCC/CONCRETE BLOCK WALLS
	200MM THK. CONCRETE BLOCK WALLS
	100MM THK. CONCRETE BLOCK WALLS
	100MM THK. BLOCK WALLS
	100MM THK. PARTITION WALLS

Conceptual Drawing

WTC Nairobi Hospital, Kenya  
Ngong Road, Nairobi.

Key Plan - 1:5000

Client / Developer

Hospital Development  
Company, Kenya

Architect

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road, Pune-411004.  
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E-mail: architectunited@vsnl.net  
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Drawing Name

Conceptual Basement Level 2 Plan

Drawing Number

WTC-AUN-MB-B2-INF-A-0101 - B2  
GENERAL ARRANGEMENT - OPTION 2

Date	North	Revisions
06.04.2023		R3



## Appendix 6: Site study reports

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PO Box 291-00511 Ongata Rongai

tel: 0722 516440

18/100/DPI

30<sup>th</sup> September 2018

**World Trade Center, Nairobi**  
**Site investigation - Engineering report**

### Summary

In this section geotechnical test results are summarised and analysed to enable project structural engineers to design foundation structures of developments. Soil has been classified and both soil & rock evaluated for strength. In outline soil on the site is a 1m to 3m thick layer clay of intermediate to high plasticity with sand & gravel inclusions. Underlying the soil is rock, tuffs, cemented volcanic ashes down to 20m or so overlying trachyte, a hard lava. The rock strength varies in depth from "weak" to "strong" as defined by BS5930: *Code of Practice for Site Investigations*; the strength corresponding with the two types of rock. The soils, very weak and mobile under change in moisture content, are unsuitable as a foundation. The rock below, with an allowable bearing pressure of 400kPa, will be an excellent foundation.

Reinforced concrete strip or pad foundation bases on firm rock are recommended for both high rise buildings not exceeding fourteen storeys in height and for low rise buildings for which reinforcement can be omitted in footings under load bearing walls. Basements are not required in any buildings.

### Table of contents:

	Summary
1.0	Introduction
2.0	Testing procedures and results
3.0	Review of results
4.0	Foundation types
5.0	Conclusion

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Figure 1	Borehole & trial pit location plan
Figure 2	Particle size analysis
Figure 3	Casagrande Plasticity Chart
Figure 4	Liquid Limit v depth below ground
Figure 5	Linear Shrinkage v Plasticity Index
Figure 6	SPT values & allowable bearing pressures v depth
Figure 7	Rock density & allowable bearing pressures v depth
Figure 8	Volume compressibility & consolidation v depth
Figure 9	Rock Quality Designation & Fracture Index v depth

### Tables:

Table 1	Borehole, trial pit, rock & sample depths and soil classification
Table 2	Natural density, moisture content, cohesion & angle of friction
Table 3	Remoulded soil properties, CBR and swell
Table 4	Properties related to SPTs
Table 5	Classification of rock by strength
Table 6:	Chemical properties & exposure classes
Table 7:	Foundation base recommendations

### Site and borehole & trial pit locations





## 1. Introduction

The site is characterised by a surface layer of intermediate to highly plastic clay unsuitable as a foundation to any type of building due to its high mobility under change in moisture content and its low strength when wet. This report analyses the soil in some detail but it should be borne in mind that foundation bases will be located on the underlying rock. Rock levels below ground are listed and displayed for the purpose of estimating quantities of earth excavation and fill.

The development comprises a mixture of multi-storey buildings not more than fourteen storeys high and low rise buildings some three storeys high all without basements. The structures are expected to be reinforced concrete frames and slabs with lateral loads on the higher rise buildings to be reinforced concrete shear walls at least in transverse directions. The plot topography rises some 3 metres to the west.

Geotechnical data for the site have been obtained from cores extracted from boreholes BH 1 to 12, each 50m deep, trial pits TP1 to 12 varying in depth from 0.8m to 3m and field & laboratory tests under a regime defined by DPI – or maybe by the developer – and described in this report

Field tests during drilling of boreholes comprised Standard Penetration Tests carried out to establish allowable bearing capacities of the soil. Laboratory tests have been carried out to classify both soil and rock, to compute strengths and to measure chemical properties.

This section of the report summarises test results with reference to test procedures described in the section "Laboratory Procedures". It also analyses data, reporting on soil and rock characteristics as they relate to structural design of the foundations and it recommends the form of structure appropriate to site conditions.

The analysis considers six principal geotechnical aspects of the sub-grade.

- Classification of materials
- Soil and rock strengths
- Settlement
- Presence of ground water
- Aggressive chemicals
- Construction factors

Materials have been classified not only for descriptive purposes but also to identify similarities which reduce the number of tests required. The principal classification tests are particle size analysis of soil by both sieving & sedimentation and by Atterberg Limits. These indicate the "plasticity" of the material important in understanding settlement and subsidence characteristics particularly the effect of soil moisture changes between wet & dry seasons. Settlement is movement of soil or rock under load and subsidence movement due to change in volume as water migrates from soil: heave if the migration is inwards. Natural density and moisture content test results are required for calculation of both pressures on foundation structures and of strengths but are also soil classification parameters.

Soil strength parameters - in-situ density, cohesion and angle of internal friction - have been measured in undisturbed samples for confirmation of strength derived from SPT values. The strength of rock has been measured by Unconfined Compression and Point Load Tests of rock cores. Rock densities have been measured as indicators of discontinuities in the rock.

Settlement characteristics have been calculated from oedometer tests of soil though due to their expense the number of tests is small. SPTs are considered to be more reliable indicators of settlement.

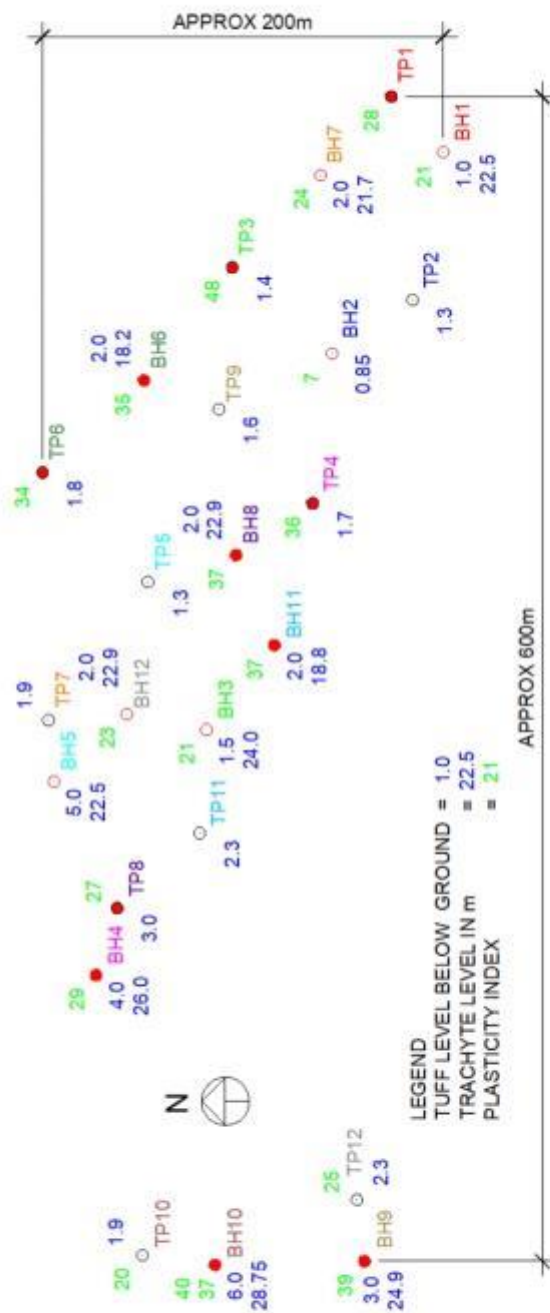
Ground water was not met in boreholes or trial pits and levels of water which was met a consequence of the drilling process in flushing out debris from the boreholes.

Chemical tests of soils have been carried out for assessment of the influence of sulfates, chlorides and acidity on deterioration of concrete and steel in foundation bases.

Finally factors which may influence construction operations have been assessed: hardness of excavation and compaction of excavated material and stability of excavation, for example.



Figure 1: Borehole & trial pit location plan



Rock levels below ground are shown in blue and Plasticity Indexes of soil above in green.

Solid red shading indicates soils with very high plasticity which are wholly unsuitable as a conventional foundation.



## 2. Testing procedures & results

### 2.1 Classification

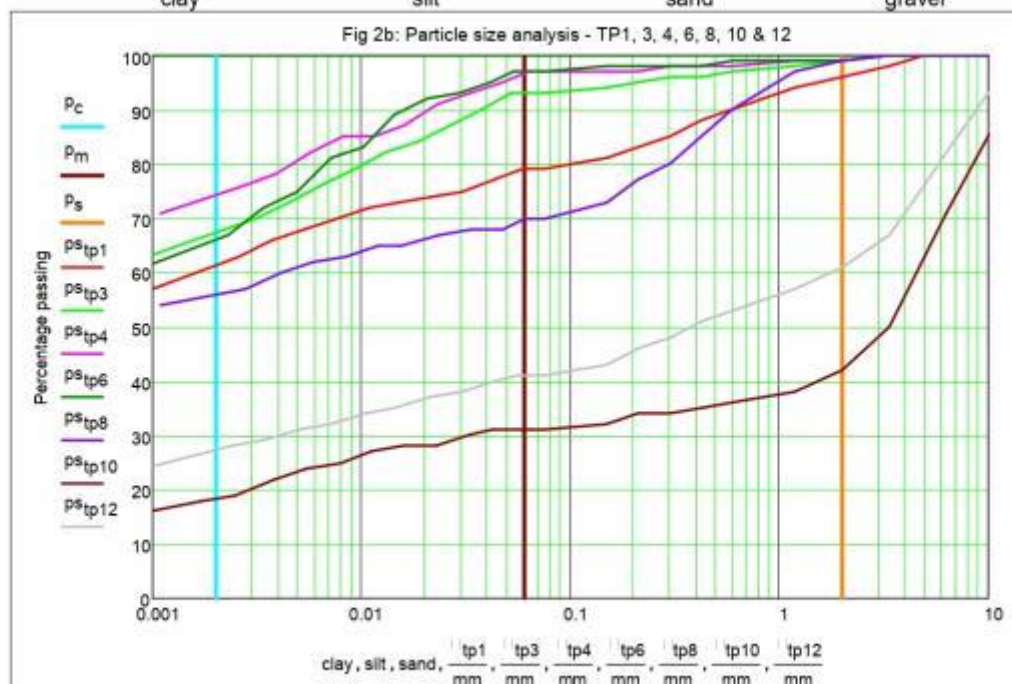
Classification defined by particle size distributions of the soil is shown in Table 1 and displayed graphically in Figures 2a & 2b and in Figures 3, 4 & 5 for Atterberg Limits & Linear Shrinkage. Colours in Table 1 correspond with those in Figures for the purpose of displaying distribution across the site.

Table 1: Borehole, trial pit, rock & sample depths and soil classification

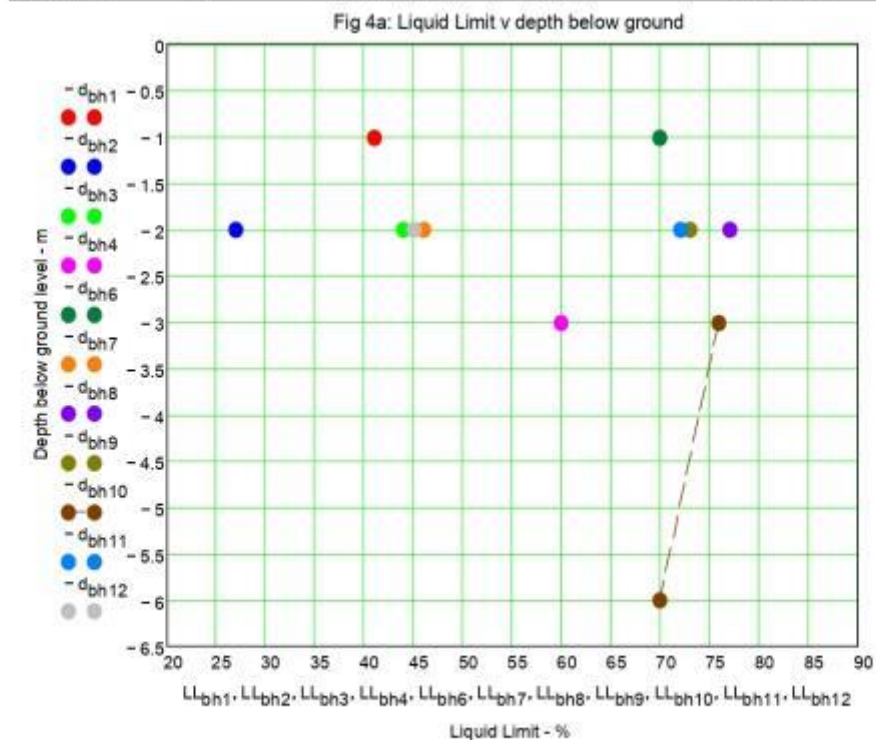
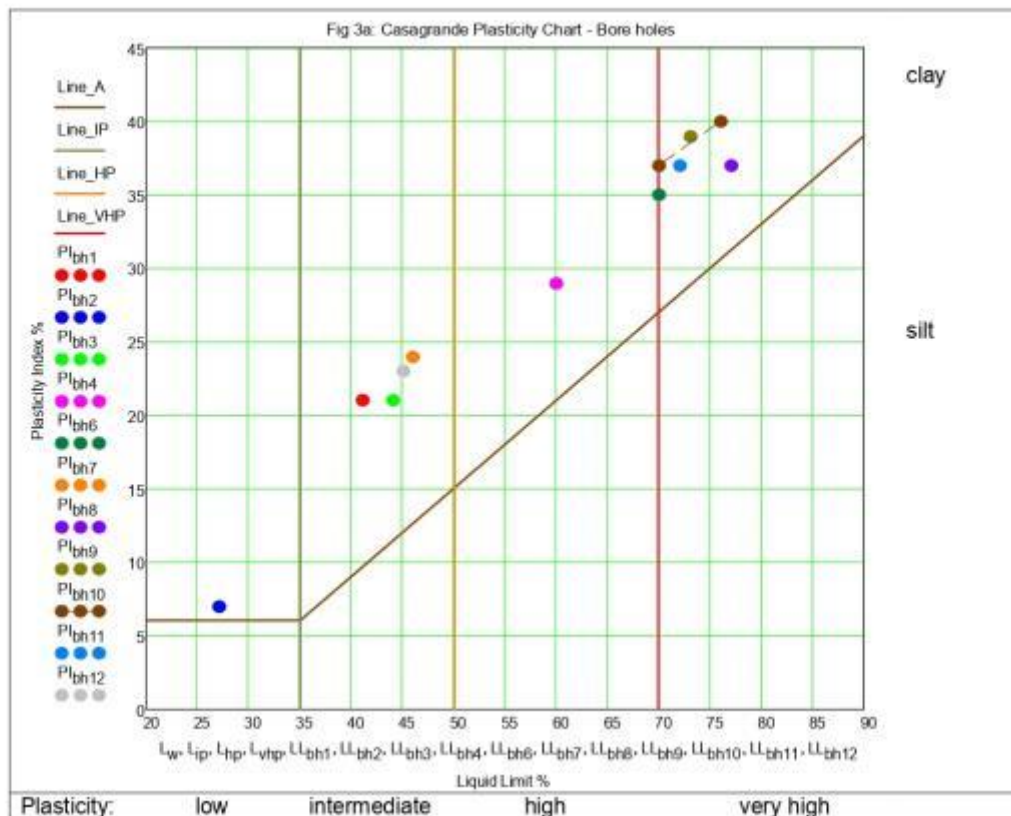
BH & TP references	BH & TP depths m	Soil sample depth m	Soil type	Rock depth m	
				Tuff	Trachyte
BH 1	50	1.0	sandy CLAY	1.0	22.5
BH 2	50	2.0	sandy CLAY	2.0	21.4
BH3	50	2.0	CLAY	1.5	24.0
BH4	50	3.0	CLAY	4.0	26.0
BH5	50	-	-	2.0	22.5
BH6	50	1.0	CLAY	2.0	18.2
BH7	50	2.0	CLAY	2.0	21.7
BH8	50	2.0	CLAY	2.0	22.9
BH9	50	2.0	CLAY	3.0	24.9
BH10	50	3.0	CLAY	6.0	28.75
		6.0	CLAY	-	-
BH11	50	2.0	CLAY	2.0	18.8
BH12	50	2.0	CLAY	2.0	22.9
TP1	1.4	0.8	CLAY	-	-
TP2	0.85	-	-	0.85	-
TP3	1.6	1.0	CLAY	1.4	-
TP4	1.8	1.0	CLAY	1.7	-
TP5	1.5	-	-	1.3	-
TP6	2.0	1.0	CLAY	1.8	-
TP7	2.2	-	-	1.9	-
TP8	3.0	3.0	CLAY	3.0	-
TP9	1.8	-	-	1.6	-
TP10	1.9	1.9	very clayey GRAVEL	1.9	-
TP11	2.5	-	-	2.3	-
TP12	2.3	2.0	gravelly CLAY	2.3	-

The greater depth of soil at BH10 may be due to a rise in the ground: this can be established from the topographical survey.

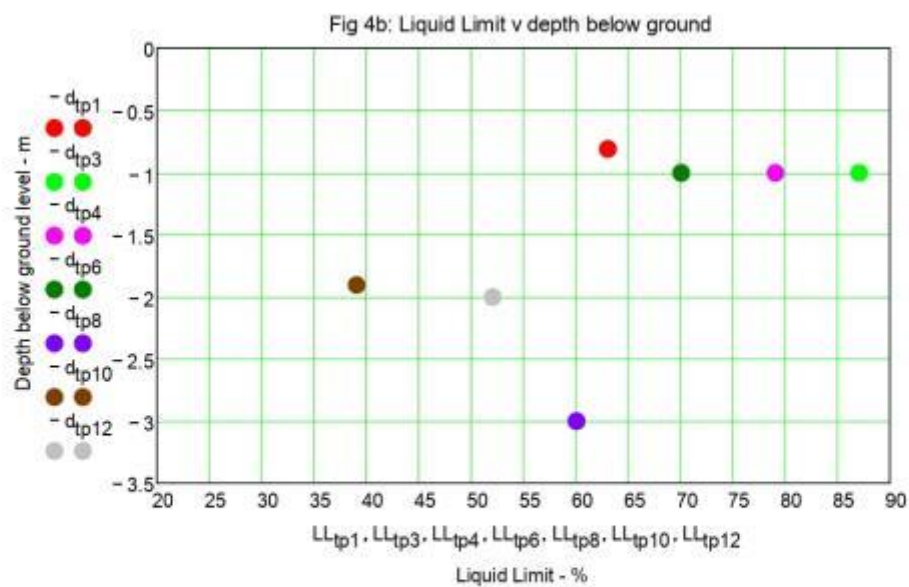
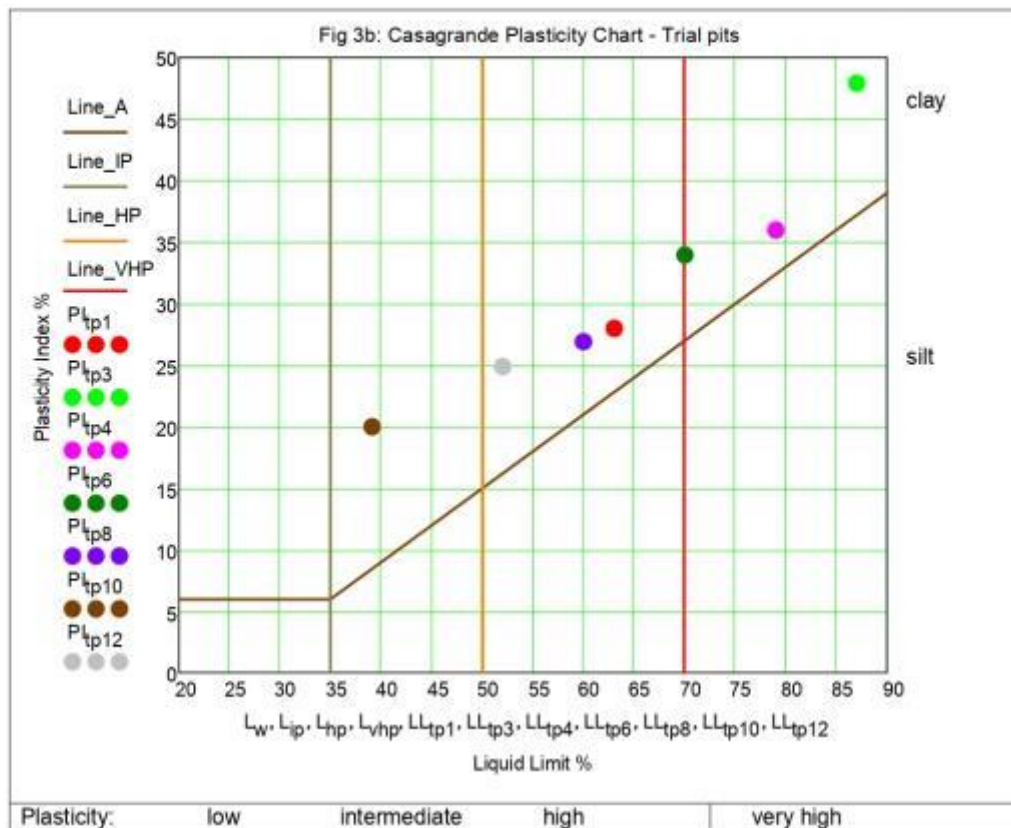


30<sup>th</sup> September 2018 5

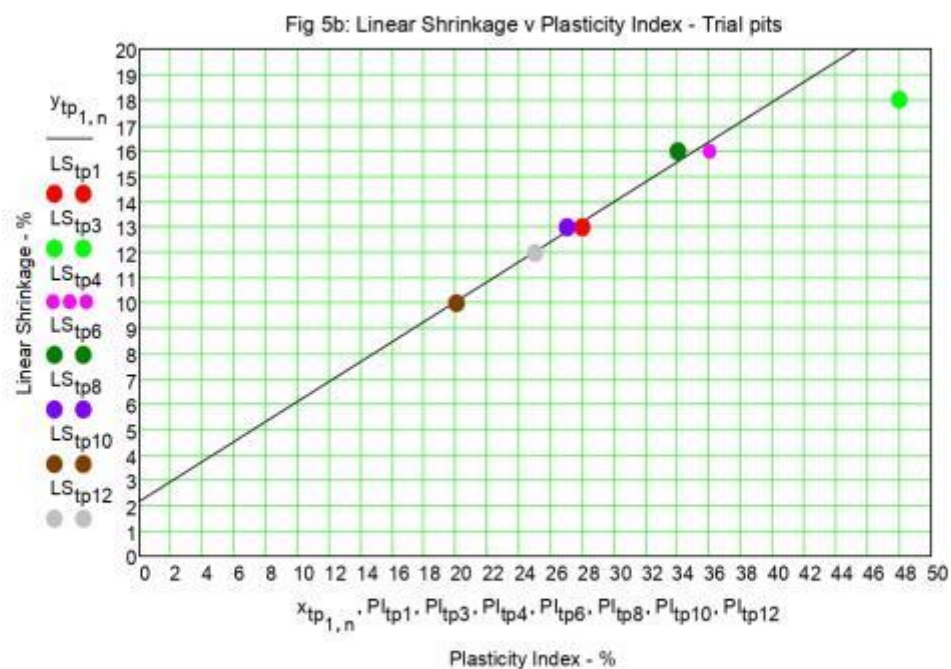
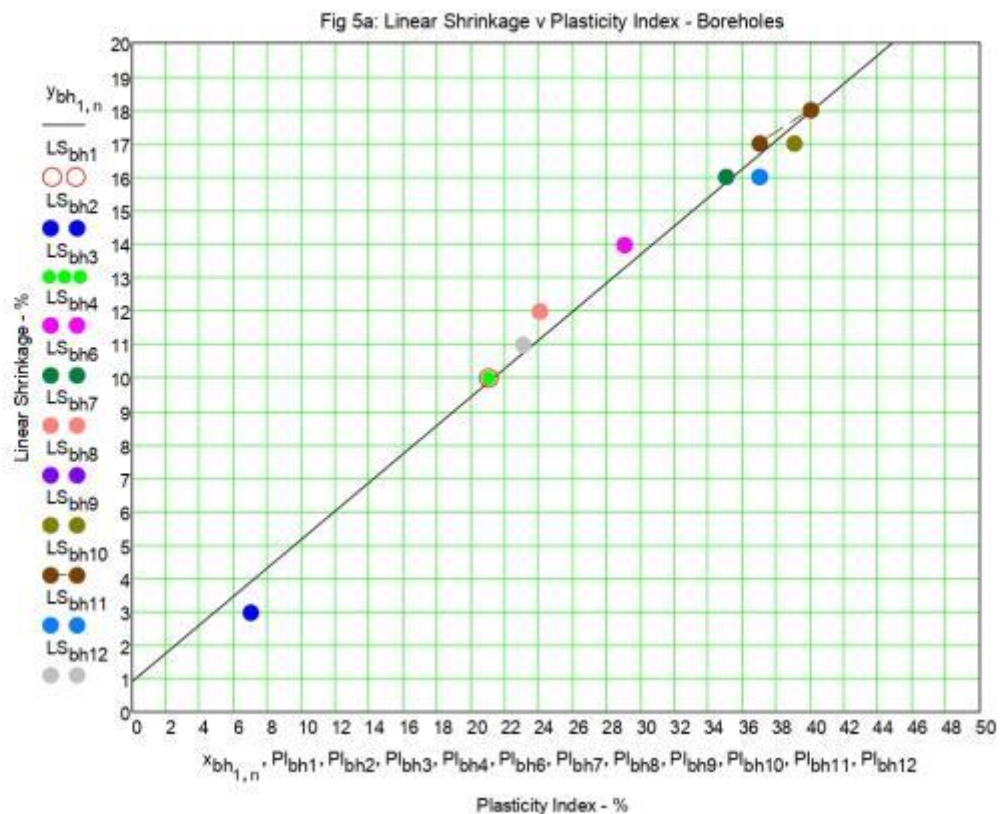














## 2.2 Density, moisture content, cohesion & friction

Table 2: Natural density, moisture content, cohesion & internal angle of friction

Location	Depth - m	Natural density kg/m <sup>3</sup>	Natural moisture content - %	Cohesion kPa	Angle of friction
BH1	2.45	1,628	36.3	19.6	18°
BH6	1.45				
BH9	1.45				
BH10	2.2		41.1		
	3.3	1,432	36.5	23.5	15°
BH11	1.45	1,532	46.4	27.5	16°
BH12	1.45	1,462	22.5	27.5	15°

Table 3: Remoulded soil properties, CBR and swell

Location	Depth m	Maximum dry density kg/m <sup>3</sup>	Optimum moisture content	CBR %	Swell mm
BH1	2.0	1,660	19%	6.4	2.5
BH12	2.0	1,540	21%	6.0	3.3
TP8	2.0	1,450	24%	2.7	2.7
TP11	2.0	1,430	23%	2.1	3.3
TP12	2.3	1,390	27%	1.7	5.5

## 2.3 Soil & rock strength

SPT properties are displayed in Table 4 and values & allowable bearing pressures in Figure 6. Strengths are reported as "allowable bearing pressure", the strength which will support "characteristic" or service loads. It is the definition used in the Building Code, the "ultimate" strength divided by a "lumped" safety factor, 3.0 for soil and 5.0 for rock: the higher figure allowing for discontinuities which occur in rock.

The definition of strength is in contrast to the term "allowable bearing capacity" in Eurocode 7 in which the lumped safety factor is separated into a number of partial safety factors.

Table 4: Properties related to SPTs

Cohesionless soils			Cohesive soils		
Nspt	Description	Density Index %	Nspt	Consistency	Strength kPa
<4	Very loose	0 – 15	<2	Very soft	<20
4-10	Loose	15 – 35	2 – 4	Soft	20 – 40
10-30	Medium dense	35 – 65	4 – 8	Firm	40 – 75
30-50	Dense	65 – 85	8 – 15	Stiff	75 – 150
>50	Very dense	85 – 100	>15	Very stiff or hard	>150

Note: Values computed from triaxial tests shown as triangles.



Fig 6.1: SPT values v depth

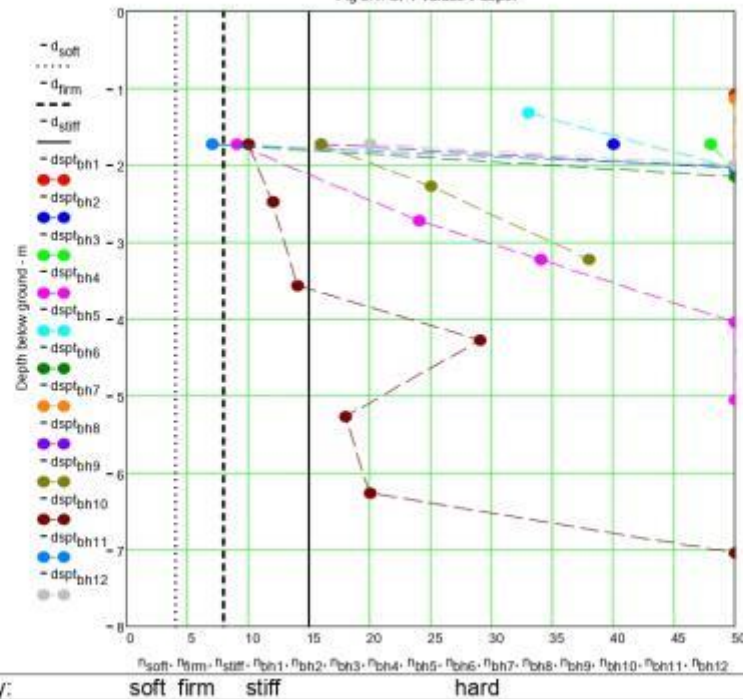
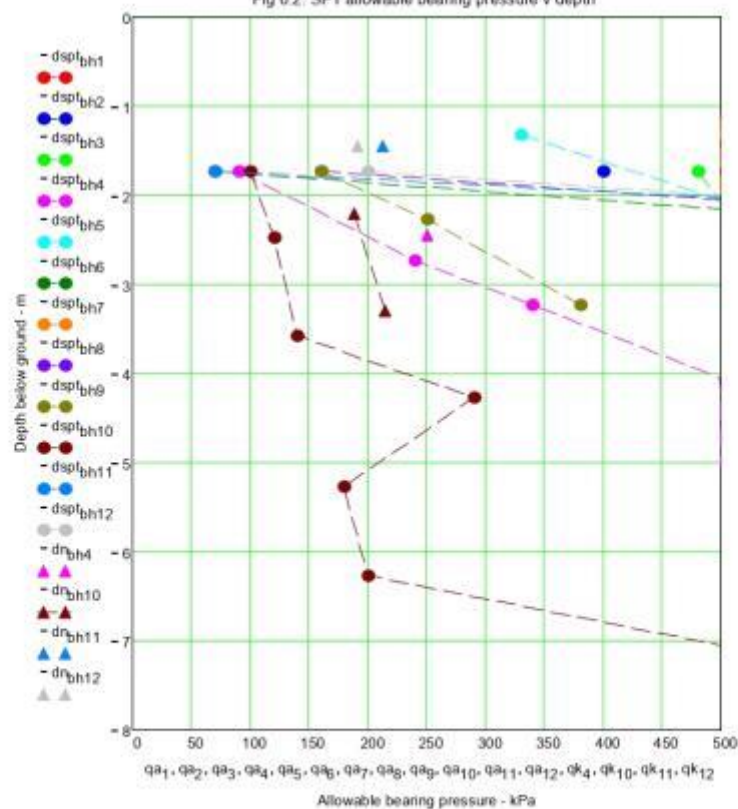


Fig 6.2: SPT allowable bearing pressure v depth

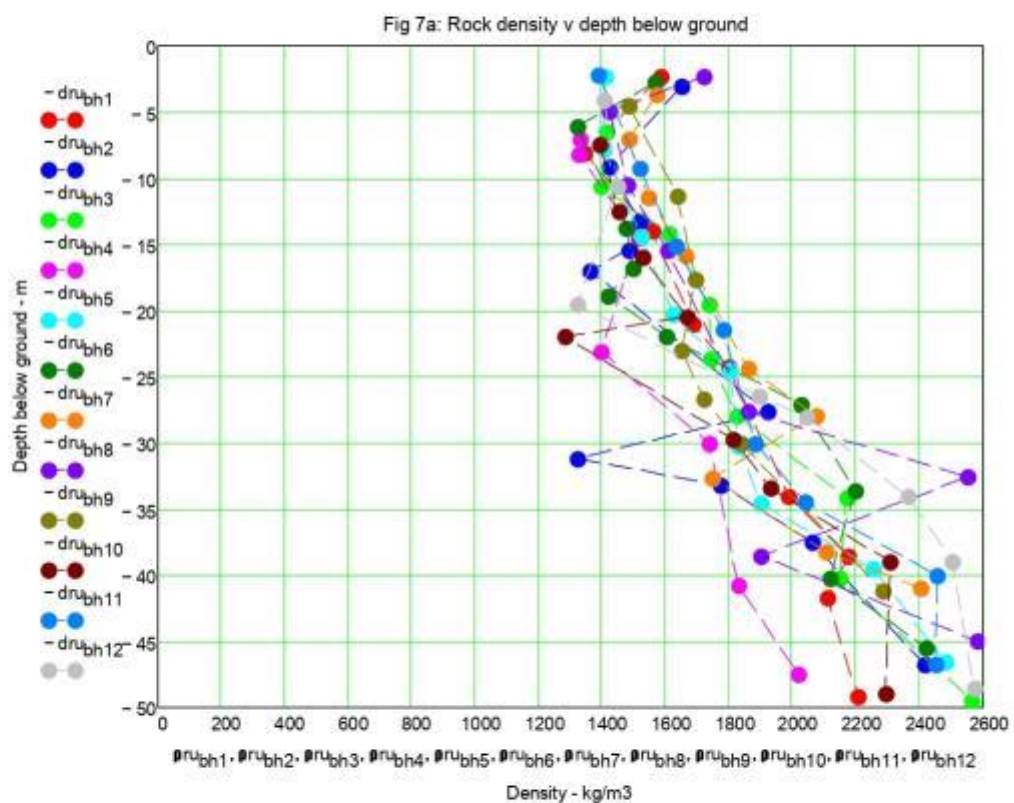




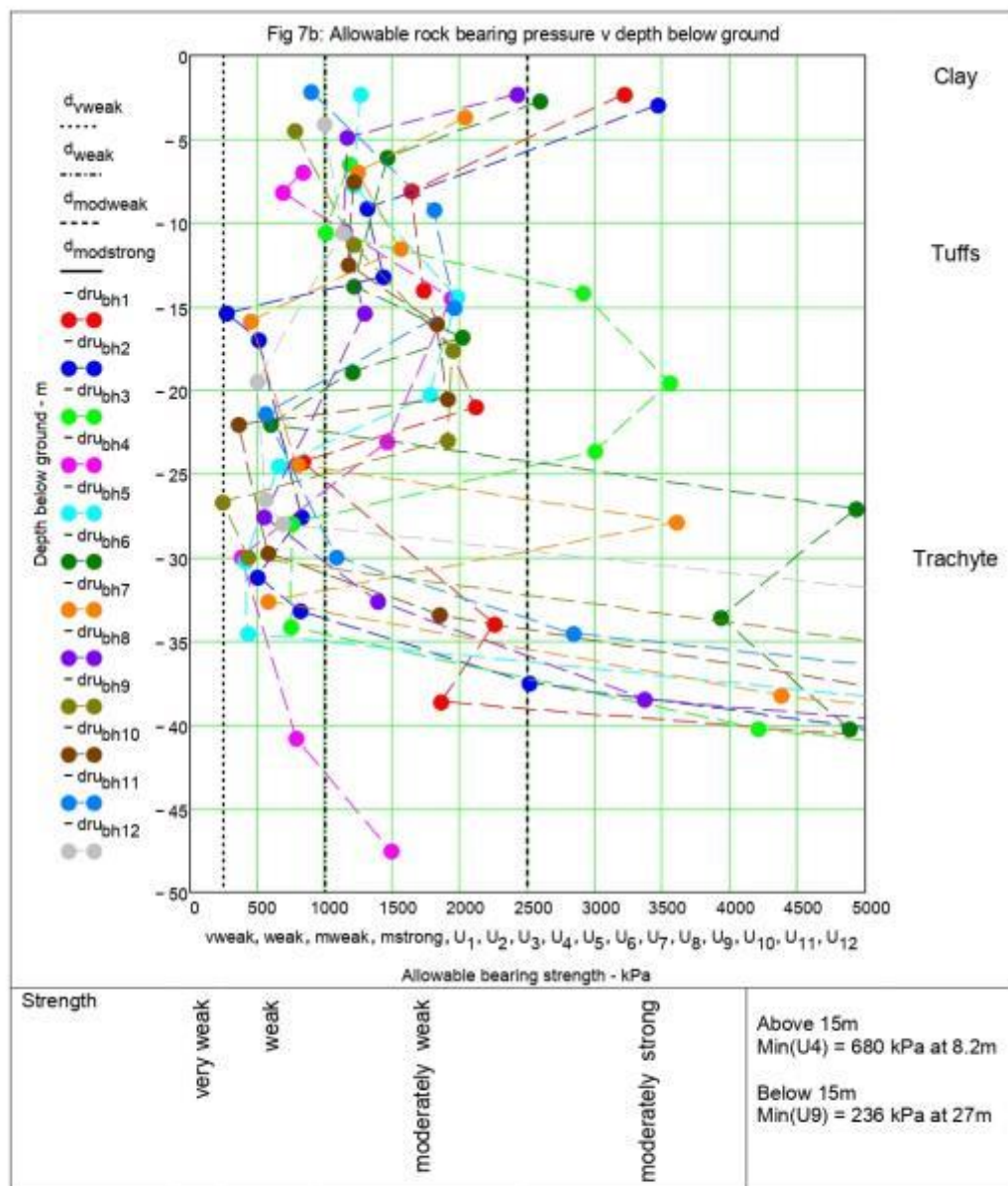
Rock classification is displayed in Table 5 and densities & strengths in Figure 7. Under the BS5930: Code of Practice for Site Investigations definition in Table 4 (and Eurocode 7) rock strength increases from "weak" to "strong", corresponding with the change from tuff to trachyte, though BH4 is an outlier.

Table 5: Classification of rock by strength

Term	UCS - MPa	Allowable bearing pressure - kPa
Very weak	<1.25	<250
Weak	1.25 to 5	250 to 1,000
Moderately weak	5 to 12.5	1,000 to 2,500
Moderately strong	12.5 to 50	2,500 to 10,000
Strong	50 to 100	10,000 to 20,000
Very strong	100 to 200	20,000 to 40,000
Extremely strong	>200	>40,000



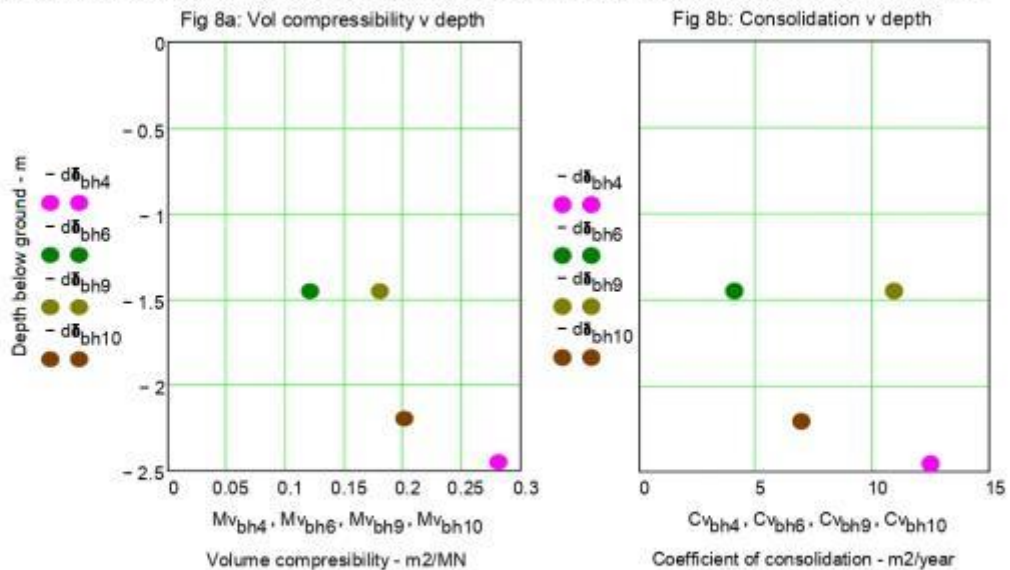






## 2.4 Settlement

Variability of compressibility & consolidation can be seen in Figure 8, the results of oedometer tests.



## 2.5 Ground water

There is no water table in this area of Nairobi. Water observed in boreholes was from drilling used to flush out debris from the boreholes; levels declined with time. But rainwater will accumulate in excavations due to impermeability of both the clay soils and rock on the site though to judge from the declining levels it may, with time, drain through the rock.

## 2.6 Chemical analysis

Limiting values of pH and sulfates in soils and ground water are given in Table 2 of BS EN 206:2013, *Concrete – Specification performance, production and conformity* for Exposure classes described in BS EN 1992-1-1:2004, *Eurocode 2: Design of concrete structures by their chemical environments*,

- Class XA1 slightly aggressive
- Class XA2 moderately aggressive or
- Class XA3 highly aggressive.

Exposure classes for chlorides are described in Table 1 of BS EN 206:2013 as

- Class XD1 moderate humidity
- Class XD2 wet, rarely dry or
- Class XD3 cyclic wet and dry.

Exposure classes are shown in Table 6 below for actual test results.

Table 6: Chemical properties & exposure classes

Location	Depth m	pH		SO <sub>4</sub> content		Chloride content	
		Actual	Exposure Class	Actual SO <sub>4</sub>	Exposure Class	Actual	Exposure Class
BH1	18.2	7.14	Not classed	0.0121%	Not classed	0.02489%	XD2
BH2	10.0	7.12	Not classed	0.0044%	Not classed	0.0204%	XD2
BH4	4.0	5.7	XA1	0.0707%	Not classed	0.4005%	XD2
BH5	2.0	6.26	XA1	0.0471%	Not classed	1.1428%	XD2
BH6	2.0	5.07	XA2	0.1955%	Not classed	0.0214%	XD2
BH8	2.3	5.9	XA1	0.0472%	Not classed	0.3255%	XD2
BH9	8.0	7.1	Not classed	0.0354%	Not classed	0.6716%	XD2
BH12	3.5	6.90	Not classed	0.0104%	Not classed	0.02923%	XD2

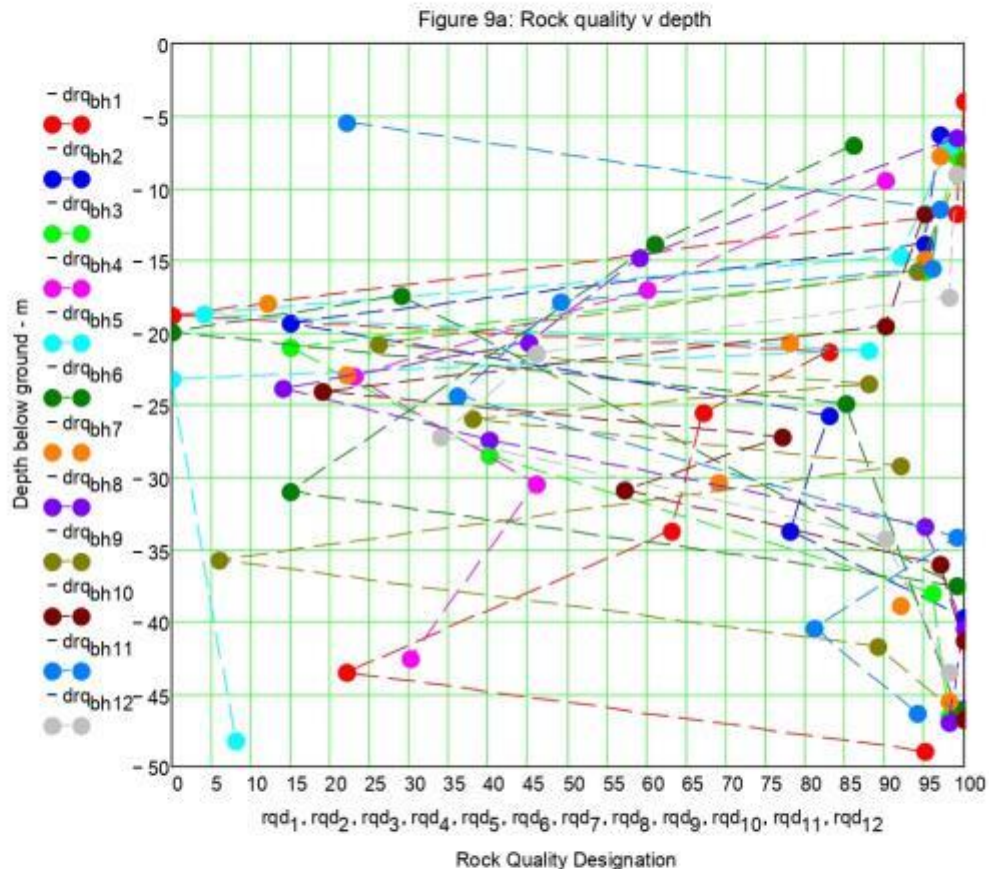
(Clay soils with permeability below 10<sup>-5</sup> m/s may be moved into a lower class. Further minimum strength classes of concrete for these environments are indicated in Tables E.1N and F1 of Eurocode 2.)



The limit at which chloride contents in soil are aggressive to reinforcement in concrete made with general purpose cement - Type I – is between 0.1% and 0.5%. Except at BH5 & BH9 no special protection against chloride attack is required; at these boreholes the values are not consistent with all other test results and may need to be confirmed if structures in reinforced concrete will be in contact with natural ground.

### 2.7 Construction factors

The topography of the site is satisfactory for rainwater drainage within the site. Soils at the ground surface will be easily excavated even by hand but should not be utilised as fill under buildings. The uppermost surface of rock is reported as highly weathered and should be removed so that foundation bases will be located on firm rock; excavated material may be used as fill.

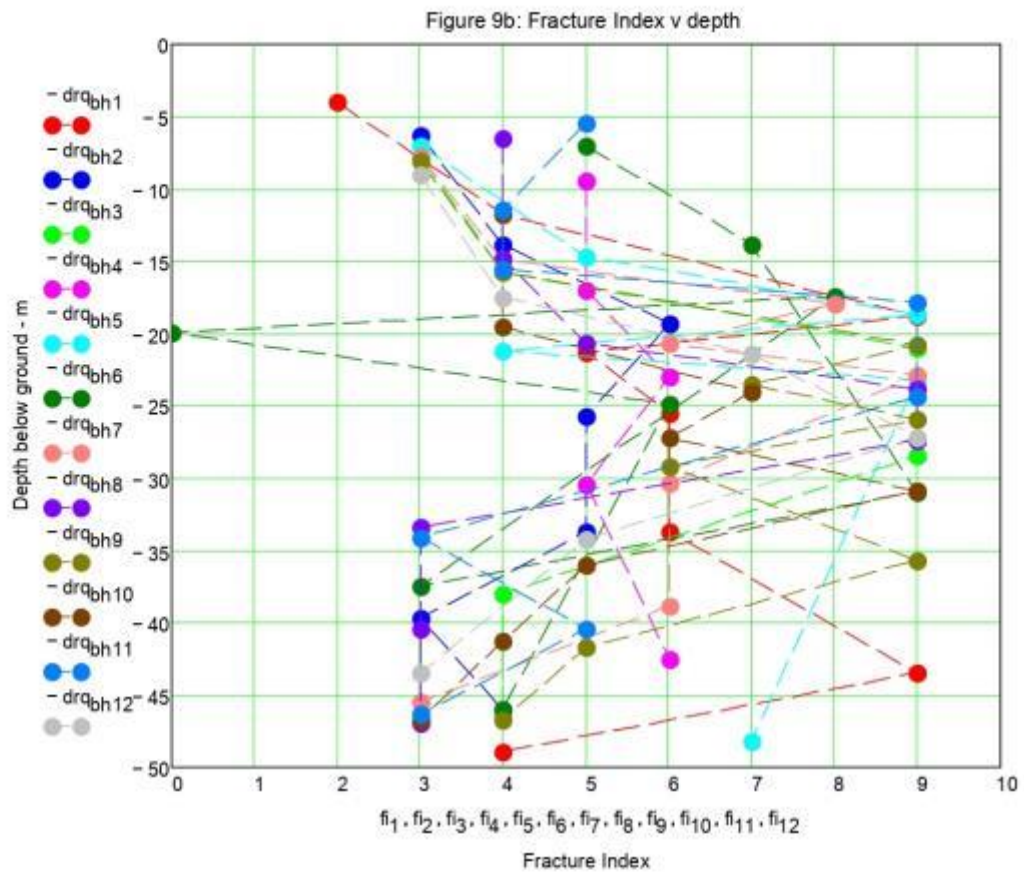


### 3 Review of results

The soils, appearing in two categories across the site, are clays of intermediate to high plasticity with some sand and gravel constituents. Those with high plasticity are wholly unsuitable as foundations and under buildings should be entirely removed. The soils with intermediate plasticity would require foundations at least 1.5m below ground and because rock with its superior strength and stability is not far below, the soil is not recommended as a foundation.

Under the soils are good quality tuffs with an allowable bearing pressure of 400kPa.





#### 4 Foundation types

Recommended foundation types are shown in Table 7.

Table 7: Foundation base recommendations

Type of structure	Type of foundation base	Allowable ground bearing pressure - kPa	Depth m
High rise buildings	Reinforced concrete strip or pad footings	400	rock
Low rise buildings	Reinforced concrete strip or pad footings	400	rock
Low rise buildings	Plain or reinforced concrete strip footings to load bearing walls	400	rock

#### 5 Conclusion

Soils on the site are unsuitable as a foundation. Foundation bases should be located on firm rock with an allowable bearing pressure of 400kPa.

*NR Evans*

NR Evans Engineer's Practising Licence 2018/A57/E573



## Hydrogeological & Geophysical Investigations

Nairobi Business Park, Ngong' Road  
(Site II)

Nairobi County, Kenya

Report Prepared by

C M Gicheruh (WD/WRP/001/21)



August, 2019

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Report No. 19/2019



## EXECUTIVE SUMMARY

### Introduction

Earth Water Ltd. was commissioned by Nairobi Business Park to carry out borehole site investigations at their parcel of land on **LR No. 24861/1** located within the Nairobi Business Park and bordering Jockey Club of Kenya along Ngong Road, next to the Ngong Race Course, in the south-west of Nairobi. The study area lies on a piece of land which is approximately 4.556 Ha. The investigated site is defined by the following co-ordinates; 01°18' 32.94" S and 036° 44' 20.85" E at an elevation of 1829m asl.

Currently in the early stages of development, the Nairobi World Trade Centre (WTC) complex will be an iconic landmark in Nairobi. Nairobi is the regional headquarters of over a hundred multinationals and organisations and is one of the few cities in the world with a national park within its boundaries, making it also a key prime tourist destination. Member Benefits include; Business networking and knowledge exchange, Trade Mission and Information, International Trade Counselling. Local Industries that will be involved include; Financial & Professional Services, Hospitality: Tourism & Leisure, Textile, Agri-Business: Food & Beverage Processing: Animal Husbandry, Engineering: R&D: Architecture & Construction. This report describes the results of boreholes site investigations for World Trade Centre.

### Geology

The investigated site is underlain by the Tertiary Volcanics mainly the Nairobi and Ngong volcanics. In the area, these volcanics comprises of Limuru Trachytes, Kabete Trachytes, Kerichwa Valley Tuffs, Basanites, the Nairobi Trachytes and the Basement system at greater depths.

### Hydrogeology

The area is situated in a zone with medium groundwater potential. The study concludes that on the basis of geological and hydrogeological evidence, the prospects of striking sufficient groundwater for domestic purposes are good. Both shallow and deep aquifers occur in the area. Aquifers in the shallow depths are to be found in the Limuru and Kabete Trachytes. Deeper aquifers are found in the Kerichwa valley series and the Nairobi Trachytes.

### Water Balance

A summary of the annual averages of the conservative estimated components of water balance on the long term for the study area is calculated as tabulated below:

Hydrologic Parameter	Estimated Value
Catchment	$4.5 \times 10^7 \text{ m}^2$
Aquifer extent	$1.0 \times 10^7 \text{ m}^2$
Aquifer thickness	50m
Storage Coefficient	$4.90 \times 10^{-3}$
Specific yield	10%
Precipitation	$4.95 \times 10^7 \text{ m}^3/\text{year}$
Recharge	$4.955 \times 10^6 \text{ m}^3/\text{year}$
Proposed abstraction	$7.3 \times 10^4 \text{ m}^3/\text{year}$

From these figures it is clear that the proposed abstraction is negligible compared to the other components of the aquifer hydrological cycles.



## **Physiography**

The investigated site lies generally on a flat land that becomes swampy when it rains. The regional Physiography can be said to be that of high level plateau dissected by minor valleys. The general area is drained by tributaries of Mtoini River which drains into the Nairobi dam and then flows to join the River Ngong.

## **Water Demand**

It is estimated that the site would have a daily water demand of 1,300m<sup>3</sup>/day and a potential irrigation demand of 0.5 m<sup>3</sup>/day resulting in a minimum supply to the site of 21.7 L/s of daily water demand.

## **Water Quality**

The water quality is expected to be good in the study area as it is in the entire Nairobi Suite except for the fluoride content which is in excess of the desirable limit of 1.5 ppm over a large part of the area.

## **Geophysics**

Geophysical fieldwork was executed on 30<sup>th</sup> July, 2019. Electrical resistivity method was employed for the geophysical investigations. Vertical Electrical Sounding (VES) was used to determine the horizontal and lithological changes in terms of electrical resistivity with depth. 6 No. of VES were executed in the survey area.

## **Groundwater Conclusions**

- The study concludes that on the basis of geological and hydrogeological evidence, the prospects for sufficient groundwater for domestic purposes are good.
- In the current study 1st aquifers are expected between 39-160m bgl.
- Boreholes in the site vicinity have several water strike levels.
- Main aquifer expected at depths above 160 to 350 m bgl.
- Deeper aquifers are expected at depths of greater than 300m bgl.
- The nearby boreholes depths range between 245-330m bgl
- An expected yield per borehole is approximated within a range of 1 – 17.8 m<sup>3</sup>/hr.
- The aquifers in the study area are adequately replenished from an underground storage reservoir that is several orders larger than the imposed abstraction, thereby ensuring a reliable long-term water supply.
- Groundwater quality in the area under investigations is usually good for human consumption. The fluoride concentration of deep groundwater in the area; south of Ngong hills will be between 1 and 4 ppm, while the maximum concentration in the Nairobi Conservation area is more than 10 ppm.
- pH and Conductivity are also satisfactory.
- Water in these areas is non-corrosive, and in most cases not particularly alkaline.

## **Surface Water Conclusions**

- Surface water use in the area under study is minimal since the largest population depend on County council water supply which is complemented with underground water in most of the premises.
- There is minimal water pollution in the area since there is a well-established sewerage system in the area, lack of extensive industrial activities in the area renders pollution to be at a minimal level.

## **Groundwater Recommendations**

- The hydrogeological conditions are considered to be the same all over the plot. Drilling to a minimum depth of 400 m bgl would give the client yields in the order of



about 15 - 20 m<sup>3</sup>/hr of water.

- 8" borehole to be drilled to a minimum depth of 400 m at the locations of VES 6. The point is bench-marked on site and is known to Mr Abraham Samoei (The premises Care-taker) and the Coordinates for the recommended drilling site are presented in the below table.

Ves No.	Coordinates			Recommend Depth
	Latitudes	Longitudes	Elevation(m)	
6	1°18'32.94"	36°44'20.85"	1829	400

- Drilling should first be done at 10" diameter to a depth of 20 m bgl and then continued at 8" diameter.
- The top 20 m should be sealed off with bentonite and cement grout to prevent surface water that floods in the area from contaminating the groundwater.
- The borehole should be installed with 6" diameter steel casings and screens with slots of 0.5 mm and high % open surface area.
- The borehole must be installed with a Water Meter and an Airline/piezometer to monitor groundwater abstraction and to facilitate regular measurements of the static water level in the borehole.
- Upon drilling completion, a 2-litre water sample from the borehole should be collected for reference to the WRA Testing Laboratory, or any other competent Water Testing Authority for a full physical, chemical and bacteriological analysis before the water is put to any use.
- A copy of the analysis report must be sent to the WRA – Regional Office for record.
- A drilling permit has to be acquired from WRA Regional Office in Machakos, through the Nairobi Sub-regional office.

### Surface water Recommendations

- Surface water sources should be conserved to avoid contamination by all the anthropogenic pollution sources
- The study area lies within the Ngong catchment and environmental conservation should be observed to ensure the water tower remains in a conducive state
- The surface water drainage system should be well rehabilitated since it seems to be non-functional within the investigated site premises to avoid anthropogenic pollution.

### Monitoring

Regular monitoring should be instituted and maintained in the boreholes in order to keep track of groundwater levels. A monitoring tube should be installed in the boreholes to be able to monitor the water levels in the wells.

### Drilling Permits

Before drilling commences, a groundwater drilling permit must be obtained from the Water Resources Authority, Athi Water Catchment Area in Machakos, through the Nairobi Sub-regional office.

### Aquifer Management Strategy

In order to verify the model results and monitor the development of the groundwater system under increased abstraction rates, it is recommended that a (long term) monitoring plan is made. Monitoring the changes in an aquifer is usually done by monitoring the changes in groundwater levels and groundwater quality. For this purpose, dedicated monitoring boreholes should be installed at locations near the boreholes and areas that are defined as



high risk areas in the model study. The number and depth of monitoring boreholes as well as monitoring frequency and monitoring parameters should be based on the outcome of the model study and actual boreholes design to ensure successful and cost-effective monitoring.

### **Borehole Construction**

Recommendations are given for borehole construction and completion methods and these are annexed in appendix 1. The importance of correct and comprehensive techniques in this particular aspect cannot be over-emphasized. It determines the water quantity, quality and longevity of the borehole.



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**LIST OF ABBREVIATIONS AND GLOSSARY OF TERMS**

**ABBREVIATIONS** (All S.I Units unless indicated otherwise)

agl	above ground level
amsl	above mean sea level
bgl	below ground level
E	East
EC	electrical conductivity (mS/cm)
h	head
hr	hour
K	hydraulic conductivity (m/day)
I	litre
m	metre
N	North
PWL	pumped water level
Q	discharge
sQ/s	specific capacity (discharge – drawdown ratio; in m. cu/hr/m)
Cu	cubic
Sq	square
S	drawdown (m)
S	South
Sec	second
SWL	static water level
T	transmissivity (m.sq/day)
VES	Vertical Electrical Sounding
W	West
WSL	water struck level
mS/cm	micro-Siemens per centimetre: Unit for electrical conductivity
°C	degrees Celsius: Unit for temperature
Wm	Ohm-m: Unit for apparent resistivity
ra	Apparent resistivity



# GLOSSARY OF TERMS

<b>Alluvium:</b>	General term for detrital material deposited by flowing water.
<b>Aquifer:</b>	A geological formation or structure, which stores and transmits water and which is able to supply water to wells, boreholes or springs.
<b>Colluvium:</b>	General term for detrital material deposited by hill slope gravitational process, with or without water as an agent. Usually of mixed texture.
<b>Conductivity:</b>	Transmissivity per unit length (m/day)
<b>Confined aquifer:</b>	A formation in which the groundwater is isolated from the atmosphere by impermeable geologic formations. Confined water is generally at greater than pressure than atmospheric, and will therefore rise above the struck water level.
<b>Development:</b>	In borehole engineering, this is the general term for procedures applied to repair the damage done to the formation during drilling. Often the borehole walls are partially clogged by an impermeable ‘wall cake’, consisting of fine debris crushed during drilling, and clays from the penetrated formations. Well development removes these clayey cakes, and increases the porosity and permeability of the materials around the intake portion of well. As a result, a higher sustainable yield can be achieved.
<b>Fault:</b>	A larger fracture surface along which appreciable displacement has taken place.
<b>Gradient:</b>	The rate of change in total head per unit of distance, which causes flow in the direction of lowest > head.
<b>Heterogeneous:</b>	Not uniform in structure or composition.
<b>Hydraulic head:</b>	Energy contained in a water mass, produced by elevation, pressure or velocity.
<b>Hydrogeological:</b>	Those factors that deal with sub-surface waters and related geological aspects of surface waters.
<b>Infiltration:</b>	Process of water entering the soil through the ground surface
<b>Joint:</b>	Fractures along which no significant displacement has taken place.
<b>Percolation:</b>	Process of water seeping through the unsaturated zone, generally from a surface source to the saturated zone.
<b>Perched aquifer:</b>	Unconfined groundwater separated from an underlying main aquifer by an unsaturated zone. Downward percolation hindered by an impermeable layer.
<b>Peneplain:</b>	A level surface, which has lost nearly all its relief by passing through a complete cycle of erosion (also used in a wider sense to describe a flat erosional surface in general)
<b>Permeability:</b>	The capacity of a porous medium for transmitting fluid.
<b>Piezometric level:</b>	An imaginary water table, representing the total head in a confined aquifer, and is defined by the level to which water would rise in a well.
<b>Porosity:</b>	The portion of bulk volume in a rock or sediment that is occupied by openings, whether isolated or connected.
<b>Pumping test:</b>	A test that is conducted to determine aquifer and/or well characteristics
<b>Recharge:</b>	General term applied to the passage of water from surface of sub-surface sources (e.g. rivers, rainfall, and lateral groundwater flow) to the aquifer zones.
<b>Saprolite:</b>	Weathered residual rock in place.
<b>Static water level:</b>	The level of water in a well that is not being affected by pumping. (Also known as ‘rest water level’)
<b>Transmissivity:</b>	A measure for the capacity of an aquifer to conduct water through its saturated thickness (m. sq. /day)
<b>Unconfined:</b>	Referring to an aquifer situation whereby the water table is exposed to the atmosphere through openings in the overlying materials (as opposed to> confined conditions)
<b>Yield:</b>	Volume of water discharged from a well.



## 1. INTRODUCTION

### 1.1 Background

Earth Water Ltd. was commissioned by Nairobi Business Park to carry out borehole site investigations at their parcel of land L.R No.24861/1 located between Nairobi Business Park and Jockey Club of Kenya along Ngong Road, next to the Ngong Race Course, South-west of Nairobi. The land is approximately 4.556 Ha where they want to develop a wellfield.

### 1.2 Aim and Objectives

The project activities aim to address the following objectives:

1. Estimating optimum long-term achievable abstraction rates;
2. Estimating the cone of depression of the potentiometric surface to avoid interference with nearby boreholes;
3. Developing an optimized wellfield layout on the property site including expected borehole depth;
4. Assessing the expected groundwater quality (based on existing data of the aquifer);
5. Gaining conceptual, area-specific understanding of the groundwater system.

### 1.3 Methodology and Approach

The study approach was as follows;

The investigations involved hydrogeological, geophysical field investigations and a detailed desk study in which the available relevant geological and hydrogeological data was collected, analysed, collated and evaluated within the context of the Client's requirements.

The data sources consulted were mainly in four categories:

- a) Published Master Plans.
- b) Geological and Hydrogeological Reports and Maps.
- c) Ministry of Water and Irrigation Borehole Completion records.
- d) Technical reports of the area by various organizations.

### 1.4 Scope of work

The proposed Hydrogeological study and report should include the following elements:

- Establish number of other ground water users in the vicinity and their respective usage capacities and water quality.
- Volume and distribution of available ground water.
- Groundwaters recharge mechanisms in the basin.
- Cost effectiveness of developing groundwater resources.
- Geohydrological modelling and mapping for respective aquifer systems.
- Environmental and other non-economic factors.
- Determine probable location within the site, expected depth and quality of borehole.
- Identify gaps in the information and infrastructure to allow a complete groundwater assessment.
- Existing waste water and drainage systems in the vicinity and the composition of the waste (samples to be taken for analysis).
- Existing bodies of water in the vicinity and the composition of the water (samples to be taken for analysis.)
- Existing chemical or Agri factories/warehouses in the immediate area that have the potential to contaminate the groundwater



- Previous developments that have been approved or consented (at Building permit or construction stage) within the subject site and its surroundings.
- Analyse available (if any) information from previous groundwater studies in the area.
- Current access to groundwater (number of boreholes and their performance characteristics)

## 1.5 Reporting Requirements

The format of writing the Hydrogeological Investigations Report, as described out in the Second Schedule of the Water Resources Management Rules, 2007. Such a report must consider the following (verbatim):-

- i. Name and details of applicant.
- ii. Location and description of proposed Activity.
- iii. Details of climate.
- iv. Details of geology and hydrogeology.
- v. Details of neighbouring boreholes, including location, distance from proposed borehole or boreholes, number and construction details, age, current status and use, current abstraction and use.
- vi. Description and details (including raw and processed data) of prospecting methods adopted, e.g. remote sensing, geophysics, geological and or hydrogeological cross sections. hydrogeological characteristics and analysis, to include but not necessarily be limited to, the following:
  - Aquifer transmissivity
  - Borehole specific capacities
  - Storage coefficient and or specific yield
  - Hydraulic conductivity.
  - Groundwater flux.
  - Estimated mean annual recharge, and sensitivity to external factors.
- vii. Assessment of water quality and potential infringement of National standards.
- viii. Assessment of availability of groundwater.
- ix. Analysis of the reserve.
- x. Impact of proposed activity on aquifer, water quality, other abstractors, including likelihood of coalescing cones of depression and implications for other groundwater users in any potentially impacted areas.
- xi. Recommendations for borehole development, to include but not limited to, the following:
  - Locations of recommended borehole(s) expressed as a coordinate(s) and indicated on a sketch map.
  - Recommendations regarding borehole or well density and minimum spacing in the project area.
  - Recommended depth and maximum diameter.
  - Recommended construction characteristics, e.g. wire-wound screen, grouting depth e. Anticipated yield.
- xii. Any other relevant information (e.g. need to monitor neighbouring boreholes during tests).

This report is written so as to cover each of the above, insofar as data limitations allow. The report also includes maps, diagrams, tables and appendices as appropriate.

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## 2. BACKGROUND INFORMATION

### 2.1 Location

The area is located between Nairobi Business Park and Jockey Club of Kenya within Nairobi Business Park premises along Ngong Road and is approximately 4.556 Ha, in the south-west of Nairobi. The investigated site is defined by the following co-ordinates; 01°18' 32.94" S and 036° 44' 20.85" E at an elevation of 1829m asl.

### 2.2 Physiography

The investigated site lies generally on a flat land that becomes swampy when it rains. The regional Physiography can be said to be that of high level plateau dissected by minor valleys. The general area is drained by tributaries of Motoini River which drains into the Nairobi dam and then flows to join the River Ngong. These then drains further downstream and are part of the Nairobi River. The Ngong hills form a distinct topographic unit dominating the general area. The area lies at an altitude of 1829 m amsl.

### 2.3 Climate and Vegetation

The climate of the area is described as semi-humid to semi-arid warm temperate (Agro-climatic zone map of Kenya), with an annual rainfall of approximately 1100 mm. The area displays a bi-modal rainfall pattern with two rainy seasons, which are concentrated in the months of March to May and October to December. The hottest part of the year is from January to March; at other times the temperatures are moderate.

### 2.4 Population

The population is estimated to be 800 people within the premises of Nairobi Business Park.

### 2.5 Water Demand

The clients have not developed the land yet, but they are intending to put up constructions and occupy the area as soon as groundwater is developed on the land. It is estimated that the site would have a daily potable water demand of 200m<sup>3</sup>/day and a potential irrigation demand of 0.5 m<sup>3</sup>/day resulting in a minimum supply to the site of 2.31 L/s of daily water demand.



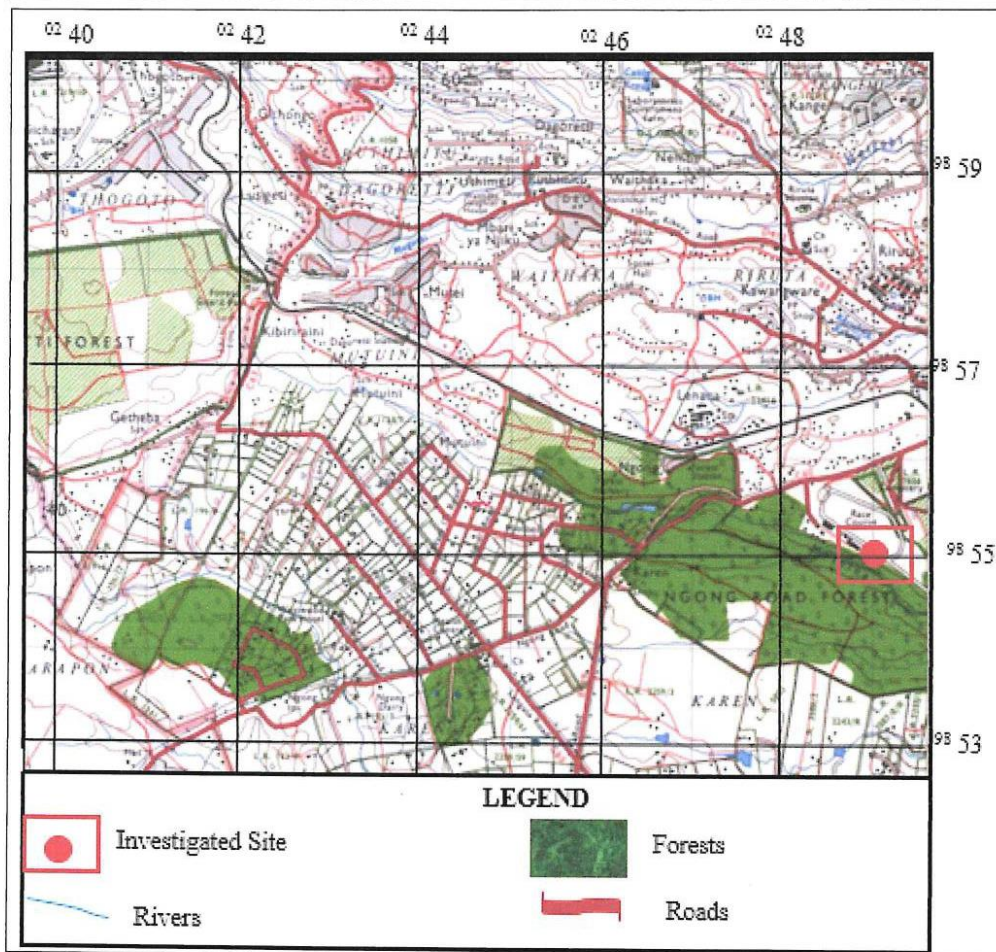


Figure 1: General Location Map of the Investigated Area



### 3. ENVIRONMENTAL AND SOCIO-ECONOMIC ACTIVITIES

#### 3.1 Environment

The area is located along Ngong Road Race Course area surrounded by recreational centres like Ngong Race Course Jockey Club where Horse racing and golf events are held. There are also several offices like the Nairobi Business Park around the area both of which are located on the land that has been leased by the Kenya Forest Service Management. It is proximal to two main roads, the Southern By-Pass Road and the Ngong Road. The area also borders the Ngong Road Forest. There are vast settlements around the region. Background Information on household survey was sourced from the Kenya National Bureau of Statistics (KNBS). Sub location Population of Households, Sampling size and sampling intensity data (Field report, 2008) is as tabulated below.

**Table 1: Households Population in the Vicinity**

Sub Location	Population of Households	Sampling size	Sampling Intensity
Ngando	7,818	23	3%
Waithaka	5,795	17	3%
Mutuini	2,395	7	3%
Karen	2,416	7	3%
Bomas	2,820	8	3%
Olympic	6,818	20	3%
Gatwikira	8,028	24	3%
	<b>36,090</b>	<b>106</b>	<b>3%</b>

Source: Field Report 2008

#### 3.2 Economic Activities

Economic growths and development is majorly depending on the strengths and future investments in different sectors of economy. The main form of income in Dagoretti and Ngong area is in industrial labour, construction, household chores, and small scale trading on groceries, Horticulture, Crop Farming, Livestock production, Dairy, Beef production and careers in carpentry, masonry and tailoring, and including middle class population working in nearby schools, hospitals and other government institutions.

##### 3.2.1 Industrial Activities

##### 3.2.1.1 Tourism industry

The city of Nairobi is a major centre of tourism in the region. Its relative proximity to many tourist attractions both in Kenya and East Africa makes it an asset of great importance in the tourism sector. As the capital city and a commercial centre, it attracts many businesspersons and leisure tourists. This is partly because its airport (Jomo Kenyatta International Airport) is the main port of entry to Kenya by air and many tourist safaris originate and end in the city. The tourism sector is dominated by nature-based tourism underpinned by the rich animal biodiversity in Kenya's national parks. Moreover, with its good conference facilities, Nairobi hosts many international conferences that have become an established facet of Kenyan tourism.



### 3.2.1.2 Textile industry

It's located in Ngong, and primarily concerned with the design, production and distribution of yarn and clothing materials. The raw material may be natural or synthetic using products of the chemical industry.

### 3.2.1.3 Housing industry

The Real Estate sector in Kenya has seen a rise that began somewhere in the mid to late 2000s because the property market is responding to demand. The office market in Kenya has moved from a position of oversupply and the market is finally stabilising, as Nairobi reinforces its position as the regional commercial hub of Sub-Saharan Africa. There have also been a significant number of development projects coming up within the greater Nairobi area.

### 3.2.1.4 Woodwork industry

It is done along Ngong Road with example of Dagoretti furniture makers. Usually it is concerned with timber trade and logging. They are also involved in production of timber furniture and secondary products like wood pulp for the pulp and paper industries; some largest producers are also among the biggest timber land owners.

### 3.2.1.5 Jua kali industry

Jua Kali is generally grouped under the informal sector of Kenya. 90% of Jua Kali is service industry: the industry comprised of small scale traders and artisans who work on the roadside and they are renowned for their ability to create almost anything on demand. Items produced by Jua Kali artisans include the steel windows, water tanks, metal boxes, furniture and utensils.

### 3.2.1.6 Previous developments that have been approved or consented within the subject site and its surroundings.

In Nairobi county development plan, there a number of projects that have been approved within the vicinity of the investigated areas and this are inclusive of the following;

- Nairobi Business Park.
- Rugby Football Union East Africa Grounds.
- Jockey Club.
- Kenya Metrology Department.
- Ngong Road construction.
- Real estate construction.

### 3.2.2 Ground Water Users in the Vicinity

Groundwater is the main source of water supply in this area. From the observations made during the fieldwork campaign, approximately 90% of the boreholes developed around the vicinity are used for commercial purposes. It was estimated that there is an average abstraction of at least 20-50m<sup>3</sup>/day per borehole. The table below shows a list of boreholes that access was granted.

**Table 2: Ground Water Users in the Vicinity Identified During the Field Campaign**

Sample No.	Description	Coordinates			Uses
		Longitude (E)	Latitude(S)	Elev. (m)	
1	Nairobi Business Park Bh	036°44'25.7"	01°18'24.4"	1817	Domestic
2	Pedmart Supermarket Bh	036°44'15.9"	01°18'21.9"	1828	Commercial



## Hydrogeological and Geophysical Investigations

## Nairobi Business Park (Site II) –Ngong Road

3	Kamau Wambiri Bh	036°44'16.2"	01°18'17.8"	1832	Commercial
4	Peanboth Bh	036°44'22.8"	01°18'20.0"	1838	Commercial
5	Tende Bh	036°44'31.5"	01°18'14.7"	1825	Commercial
6	Kevian Kenya Ltd Bh	036°44'44.1"	01°18'16.6"	1820	Commercial & Industrial
7	Mamka Bh (honey well apa)	036°44'12.1"	01°18'17.8"	1831	Domestic in the Apartment
8	TES Apartment Bh	036°43'59.8"	01°18'21.4"	1833	Commercial & Domestic

### 3.2.3 Ground water pollution

Water users within the vicinity mostly depend on groundwater for various activities inclusive of domestic, carwash and industries. Possible groundwater pollution sources include sewerage, cemeteries, domestic waste and landfills. Groundwater may become contaminated due to improper disposal of liquid wastes, defective well construction and failure to seal abandoned wells. These provide openings for downward movement of water into subsurface formations without the process of natural infiltration. Contamination may also take place through the movement of waste water through large openings such as animal burrows, fissures in rocks, coarse gravel formations or manmade excavations.



## 4. GEOLOGY

The investigated site lies on Tertiary volcanic material overlying Basement System rocks at very great depth. In the two sections below, a discussion on the geology in a regional context is followed by a more detailed assessment of the geology in the investigated area.

### 4.1 Regional Geology

The area is located on the eastern side of the Gregory Rift Valley. Before the formation of the Rift Valley the whole area was made up of Pre-Cambrian Basement System crystalline rocks of the Mozambique Belt. These very old rocks were laid down, metamorphosed, exposed and eroded and were in pre-Tertiary times an 'ancient' land surface.

The formation of the Great Rift was followed by extensive and widespread volcanic activity. In the Nairobi area this activity covered the Old Land Surface, and was characterized by periods of extrusive activity followed by periods of relative calm during which erosion by wind and water occurred. In early Tertiary, during a period of substantially moister climate, numerous river systems deposited erosion debris in extensive lakes, leaving behind the Athi Tuff and Lakebed deposits which today form a very important aquifer known loosely as the Athi Series.

This intermittent volcanic and erosive activity continued throughout the Tertiary Period and into the Pleistocene Epoch of the Quaternary Period, leaving deposits which today are six or seven hundred meters thick in places. In general the sequence is relatively well understood though local detail is sometimes lacking.

In Recent times volcanic activity has given way to a prolonged erosive period. This has exposed almost all of the volcanic material at some location, to a lesser or greater extent. To the east of the City the lavas, sediments and pyroclastics are significantly more eroded than they are to the west. There is a well-developed soil cover, and alluvial deposits lie in the valley bottoms of many of the small rivers that traverse the region running roughly west - east.

### 4.2 Structural Geology

The Gregory Rift Valley is the most striking structural feature. The eastern flank of rift valley is marked by a wide zone of sub-parallel faults occupying the western third of the area. These faults have resulted to the Kikuyu scarp, the central portion of a complex Rift margin comprising the Kapiti scarp to the South and the Kinangop scarp to the North.

### 4.3 Geology of the Investigated Area

The investigated area is overlain by superficial deposits material which resulted from weathering and erosion of volcanic lavas, pyroclastics and sediments. The superficial deposits are underlain by the Limuru trachytes. The volcanics in the study area are composed of the Kerichwa valley tuffs, Basanites and the Nairobi trachytes. The formations in the area are further discussed in details as follows:-

#### 4.3.1 Superficial Deposits

They are deposits of recent age comprising the weathered products of the volcanics known as the incoherent black soils. These are clayey soils which are water logged in rainy season. Also conglomerates and alluvial deposits are exposed in river courses.



#### 4.3.2 Limuru Trachytes

The Limuru Trachytes and associated pyroclastic rocks represent some of the final outpouring of lava and volcanic ejectamenta from the East African Rift. The trachytes were derived by eruptions along fault zones connected with rift faulting rather than from central volcanoes, the evidence available suggesting their derivation from the Kedong escarpment northwards to the Aberdare range. Many of the flows spilled over the margin of the Rift, flooding the eastern slopes of the Kikuyu highlands as far east as Nairobi. Others are confined to the Rift zone and have flowed in a southerly direction consequent upon the slope of the Rift floor. These trachytes form the thickest individual lava type in the Nairobi area and, with the intercalated trachytic and agglomerate tuffs, more than 152 m are estimated to be present in some boreholes (Gevaerts, 1964 p 7). They certainly represent a very large volume of lava for they are also extensively developed in the neighbouring Kajjado area (Matheson, 1966) and in the Magadi area where they extend across the Tanzania border (Baker, 1958 and 1963).

The Limuru Trachyte is soft, but rarely fissile, and highly porphyritic with stumpy feldspars in a pale grey groundmass. Typically, the rock contains large anorthoclase phenocrysts in a matrix of untwined orthoclase, kataphorite and aegirine-augite. The phenocrysts are frequently cracked and range in size up to a centimetre, occurring as separate crystals. Inclusions within the feldspars are common; some may be concentrated round the margins of the phenocrysts, and were identified as soda-pyroxene.

#### 4.3.3 Kabete Trachytes

The Kabete Trachyte is a grey-green, porphyritic rock of granular appearance, weathering to a soft grey colour and having a similar appearance to the grey Nairobi Stone. Typically, it occurs as an outcrop in the Kabete area and it overlies both the Kerichwa Valley Tuffs and the Nairobi Trachyte and is, in turn, overlain by the Karura and Limuru Trachytes. Its most northerly extension was mapped in the Tusoga stream, a tributary of the Ruiruaka, and it seems that the trachyte was a relatively narrow lava flow that erupted from the Muguga-Limuru area and flowed as far east as longitude 36°45' at its maximum extent. Nowhere does it form the prominent features exhibited by other lavas and it must be concluded that the lava is comparatively thin in relation to others of the Nairobi region. Boreholes in the Kabete area penetrated about 30 m of the lava.

#### 4.3.4 Upper Kerichwa Valley Tuffs

Although the Lower and Middle Tuffs are confined mainly to valleys or the low ground overlying the older lavas, the Upper Tuffs are more widespread and originally must have covered nearly the entire area, valleys and interfluves alike, in a blanket of pumiceous tuff. Stratigraphic relationships are best seen in the southern part of the area. Members of the Kerichwa Valley Tuffs are occasionally exposed at the contact zone of the Limuru Trachyte and underlying lavas.

Bedding is absent in the tuffs with non-uniform thickness but is dependent on the degree of welding and on the relief of the underlying buried landscape. It is unlikely that more than one ash flow unit is present over the larger part of the area though a conglomerate lens within the tuff, in the railway cutting near the Meteorological Office on the western outskirts of Nairobi, suggests a period of erosion between two successive ash flows. Over wide areas the tuff is soft and porous, contains pumice fragments and locally becomes welded and harder with increase in its content of glassy fragments. The rock though soft is



tenacious. It does not fracture easily when hammered and consequently is used extensively as a building stone.

The amount of gas emitted from these flows was probably very limited for these Upper Tuffs that contain few or no crystalline encrustations precipitated from vapour. Lack of flattening of the pumice fragments on a large scale indicates that the flows were viscous though of sufficiently high temperature to permit flow and partial welding.

#### 4.3.5 Middle Kerichwa Valley Tuffs

It's commonly named as Nairobi Claystone, Nairobi Building Stone, and Nairobi Freestone. It is fine-grained with partially devitrified character and indistinct banding, characteristics of an ancient lava flow. The rock is remarkable for its consistency over tens of square kilometres distribution, conchoidal fracture and tendency to develop columnar jointing all suggest a rock that is previously fluid. The regular jointing which has clearly developed during the period of cooling is confined to this unit.

#### 4.3.6 Lower Kerichwa Valley Tuffs

They generally occur in valleys or less frequently as stratified deposits overlying the Nairobi Phonolite. Deposits of these rocks were probably much more extensive but have suffered considerable erosion due to their friability. In many re-excavated valleys these lowest deposits probably filled as much as one third of each original valley. Excellent exposures may be seen in most river courses in and around the Nairobi municipality, notably at Ainsworth Bridge.

Many of the rocks are soft, porous, buff to black ashy to lapilli tuffs, consisting of sub-rounded fragments of black glass, pumice or small rock fragments. They vary in size up to 51 mm oriented in a matrix of dark ashy, crystallo-lithic tuff. Locally the rocks are agglomeratic. Colour variations (partly due to weathering) are common particularly near the top of the succession.

#### 4.3.7 Basanites

The basanites are dense, blue-black rocks containing large phenocrysts of pale brown, zoned pyroxene associated with small olivine pseudomorphs in a fine-grained groundmass of augite, feldspar, magnetite and nepheline. The subhedral titanite phenocrysts are commonly 10 mm in length, some are twinned and all show strong zoning often in a complicated pattern. Inclusions of ore and orientated, needle-like crystals are common.

#### 4.3.8 Nairobi Trachytes

These are widely distributed trachytes, extending from the Dagoreti-Karen area as far east as Nairobi City and northwards to Kiambu and South Githunguri. The rock forms conspicuous outcrops, particularly in the South where it forms a flat-topped plateau terminating in a low but prominent escarpment overlooking the Mbagathi valley and the National Park. Clearly the Mbagathi River is a lateral stream due to its later valley development to the trachyte outcrop. Boreholes in the Nairobi municipality have in places penetrated a continuous sequence of lavas, without interbedded sediment totalling approximately 91 m. At Ruaraka the lava is 61 m thick. A number of thin flows each with a distinct topographic expression are recognizable in the western part of Nairobi area and roads leading into the centre of Nairobi from the west cross the Nairobi Trachyte.



**4.3.9 The Undifferentiated Crystalline Basement System Rocks**

They are the representatives of the Mozambique belt forming the Basement rocks in the investigated area. They are the resultants of intense pressure and thermal activity over a long period of time.

**4.4 Geological Logs for Boreholes in the Vicinity of the Investigated Area****Table 3: Mr. Geoffrey Wandeto Borehole Drilling Logs (Dagoretti)**

Depth (m bgl)	Description	Depth (m bgl)	Description
0-5.5	Silty / clay soils (fine grained)	104.5-110	Phonolitic formation- Highly weathered
5.5-16.5	Tufferous formation-Greyish	110-121	Phonolitic formation Highly weathered – aquiferous
16.5-27.5	Clay-dark gray and brownish gray	121-126.5	Phonolitic-Dark greyish
27.5-38.5	Trachytic Tuff	126.5-143	Phonolite-Compact
38.5-44	Phonolite –Dark greyish	143-148.5	Phonolite-Partially weathered dark greyish
44-49.5	Phonolite-Partially Weathered	148.5-203.5	Phonolitic formation-Gravel noted (aquiferous)
49.5-66	Phonolitic formation- Compact	203.5-209.0	Phonolite-Dark
66-77	Phonolitic formation- Less compact.	209.0-222.5	Phonolitic trachyte (dark and compact)
77-88	Phonolitic formation –partially weathered(few gravels noted)	222.5-225	Fractured phonolite-increased yield
88-93.5	Phonolitic formation -Compact	225-245	Phonolite- Compact
93.5-104.5	Weathered phonolitic formation -80% gravel		

**Table 4: Dr. Christopher Maina &M/s Martha Maina (Dagoretti)**

Depth (m)	Description
13.86 – 32.34	weathered sand soils
32.34-46.2	Old land surface (moist)
46.2-69.3	highly weathered phonolite
69.3-92.4	Weathered phonolites with sand sediments
92.4-110.88	Weathered tuffs dry
110.88-115.5	Fresh phonolites
115.5-147.84	Phonolites (moist)
147.84-152.46	1 <sup>st</sup> aquifer (weathered phonolites)
152.46-170.94	Upper Athi Series
170.94-184.8	A minor aquifer Athi Series
184.8-203.28	Clay soils
207.9-226.38	A minor aquifer
226.38-249.48	Aquifer
249.48-329	Aquifer



**Table 5: Rugby Football Union East Africa Grounds Borehole Logs**

Depth (m)	Descriptions
0 – 4	Reddish to brownish top soil
4 – 20	Blackish to brownish soil.
20 - 50	Weathered Nairobi Trachyte
50 - 94	Slightly Weathered Nairobi Trachyte
94 - 100	Brown sandy to gravel
100 -122	slightly weathered trachyte
122 -160	Brownish gravel and sandy material.
160 -208	Decomposed Kerichwa Trachyte
208 -234	Slightly Weathered Kerichwa Trachyte
234 -246	highly weathered Kerichwa Trachyte
246 -330	Upper Athi Series

**Table 6: Mr. Jeseo Gacharira Ngari Borehole Drilling Logs (Mbaazi Avenue -Lavington)**

Depth (m bgl)	Description
0 - 9	Dark brownish soils
9 -14	Clay
14-18	Highly weathered Tuffs with Clays
18 - 37	Compact Trachytic Tuff
37 - 55	Slightly weathered Trachyte
55-133	Compact Trachyte
133-146	Weathered Trachyte
146 - 174	Slightly weathered Trachyte
174 - 205	Compact Phonolite
205 - 238	Slightly weathered Phonolite
238 - 247	Highly decomposed Phonolites (brownish in colour)
247 - 274	Compact Phonolite
274 - 288	Weathered Phonolite -Slightly Aquiferous (<2m <sup>3</sup> /hr)
288 – 315	Compact Phonolite
315 - 321	Weathered Phonolite - Aquiferous (3m <sup>3</sup> /hr)
321 - 330	Compact Phonolite
330 - 360	Weathered Tuffs and sediments - Aquiferous (7 m <sup>3</sup> /hr)
360 - 370	Highly weathered Tuffs with Sediments and clays
370 - 378	Weathered Tuffs with Sediments Aquiferous (4m <sup>3</sup> /hr)
378 - 400	Compact Phonolite

**N/B:** From the above logs the following are noted;

- 1<sup>st</sup> aquifers were struck between 110-147.84m bgl, (within layers of weathered phonolites).
- Bhs has got several aquifers struck levels.
- Deeper aquifers were struck i.e. > 300m bgl
- The borehole depths range between 245- 400m bgl



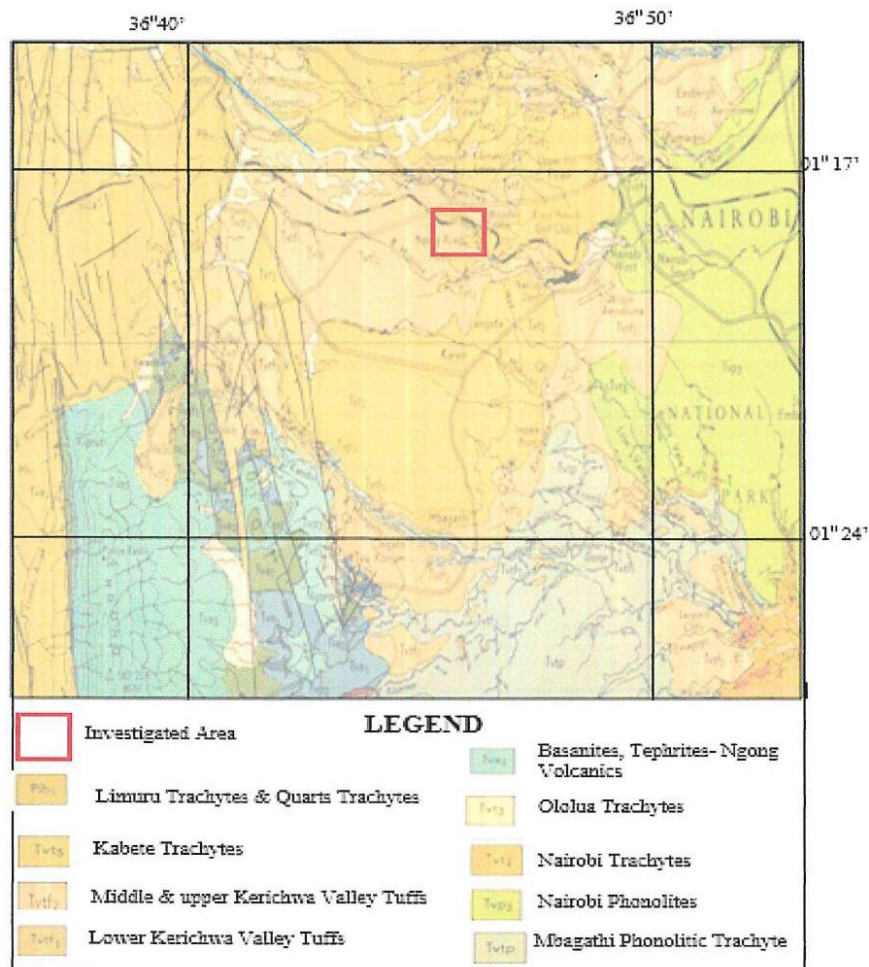
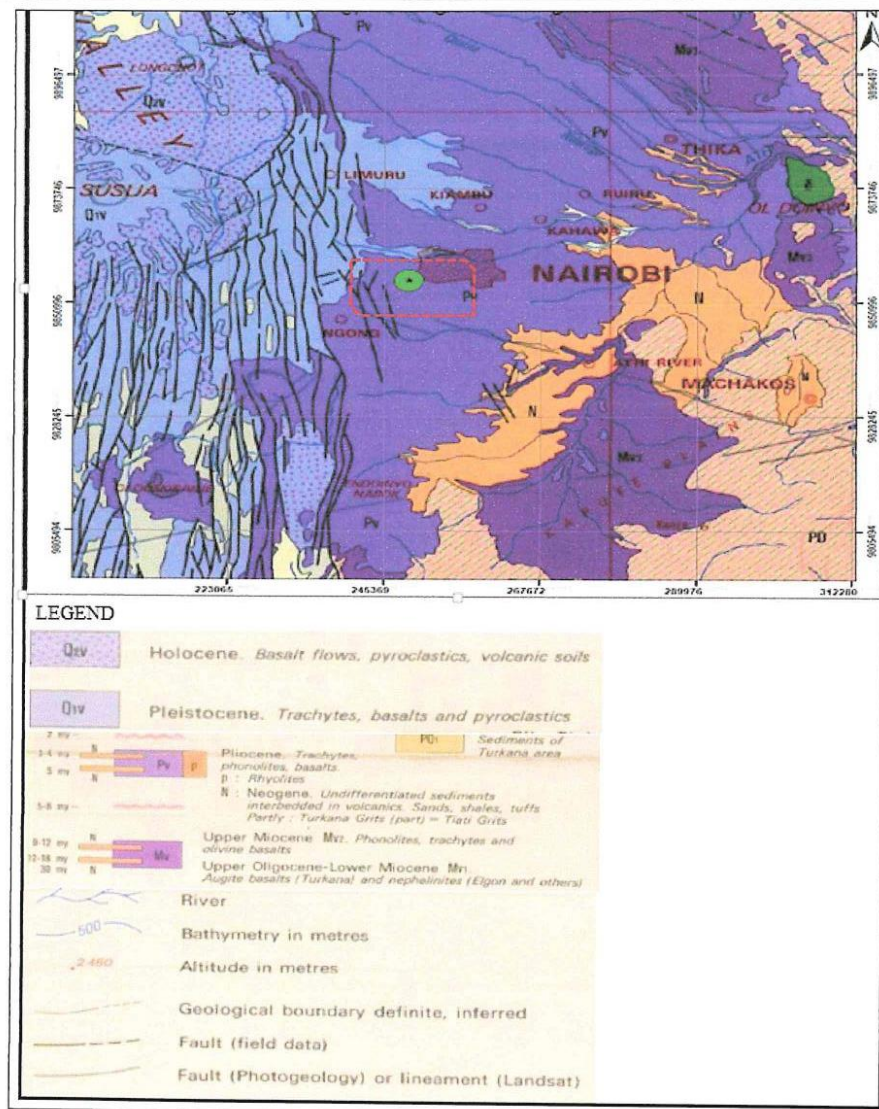


Figure 2: Geological Map of the Investigated Area





**Figure 3: Regional Geological Map of the Investigated Area**



## 5. HYDROGEOLOGY

In evaluation of groundwater potential of an area, several criteria have to be considered for the optimum siting of a borehole. Considering the geological formations identified in the area in terms of their hydrogeological properties satisfies these best. The volcanic rocks in the investigated area and the vicinity depend largely on the development of secondary structures mainly faults, their subsurface extent and interconnection to other similar structures on a regional extent as aquifers. Another major factor is the degree of weathering of these rocks and porosity. In general, groundwater in volcanic rocks is limited to fractures and erosion levels within the volcanic succession. Lavas are generally not water bearing because of their un-fractured and impervious nature.

The recharge mechanism and the rate of replenishment of the confined aquifers, which underlie the Nairobi area, have not been fully established. However a broad pattern of recharge can be described: It has been determined that the Kerichwa Valley Series (KVS) are replenished directly through the soil or via the local stream systems. The KVS may then be a recharge conduit to deeper aquifers.

The Ondiri/Lari area forms the most important recharge area for the Nairobi aquifers. Here water percolates directly into the faults and cracks within the Pleistocene Limuru Trachyte formation through which deeper and adjacent units are recharged over time. A smaller recharge area is located west of Kikuyu. Rainfall on the east flank of the Rift Valley is high (915 mm/year at Kikuyu and from 965 to 1,400 mm/year at Uplands and Lari). The amount of recharge and groundwater flow is known to be very significant e.g. the Kikuyu Spring east of Kikuyu Township yields 4,500 m<sup>3</sup>/day

A study of the water resources of the Ndeiya/Karai area of Kiambu District, west of Limuru (HEEDERIK et al, 1984), showed that a significant volume of water is recharged annually in the higher parts of this area, some of which flows to the east. This presumably recharges the Upper Athi Series and other Nairobi aquifers. Total effective recharge is not known, but certain areas of Nairobi are known to be pumping at a greater rate than local effective recharge. In the near future progressively more reliance will be placed on groundwater resources (as suitable new surface water schemes can no longer be found for Nairobi City Water Supply). Certainly more Nairobi areas will be over-exploited; if no appropriate water conservation measures are taken. Detailed hydrogeological investigations for the Nairobi have to be carried out to reveal the necessity and kind of the measures to be taken. In general the drainage pattern of this area is controlled by the pre-volcanic high ground along the edge of the Rift Valley.

### 5.1 Hydrogeology of the Investigated Area

The investigated site is located in a hydrogeological zone characterized by moderate groundwater potential. Aquifers are found above as well as below the Nairobi Trachytes. The first aquifer is expected at about 39-160m bgl and the main aquifer to depths >160m bgl. The borehole yields in the Dagoretti area has been determined to range from 1 m<sup>3</sup>/hr to 17.8 m<sup>3</sup>/hr and the yield is proportional to the depths drilled. Deeper boreholes have been determined to have higher yields than the shallower boreholes. Drilling to a depth of at least 400 m bgl is capable to give the client productivity of up to 10-20 m<sup>3</sup>/hr.

The Ngong road forest and Ngong Hills forms the most important recharge area for the aquifers. Here water percolates indirectly into the faults and cracks within the Pleistocene Ngong Volcanic through which deeper and adjacent units are recharged over time. The major recharge area is located east of Ngong Hills where rainfall reaches 1,200 mm/year.



### 5.1.1 Hydraulic Characterists of the Aquifer

#### 5.1.1.1 Borehole Data

Drilling records have been studied for 62 No. boreholes within the vicinity of the investigated area (**In Appendix 4 of this Report**). A sample (14 No. BHs) of this boreholes were used in calculation of the aquifer parameters, which are located within a radius of approximately 5 Km off the investigated site. The records are summarized in Table below. The yields of the boreholes that have been tested ranges between 1 to 17.8 m<sup>3</sup>/hr with an average of 7.36 m<sup>3</sup>/hr. The wide range of the yield may be accounted for by different total depth ranges of 48-304 m, differences in geology, and differences in the quality of borehole construction and completion. It can therefore be concluded that the area has a medium ground water potential.

**Table 7: Listing of Boreholes Close to the Investigated Site**

BOREHOLE DATA FROM DESK STUDY							
BH C-No.	Owner	Depth (m)	WSL (m)	W.R.L (m)	Yield (m <sup>3</sup> /h)	PWL	Year
825	Lenana School	136	30,41	51	11.4	-	-
14758	Sarah Wanjiro	250	180,220	116.23	17.80	166.52	-
17870	Commonwealth Grave	265	25,100,160	103.6	7.02	234.22	-
12822	Dept of Metrology	304	102, 150	151.9	9.0	181.5	2000
13929	Bruno C.	144	100, 138	120	13	120.5	2003
11018	Sterling Craft	280	32, 104	94	7.2	113.6	1994
13267	Jockey Club of Kenya	352	32,154, 250, 330	98	4	160.4	2002
15235	Kenya Lutheran Church	304	172, 238	127.1	9	187.8	2006
13458	Shalom	251	143, 209	137.5	4	175.3	2002
11323	Wanjiru Kigundu	200	24, 96	11	4	92	1996
3251	W. K. Ndweru	48	42	5.4	1		1963
11015	Augustine Petrol Station	280	150, 230	111.6	7.2	124.7	1994
1532	Jockey Club	152	54, 137	51	3.5		1951
3589	Jockey Club	268	261	85.6	13.6		1969
2918	Jockey Club	305	107, 244	77.1	13.6		1954
5204	DWD-Lenana	118	30, 84	43.9	3.6	93.76	1982
2373		269	250	21.3	6.8		1955
2032	NCC	274	232	89.6	5.2		1953
12320	J.N. Kiame	186	34, 190	166.5	12	121.7	1994
WRA BOREHOLE DATA							
S/NO	WRMA NO.	NAME		Distance (Meters)	Depth (M)	STATUS	
1	WRMA/30/NRB/3BA/113954/G	Lucy Wanjiru Waweru		450/N	250	Valid Permit	
2	Newly Proposed	Nairobi Business Park BH1		250/N	-	-	

#### 5.1.1.2 Specific Capacity

Specific capacity is a crude indication of the efficiency of the borehole as an engineered structure calculated by dividing the discharge rate as m<sup>3</sup>/day by the total drawdown. High specific capacities generally indicate high transmissivities while low specific capacities indicate low transmissivities.

The specific capacity (yield-drawdown ratio) of the boreholes in the study area ranges from 1.18 to 32.72 m<sup>2</sup>/day. The variation is partly determined by the depth of the borehole. The specific capacity of the surveyed borehole is expected to be high and to decrease gradually at



Increasing abstraction rates. The specific capacity of some boreholes (**Only for Bhs having the both the drawdown and yield**) has been calculated and is presented in the table below.

**Table 8: Borehole Specific Capacities**

Bh C-No.	Owner	Yield (m <sup>3</sup> /h)	Total Drawdown (m)	Specific Capacity (m <sup>3</sup> /day)
12822	Dept of Metrology	9.0	29.6	7.29
13929	Bruno C.	13	0.5	624
11018	Sterling Craft	7.2	19.6	8.82
13267	Jockey Club of Kenya	4	62.4	1.54
15235	Kenya Lutheran Church	9	60.7	3.55
13458	Shalom	4	37.8	2.54
11323	Wanjiru Kigundu	4	81	1.18
11015	Augustine Petrol Station	7.2	13.1	13.19
12320	J.N. Kiame	12	55.2	5.22
5357	Wehu Kenyatta	2.4	9.6	6
4926	KSTC	4.0	41.6	2.31
13170	John Murimu	24	17.6	32.72
12809	Kenya Power	6	46.3	3.11
14124	Junction Ltd	8	31.7	6.05

#### 5.1.1.3 Transmissivity

This is the rate of flow of water under a unit hydraulic gradient through a cross section of unit width across the entire saturated section of the aquifer. Strictly speaking, transmissivity should be determined from the analysis of a well test, data from the boreholes within a radius of 5km was used to determine the transmissivity of the aquifer in the study area. The transmissivity of the area has thus been determined to be **6.5766 m<sup>2</sup>/day**.

#### 5.1.1.4 The Storage Coefficient

The storage coefficient of an aquifer is the volume of water released from or taken up per unit surface area per unit change in head. It is dimensionless. In an aquifer test, a borehole is pumped at a known discharge rate and water levels in one or more neighbouring observation boreholes, and the shape and type of drawdown curve in the observation borehole(s) is used to calculate the storage coefficient.

The Study on The National Water Master Plan of December, 1991 gives the storage coefficient value of the aquifer in the area to be  $4.90 \times 10^{-3}$ .

#### 5.1.2 Groundwater Recharge and Discharge Estimation

The investigated area lies in the Athi Catchment system, the aquifers recharge to the investigated area is mainly via Motoini River a tributary of the Ngong River, which arise from the Ngong road forest. The main catchment area is the Ngong hills which has been estimated to be 45 Km<sup>2</sup>.

The catchment area is characterized by the Ngong volcanics covering an area of about 45 km<sup>2</sup>. The average rainfall is assumed to be 1100 mm for the entire area. The available gross volume of precipitation within the water budget zone is therefore  $4.5 \times 10^7 \times 1.1 = 4.95 \times 10^7$  m<sup>3</sup> per year.

The aerial extent of the aquifer is unknown. A conservative theoretical approximation of the areal extent has been proposed to be 10 km<sup>2</sup>, which is equivalent to  $1.0 \times 10^7$  m<sup>2</sup>. In addition, probably not all of the groundwater aquifers are participating in the hydrological system of the area



Due to the complexity of the geology of the area and lack of adequate borehole drilling data, it is difficult to estimate the recharge in the project area. Nevertheless, an estimate can be made as follows. Considering a catchment area of 45 km<sup>2</sup>, a mean annual rainfall of 1100 mm and an infiltration rate of 10%, the amount of water being recharged into the groundwater storage is estimated to be: 4.95 x 10<sup>6</sup> m<sup>3</sup> per year. Even when assuming a major groundwater abstraction in the region, the recharge into the groundwater storage is more than enough to supply for domestic use in one year (3.65 x 10<sup>3</sup> m<sup>3</sup> per year). Hence, the danger of groundwater depletion is rather remote.

## 5.1.3 Ground Water Movement

Ground water in this region is supplied by a number of aquifers either in fluvial or lacustrine deposits intercalated in most formations or between the principal lava flows. The harder tuffs and lavas yield little or no water due to their generally impervious character. In addition faults fissures and joints all may carry water.

## 5.1.4 Safe Yield

From the available data, it is assumed that at an expected pumping rate of 10 m<sup>3</sup>/day in the borehole, both the drawdown and the gradient of the cone of depression will be small. The aquifer in the Nairobi area is very large and thus, the annual average deep-percolation in this area has been estimated to be sufficient to yield the planned yearly groundwater abstraction of 3.65 x 10<sup>3</sup> m<sup>3</sup> from the aquifer system. Thus, even when no recharge of the aquifer from the precipitation and the adjoining alluvial aquifers takes place, the proposed amount of water can be abstracted without changing the groundwater level dramatically. During dry periods, the natural lateral groundwater flow into the aquifer is estimated still to be higher than the proposed groundwater abstraction.

## 5.1.5 Groundwater and Surface Water Quality

Groundwater quality in the Ngong area is usually good for human consumption. However in a large part of the area fluoride concentration is above the maximum recommended level of 1.5 ppm by the WHO guide levels. The fluoride concentration of deep groundwater in the area south of Ngong hills will be between 1 and 4 ppm, while the maximum concentration in the Nairobi Conservation area is more than 10 ppm. Turbidity is also considered to be higher than the maximum allowable limit. Other parameters e.g. Permanganate value, Iron, Manganese, Calcium, Magnesium, Chloride, Nitrate, Nitrite, Total Dissolved Solids and Sulphate are within the WHO recommended limits. pH and Conductivity are also satisfactory, water in these areas is non-corrosive, and in most cases not particularly alkaline.



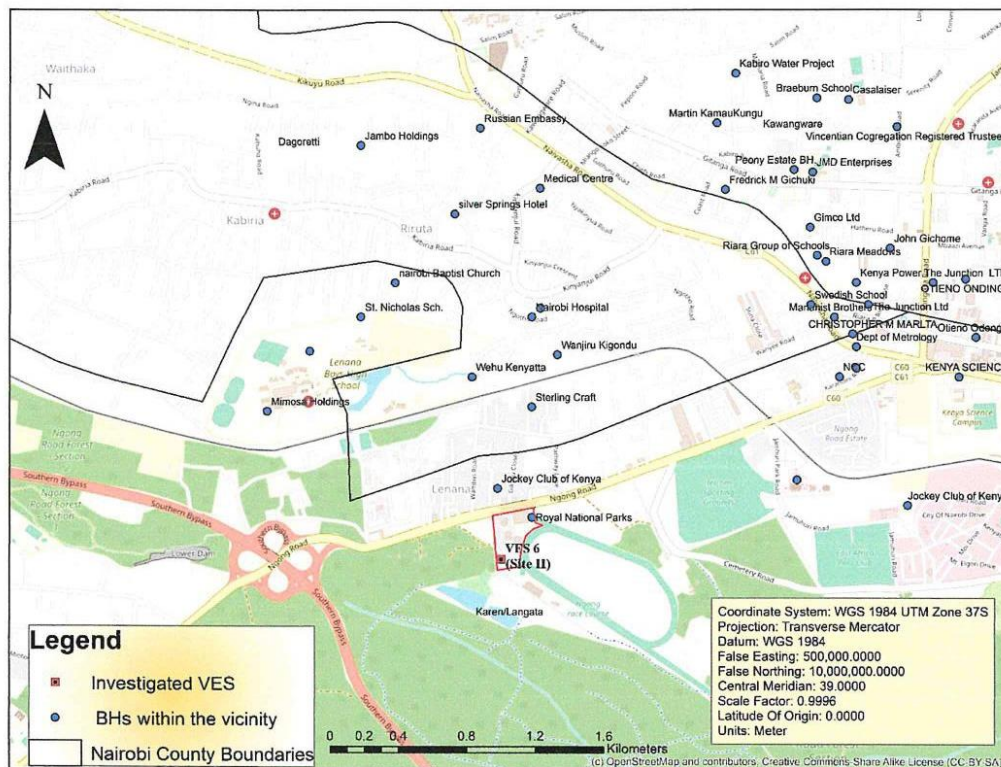


Figure 4: Location Map of Boreholes in the Vicinity of the Investigated Area from Desktop study data.

### 5.2 Test Pumping Data and Analysis of Boreholes in the Vicinity

Test pumping data analysis considered the following available borehole data due to their proximity to the investigated area: Dr. Christopher Maina - Dagoretti, Rugby Football Union of East Africa, Hekima College Mr. Geoffrey Wandeto -Dagoretti and Mr Jesse Ngari Gacharira.

#### 5.2.1 Dr. Christopher Maina & Martha Wanjiru Maina Borehole - Dagoretti

##### 5.2.1.1 Pumping Test & Recovery Analysis

Using a submersible pump SHARKTI QF 30-25, set at the depth of 290m bgl, the pump used could only give a maximum drawdown of 91.23 out of a possible drawdown of 180 m thus 50.68%. This borehole could sustain a pump with higher discharge. The pumping involved a constant discharge test of 11.01 m<sup>3</sup>/hr for 24 hours then followed by a recovery test for 3 hours.



**5.2.1.2 Aquifer Hydraulic Parameters****a) Specific Capacity**

This is a crude indication of the efficiency of the borehole as an engineered structure, and is calculated by dividing the discharge rate (as m<sup>3</sup>/day) by the total drawdown. High specific capacities generally indicate high transmissivity, low specific capacities the opposite.

The specific capacity (yield-drawdown ratio) of Dagoretti borehole (Dr. Christopher Maina) is 2.89

**Table 9: Borehole Specific Capacity**

Yield (m <sup>3</sup> /h)	Total Drawdown (m/day)	Specific Capacity (m <sup>3</sup> /day/m)
11.01	91.23	2.89

**b) Transmissivity**

This is the rate of flow of water under a unit hydraulic gradient through a cross section of unit width across the entire saturated section of the aquifer. Strictly speaking, transmissivity should be determined from the analysis of a well test, but here we use the Jacobs method to estimate it.

The product of (K) and thickness (D) is defined as the transmissivity (T) of an aquifer system (KD=T). This property can be derived from the commonly applied Jacobs formula (Driscoll 1986):

$$T = 2.3Q/4\pi\Delta s$$

Where:  $\Delta s$  = increase in drawdown over 1 log cycle of time.

With a yield of 264.24 m<sup>3</sup>/day and a  $\Delta s$  of (83.65 – 54.64) 29.01 m/log cycle, the apparent transmissivity is 1.667m<sup>2</sup>/day. With a total penetrated aquifer thickness of 18 m, using  $T=Kb$  (where K is the conductivity and b is the thickness), it then follows that the average conductivity of the water bearing layers is 0.093 m/day. This is indeed rather high, suggesting that the main aquifer material comprises coarse sediments, and highly fractured/weathered rocks.

**Table 10: Transmissivity and Hydraulic Conductivity**

Transmissivity (m <sup>2</sup> /day)	Aquifer Thickness (m)	Hydraulic Conductivity (m/day)
262.4	12	3.725

**c) The Storage Coefficient**

The storage coefficient of an aquifer is the volume of water released from or taken up per unit surface area per unit change in head. It is dimensionless. Empirical values of the storage coefficient cannot be determined from the test done as aquifer testing was not done. In an aquifer test, a borehole is pumped at a known discharge rate and water levels in one or more neighboring observation boreholes, and the shape and type of drawdown curve in the observation borehole(s) is used to calculate the storage coefficient.



## 5.2.2 Rugby Football Union of East Africa

### 5.2.2.1 Pumping Test & Recovery Analysis

Test pumping operation was carried out. The initial discharge was 18.3 m<sup>3</sup>/hr but it continued decreasing with increase in the head until it stabilized at 14.3 m<sup>3</sup>/hour at a dynamic water level of 214 m bgl.

### 5.2.2.2 Aquifer Hydraulic Parameters

#### a) Specific Capacity

This is a crude indication of the efficiency of the borehole as an engineered structure, and is calculated by dividing the discharge rate (as m<sup>3</sup>/day) by the total drawdown. High specific capacities generally indicate high transmissivity, low specific capacities the opposite

The specific capacity (yield-drawdown ratio) of the borehole is 10.65.

**Table 11: Borehole specific capacity**

Yield (m <sup>3</sup> /h)	Total Drawdown (m/day)	Specific Capacity (m <sup>3</sup> /day/m)
14.3	32.2	10.65

#### b) Transmissivity

This is the rate of flow of water under a unit hydraulic gradient through a cross section of unit width across the entire saturated section of the aquifer. Strictly speaking, transmissivity should be determined from the analysis of a well test, where there is an observation borehole, but here we use the Jacobs method to estimate it.

The product of (K) and thickness (D) is defined as the transmissivity (T) of an aquifer system (KD=T). This property can be derived from the commonly applied Jacobs formula (Driscoll 1986):

$$T = 2.3Q/4[\Delta s]$$

Where:  $\Delta s$  = increase in drawdown over 1 log cycle of time.

With a yield of 343 m<sup>3</sup>/day and a  $\Delta s$  of (27.93 – 22.27) 5.66 m/log cycle, the apparent transmissivity is 11.09 m<sup>3</sup>/day/m. With a total penetrated aquifer thickness of 15 m, using  $T = Kb$  (where K is the conductivity and b the thickness), it then follows that the average conductivity of the water bearing layers is 0.7393 m/day. This is indeed rather low, suggesting that the main aquifer material comprises of fine sediments, and highly fractured/weathered rocks.

**Table 12: Transmissivity and Hydraulic Conductivity**

Transmissivity (m <sup>3</sup> /day/m)	Aquifer Thickness (m)	Hydraulic Conductivity (m/day)
11.09	15	0.7393

Even though the observed drawdown levels provide information on the combined well and aquifer hydraulic properties, observations of the upcoming water are important for the determination of the feasibility of continuous abstraction.



c) **The Storage Coefficient**

The storage coefficient of an aquifer is the volume of water released from or taken up per unit surface area per unit change in head. It is dimensionless. Empirical values of the storage coefficient cannot be determined from the test done as aquifer testing was not done. In an aquifer test, a borehole is pumped at a known discharge rate and water levels in one or more neighboring observation boreholes, and the shape and type of drawdown curve in the observation borehole(s) is used to calculate the storage coefficient.

**5.2.3 Mr. Geoffery Wandeto Borehole -Dagoretti**

**5.2.3.1 Pumping Test & Recovery Analysis**

Test pumping was tested at 198 m bgl using Sp 17-20 beginning with step drawdown tests of 5, 10, 15 and 19 m<sup>3</sup>/hr. This was followed by a constant discharge test of 18m<sup>3</sup>/hr for 24 hours giving a maximum drawdown of only 5.48 m out of a possible drawdown of 92.16 m thus 5.95%. This was preceded by a 30 minutes recovery test attaining 65.32% of the total drawdown. This borehole could sustain a pump with higher discharge.

**5.2.3.2 Aquifer Hydraulic Parameters**

a) **Specific Capacity**

This is a crude indication of the efficiency of the borehole as an engineered structure, and is calculated by dividing the discharge rate (as m<sup>3</sup>/day) by the total drawdown. High specific capacities generally indicate high transmissivity; low specific capacities indicate the opposite.

The specific capacity (yield-drawdown ratio) of the borehole is **3.2847 (m<sup>2</sup>/hr)**

**Table 13: Borehole Specific Capacity**

Yield (m <sup>3</sup> /hr)	Total Drawdown (m)	Specific Capacity (m <sup>2</sup> /day)
18	5.48	78.83

b) **Transmissivity**

This is the rate of flow of water under a unit hydraulic gradient through a cross section of unit width across the entire saturated section of the aquifer. Strictly speaking, transmissivity should be determined from the analysis of a well test, but here we use the Jacobs method to estimate it.

The product of (K) and thickness (D) is defined as the transmissivity (T) of an aquifer system (KD=T). This property can be derived from the commonly applied Jacobs formula (Driscoll 1986):

$$T = 1.22Q * 24 \text{hrs} / \sum \Delta s$$

Where:  $\Delta s$  = increase in drawdown over 1 log cycle of time.

With a yield of **432m<sup>3</sup>/day** and a  $\Delta s$  of (158.32 – 152.84) **5.48m/log cycle**, the apparent transmissivity is **96.18m<sup>2</sup>/day**. With a total penetrated aquifer thickness of 18m, using **T=Kb** (where K is the conductivity and b the thickness), it then follows that the average conductivity of the water bearing layers is 5.34m/day. This is indeed rather high, suggesting



that the main aquifer material comprises coarse sediments, and highly fractured/weathered rocks.

**Table 14: Transmissivity and Hydraulic Conductivity**

Transmissivity (m <sup>2</sup> /day)	Aquifer Thickness (m)	Hydraulic Conductivity (m/day)
96.18	18	5.34

Even though the observed drawdown levels provide information on the combined well and aquifer hydraulic properties, observations of the upcoming water are important for the determination of the feasibility of continuous abstraction.

**c) The Storage Coefficient**

The storage coefficient of an aquifer is the volume of water released from or taken up per unit surface area per unit change in head. It is dimensionless. Empirical values of the storage coefficient cannot be determined from the test done as aquifer testing was not done. In an aquifer test, a borehole is pumped at a known discharge rate and water levels in one or more neighboring observation boreholes, and the shape and type of drawdown curve in the observation borehole(s) is used to calculate the storage coefficient.

**5.2.4 Mr. Jesse Gacharira Ngari Borehole - Lavington**

**5.2.4.1 Pumping Test & Recovery Analysis**

Pumping test was performed using a submersible pump SP17-40, set at the depth of 374 m bgl. Test pumping was done in two phases. The first phase involved a 4-stage step drawdown test with discharges of 4, 8, 12 and 16 m<sup>3</sup>/hr. The second phase involved a constant discharge test at a discharge of 16m<sup>3</sup>/hr for 24 hours. The constant discharge test attained a maximum drawdown of 35.77 m out of a possible drawdown of 172.65 thus 20.72%. A recovery test was done for 6 hours attaining a total recovery of 81.14% (29.02m recovery) of the total drawdown. This borehole could sustain a pump with higher discharge.

**5.2.4.2 Aquifer Hydraulic Parameters**

**a) Specific Capacity**

This is a crude indication of the efficiency of the borehole as an engineered structure, and is calculated by dividing the discharge rate (as m<sup>3</sup>/day) by the total drawdown. High specific capacities generally indicate high transmissivity, low specific capacities indicate the opposite.

The specific capacity (yield-drawdown ratio) of the borehole is **0.4473 (m<sup>2</sup>/hr)**

**Table 15: Borehole Specific Capacity**

Yield (m <sup>3</sup> /hr)	Total Drawdown (m)	Specific Capacity (m <sup>2</sup> /day)
16	35.77	10.73

**b) Transmissivity**

This is the rate of flow of water under a unit hydraulic gradient through a cross section of unit width across the entire saturated section of the aquifer. Strictly speaking, transmissivity should be determined from the analysis of a well test, but here we use the Jacobs method to estimate it.



The product of (K) and thickness (D) is defined as the transmissivity (T) of an aquifer system ( $KD=T$ ). This property can be derived from the commonly applied Jacobs formula (Driscoll 1986):

$$T = 1.22Q \cdot 24 \text{hrs} / \Delta s$$

Where:  $\Delta s$  = increase in drawdown over 1 log cycle of time.

With a yield of  $384 \text{m}^3/\text{day}$  and a  $\Delta s$  of  $(263.12 - 227.35) 35.77 \text{m/log cycle}$ , the apparent transmissivity is  $13.09 \text{m}^2/\text{day}$ . With a total penetrated aquifer thickness of 19m, using  $T=Kb$  (where K is the conductivity and b the thickness), it then follows that the average conductivity of the water bearing layers is  $0.6889 \text{m/day}$ .

The  $\Delta S$  was determined from the drawdown-time graph given below:

**Table 16: Transmissivity and Hydraulic Conductivity**

Transmissivity ( $\text{m}^2/\text{day}$ )	Aquifer Thickness (m)	Hydraulic Conductivity (m/day)
96.18	19	0.6869

Even though the observed drawdown levels provide information on the combined well and aquifer hydraulic properties, observations of the upcoming water are important for the determination of the feasibility of continuous abstraction.

**c) The Storage Coefficient**

The storage coefficient of an aquifer is the volume of water released from or taken up per unit surface area per unit change in head. It is dimensionless. Empirical values of the storage coefficient cannot be determined from the test done as aquifer testing was not done. In an aquifer test, a borehole is pumped at a known discharge rate and water levels in one or more neighbouring observation boreholes, and the shape and type of drawdown curve in the observation borehole(s) is used to calculate the storage coefficient.



## 6. GEOPHYSICAL INVESTIGATIONS

Investigations of the groundwater resources in the area included the use of geophysical techniques to probe the sub-surface. A variety of methods are available to assist in the assessment of geological sub-surface conditions. The main emphasis of the fieldwork undertaken was to determine the thickness and composition of the sub-surface formations and to identify water-bearing zones. This information was principally obtained in the field using Vertical Electrical Sounding (VES) methodology with the SAS 1000 Terrameter. The VES probes the resistivity layering below the site of measurement. This method is described below.

### 6.1 Resistivity Method

Vertical electrical soundings (VES) were carried out to probe the condition of the sub-surface and to confirm the existence of deep groundwater. The VES investigates the resistivity layering below the site of measurement. This technique is described below.

#### 6.1.1 Basic Principles

The electrical properties of rocks in the upper part of the earth's crust are dependent upon the lithology, porosity, and the degree of pore space saturation and the salinity of the pore water. Saturated rocks have lower resistivities than unsaturated and dry rocks. The higher the porosity of the saturated rock or the higher the salinity of the saturating fluids lowers the resistivity. The presence of clays and conductive minerals also reduces the resistivity of the rock.

The resistivity of earth materials can be studied by measuring the electrical potential distribution produced at the earth's surface by an electric current that is passed through the earth.

The resistance  $R$  of a certain material is directly proportional to its length  $L$  and cross-sectional area  $A$ , expressed as:

$$R = R_s * L/A \quad (\text{in Ohm})$$

Where  $R_s$  is known as the specific resistivity, characteristic of the material and independent of its shape or size.

With Ohm's Law,

$$R = dV/I \quad (\text{Ohm})$$

Where  $dV$  is the potential difference across the resistor and  $I$  is the electric current through the resistor. The specific resistivity may be determined by:

$$R_s = (A/L) * (dV/I) \quad (\text{in Ohm m})$$



## 6.1.2 Vertical Electrical Sounding (VES)

When carrying out a resistivity sounding, current is led into the ground by means of two electrodes. With two other electrodes, situated near the center of the array, the potential field generated by the current is measured. From the observations of the current strength and the potential difference, and taking into account the electrode separations, the ground resistivity can be determined.

During a resistivity sounding, the separation between the electrodes is step-wise increased (in what is known as a Schlumberger Array), thus causing the flow of current to penetrate greater depths. When plotting the observed resistivity values against depth on double logarithmic paper, a resistivity graph is formed, which depicts the variation of resistivity with depth. This graph can be interpreted with the aid of a computer programme, and the actual resistivity layering of the subsoil is obtained. The depths and resistivity values provide the hydrogeologist with information on the geological layering and thus the occurrence of groundwater.



## 7. FIELDWORK AND RESULTS

### 7.1 Fieldwork

Fieldwork was carried out on 30<sup>th</sup> July 2019. Six vertical electrical sounding (VES) were executed. The vertical electrical sounding was carried out in order to unveil the hydrostratigraphy of the area and consequently the subsurface conditions.

### 7.2 Results

The results of interpretation of the resistivity soundings data are presented in the following sections. In addition, this section briefly describes the results of the measurements and also presents plots of the interpretation graphs for the resistivity soundings.

**Table 14: Interpretation of Results for the Recommended Site VES 6.**

VES	Resistivity (Ohm-m)	Depth (m bgl)	Geological Interpretation	Hydrogeological Significance
Layer 1	252.7	2.4	Superficial layer volcanic material	Dry
Layer 2	37	11	Weathered Limuru Trachytes	Moist
Layer 3	101	40	Compact Limuru Trachytes	Dry
Layer 4	30	163	Weathered Kerichwa Valley Tuffs & Nairobi	Aquiferous
Layer 5	33	>163	Weathered Tuffs, Basanites and Nairobi Trachytes	Aquiferous

The VES interpretation results indicate a superficial layer comprising dry volcanic material to a depth of 2.4 m bgl with a resistivity of 252.7  $\Omega$ .m. The 252.7  $\Omega$ .m  $\Omega$ .m is underlain by a 37  $\Omega$ .m resistivity layer to a depth of 11 m bgl interpreted to be weathered Limuru Trachytes. This layer is then underlain by 101  $\Omega$ .m resistivity layer to a depth of 40 m bgl interpreted to be dry compact Limuru Trachytes. An aquiferous 30  $\Omega$ .m layer of weathered Kerichwa Valley Tuffs and Nairobi Trachytes to a depth of 163 m bgl underlie the compact Limuru Trachytes. A 33  $\Omega$ .m resistivity layer of weathered tuffs, Basanites and the Nairobi Trachytes underlies the 30  $\Omega$ .m layer to a depth of >163 m bgl, and forms the base layer of all probed layers/formation. It is interpreted to be aquiferous.



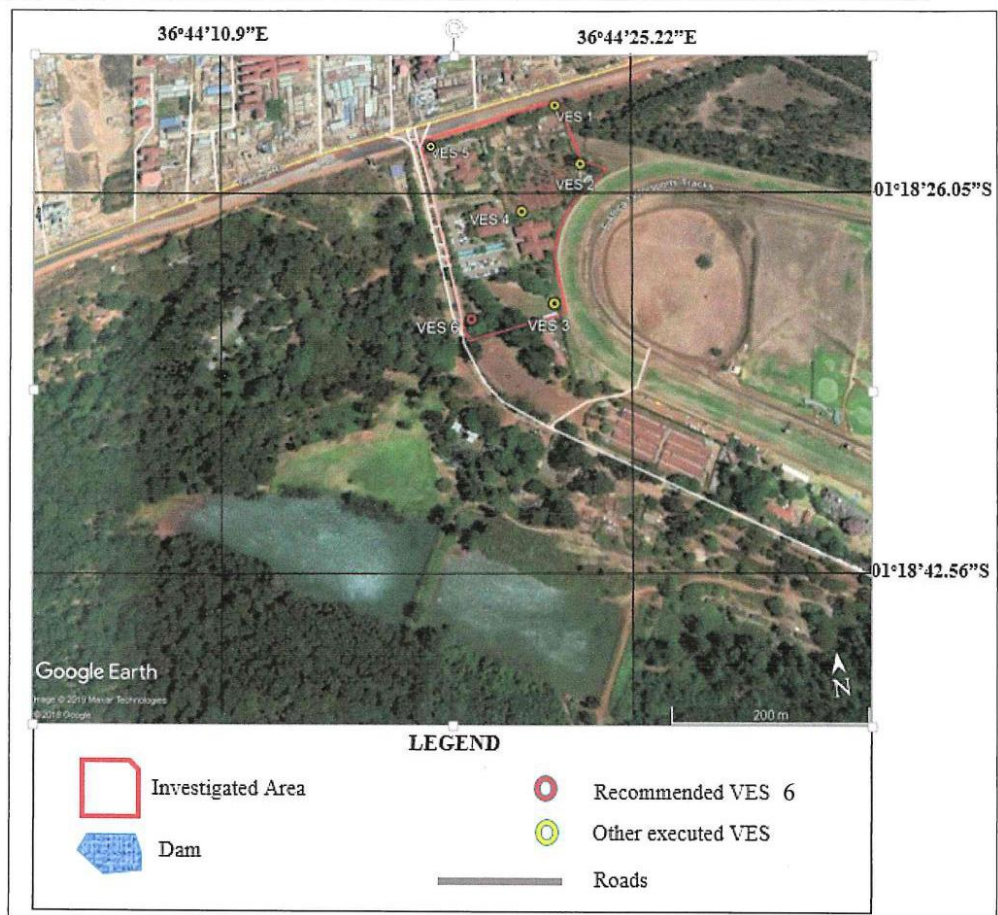


Figure 5: VES Location Map



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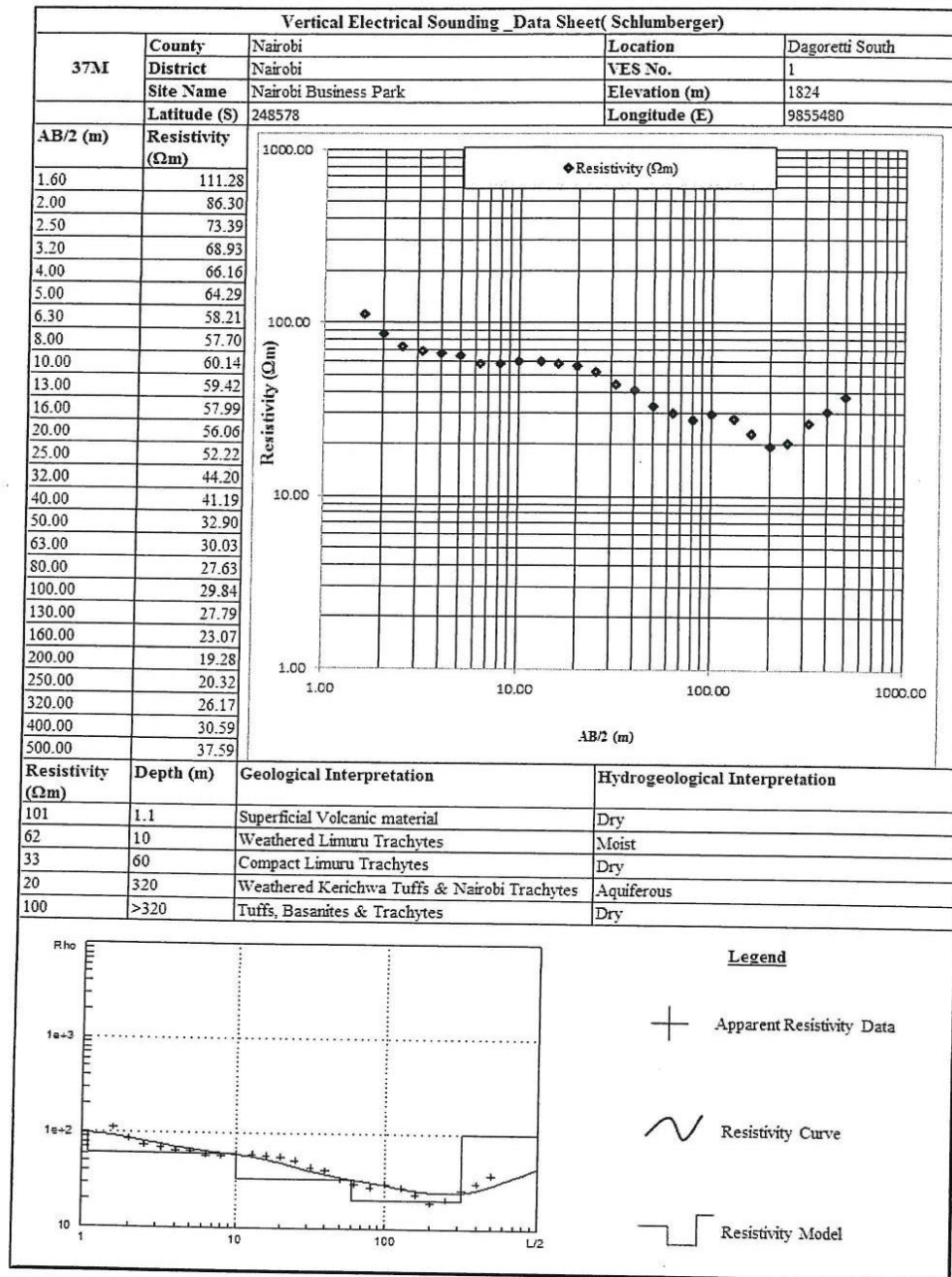


Figure 6: Interpretation Graph for VES 1



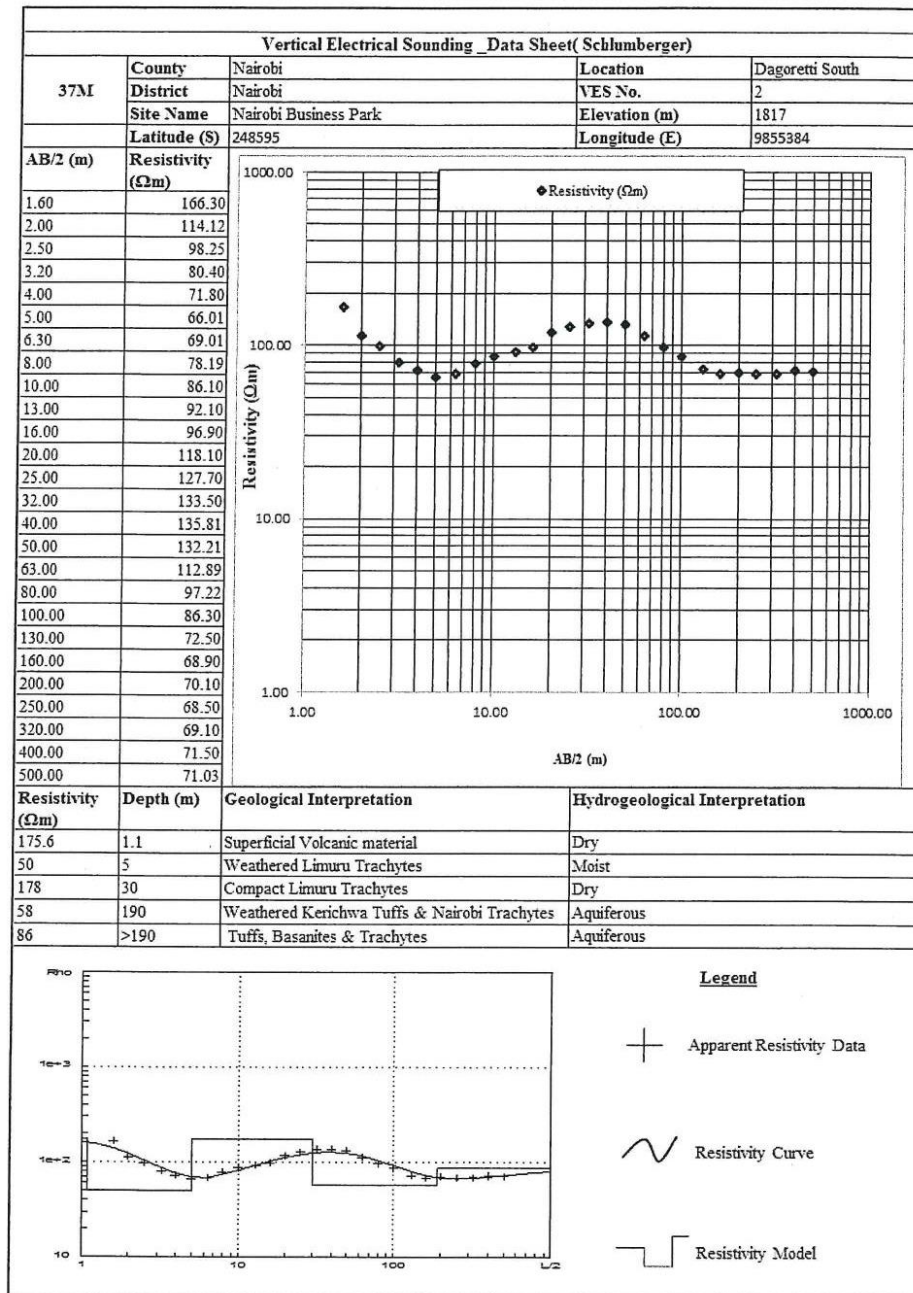


Figure 7: Interpretation Graph for VES 2



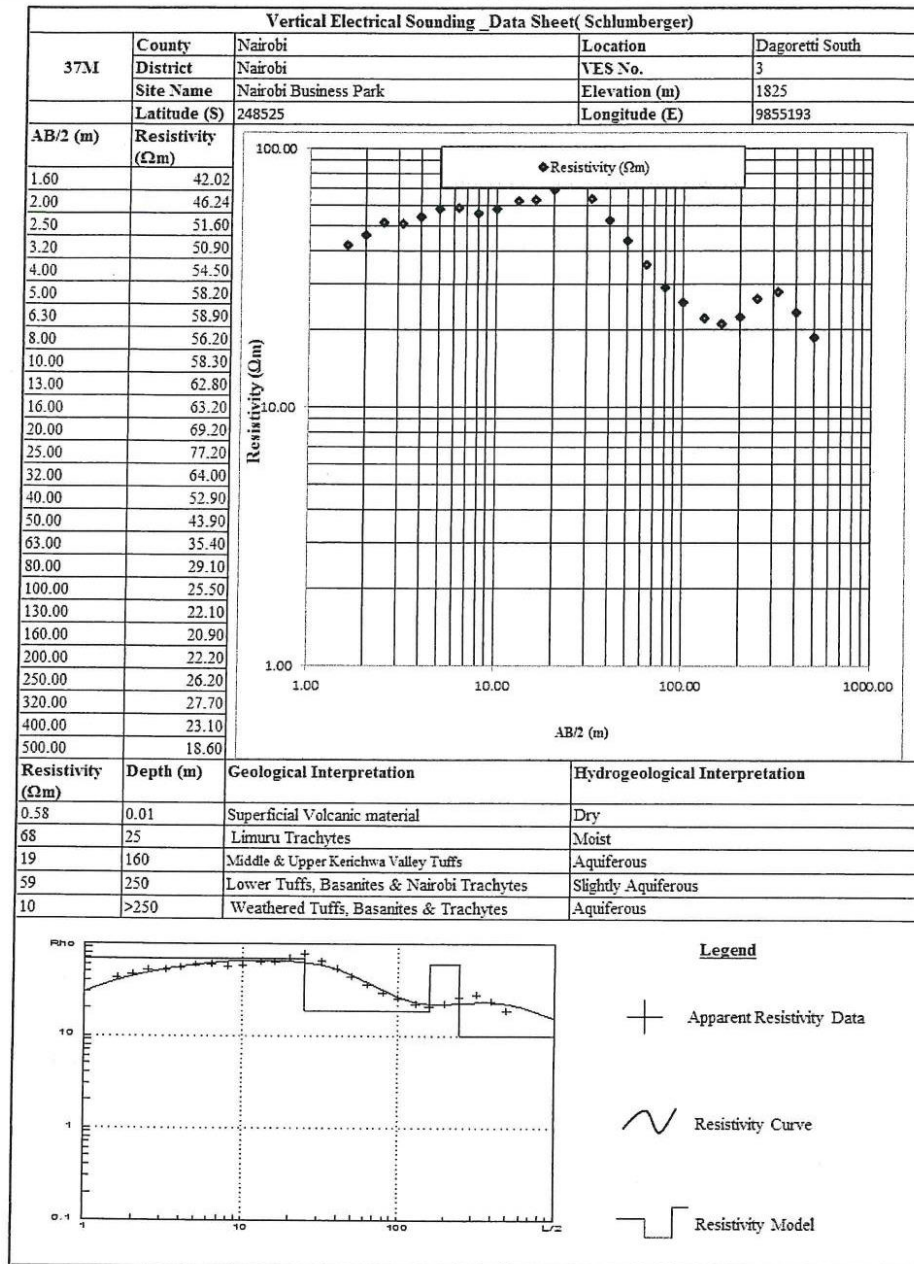


Figure 8: Interpretation Graph for VES 3



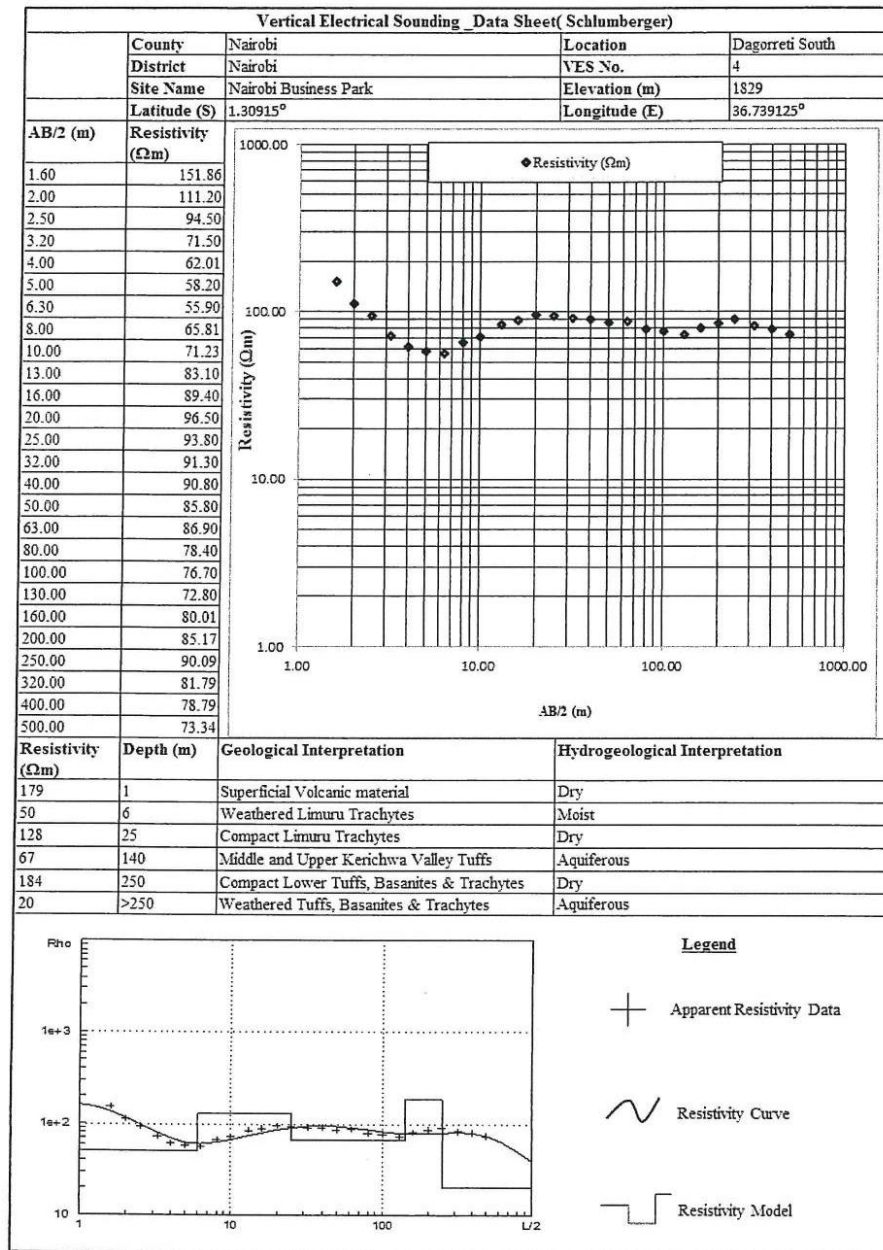


Figure 9: Interpretation Graph for VES 4



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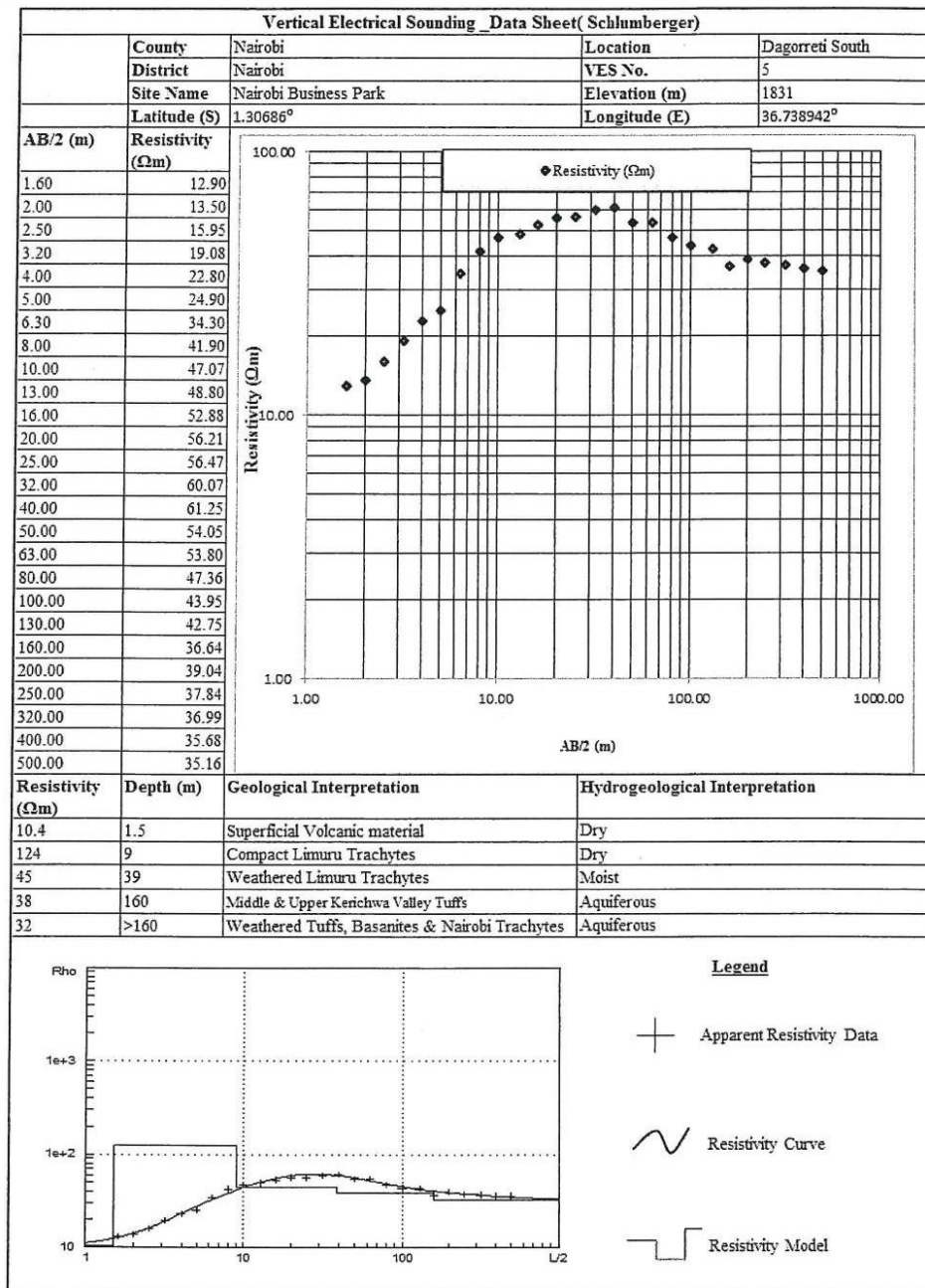


Figure 10: Interpretation Graph for VES 5



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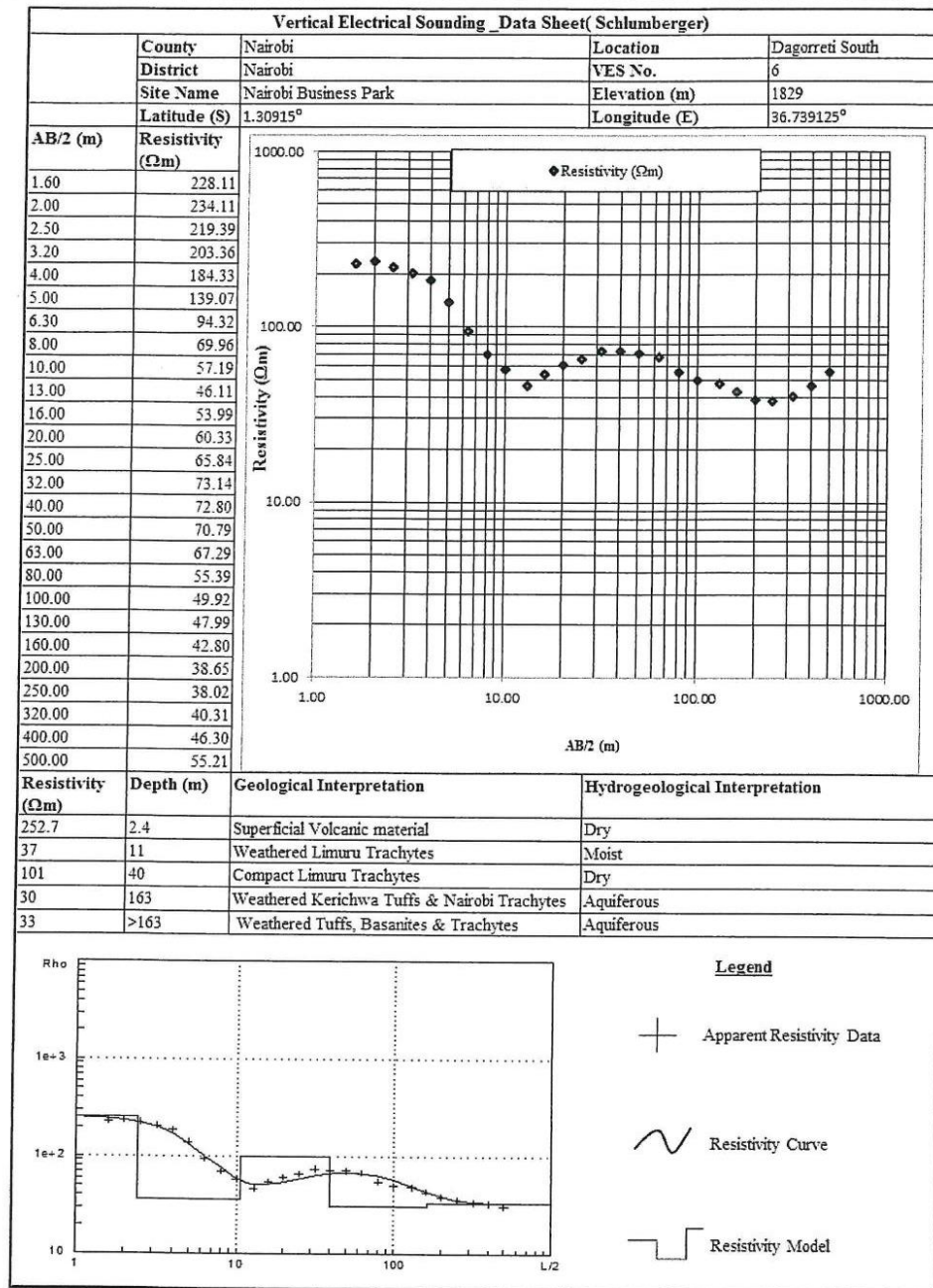


Figure 11: Interpretation Graph for VES 6



## 8. CONCLUSIONS AND RECOMMENDATIONS

### 8.1 Groundwater Conclusions

- The study concludes that on the basis of geological and hydrogeological evidence, the prospects for sufficient groundwater for domestic purposes are good.
- Boreholes in the site vicinity have several water strike levels.
- 1<sup>st</sup> aquifers are expected between 110-150m bgl, within layers of weathered phonolites.
- Deeper aquifers are expected at depths of greater than 300m bgl.
- In nearby boreholes, deeper aquifers were struck at depths > 300m bgl
- The nearby boreholes depths range between 245-400m bgl
- The aquifers in the study area are adequately replenished from an underground storage reservoir that is several orders larger than the imposed abstraction, thereby ensuring a reliable long-term water supply.
- Groundwater quality in the area under investigations is usually good for human consumption, the fluoride concentration of deep groundwater in the area south of Ngong hills will be between 1 and 4 ppm, while the maximum concentration in the Nairobi Conservation area is more than 10 ppm.
- pH and Conductivity are also satisfactory, water in these areas is non-corrosive, and in most cases not particularly alkaline.

### 8.2 Surface Water Conclusions

- Surface water use in the area under study is minimal since the largest population depend on County council water supply which is complemented with underground water in most of the premises.
- There is minimal water pollution in the area since there is a well-established sewerage system in the area, lack of extensive industrial activities in the area renders pollution to be at a minimal level.

### 8.3 Groundwater Recommendations

In view of the above conclusions it is recommended that:

- 8" borehole to be drilled to a depth of at least **400 m** at the locations of VES 6. The point is bench-marked on site and is known to Mr Abraham Samoei (The premises Care-taker) and the Coordinates for the recommended drilling site are **1°18'32.94"S, 36°44'20.85"E, and elevation 1829m.**
- Drilling should first be done using a 10" diameter hammer to a depth of 20 m bgl and then continued to the final depth of 400 m bgl with an 8" diameter hammer.
- The top 20 m should be sealed off with bentonite and cement grout to prevent contamination of the groundwater
- The borehole must be installed with a Water Meter and an Airline/piezometer to monitor groundwater abstraction and to facilitate regular measurements of the static water level in the borehole.
- Upon drilling completion, a 2-litre water sample from the borehole should be collected for reference to the WRA Testing Laboratory, or any other competent Water Testing Authority for a full physical, chemical and bacteriological analysis before the water is put to any use.
- A copy of the analysis report must be sent to the WRA – Regional Office for record.
- A drilling permit has to be acquired from WRA Regional Office in Machakos.

In Appendix 1, additional recommendations on the construction and completion of a borehole are given.



## 8.4 Surface water Recommendations

- Surface water sources should be conserved to avoid contamination by all the anthropogenic pollution sources
- The study area lies within the Ngong catchment and environmental conservation should be observed to ensure the water tower remains in a conducive state
- The surface water drainage system should be well rehabilitated since it seems to be non-functional within the investigated site premises to avoid anthropogenic pollution.



## 9. REFERENCES

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**GEVAERTS, E A L, 1970.** Hydrogeology of the Nairobi Area (2<sup>nd</sup> Ed.), Water Development Division, Ministry of Agriculture, Nairobi

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## APPENDICES



## **Appendix 1: Drilling**

### **Borehole Construction**

#### **Drilling Technique**

Drilling should be carried out with an appropriate tool preferably a rotary drilling machine.

Geological rock samples should be collected at 2 metre intervals. Struck and rest water levels and if possible, estimates of the yield of individual aquifers encountered, should also be noted.

#### **Well Design**

The design of the well should ensure that screens are placed against the optimum aquifer zones. An experienced hydrogeologist should make the final design.

#### **Casing and Screens**

The well should be cased and screened with good quality material. Owing to the depth of the borehole, it is recommended to use steel casings and screens of high open surface area.

We strongly advise against the use of torch-cut steel well casing as screen. In general, its use will reduce well efficiency (which leads to lower yield), increase pumping costs through greater drawdown, increase maintenance costs, and eventually reduction of the potential effective life of the well.

#### **Gravel Pack**

The use of a gravel pack is recommended within the aquifer zone, because the aquifer could contain sands or silts which are finer than the screen slot size. An 8" diameter borehole screened at 6" will leave an annular space of approximately 1", which should be sufficient. Should the slot size chosen be too large, the well will pump sand, thus damaging the pumping plant, and leading to gradual 'siltation' of the well. The slot size should be in the order of 1.5 mm. The grain size of the gravel pack should be an average 2 - 4 mm.

#### **Well Construction**

Once the design has been agreed, construction can proceed. In installing screen and casing, centralizers at 6 metre intervals should be used to ensure centrality within the borehole. This is particularly important for correct insertion of artificial gravel pack all around the screen. After installation, gravel packed sections should be sealed off top and bottom with clay (2 m).

The remaining annular space should be backfilled with an inert material, and the top five metres grouted with cement to ensure that no surface water at the wellhead can enter the well bore and cause contamination.



## Well Development

Once screen, pack, seals and backfill have been installed, the well should be developed. Development aims at repairing the damage done to the aquifer during the course of drilling by removing clays and other additives from the borehole walls. Secondly, it alters the physical characteristics of the aquifer around the screen and removes fine particles.

We do not advocate the use of over pumping as a means of development since it only increases permeability in zones, which are already permeable. Instead, we would recommend the use of air or water jetting, or the use of the mechanical plunger, which physically agitates the gravel pack and adjacent aquifer material. This is an extremely efficient method of developing and cleaning wells.

Well development is an expensive element in the completion of a well, but is usually justified in longer well-life, greater efficiencies, lower operational and maintenance costs and a more constant yield. Within this frame the pump should be installed at least 2 m above the screen, certainly not at the same depth as the screen.

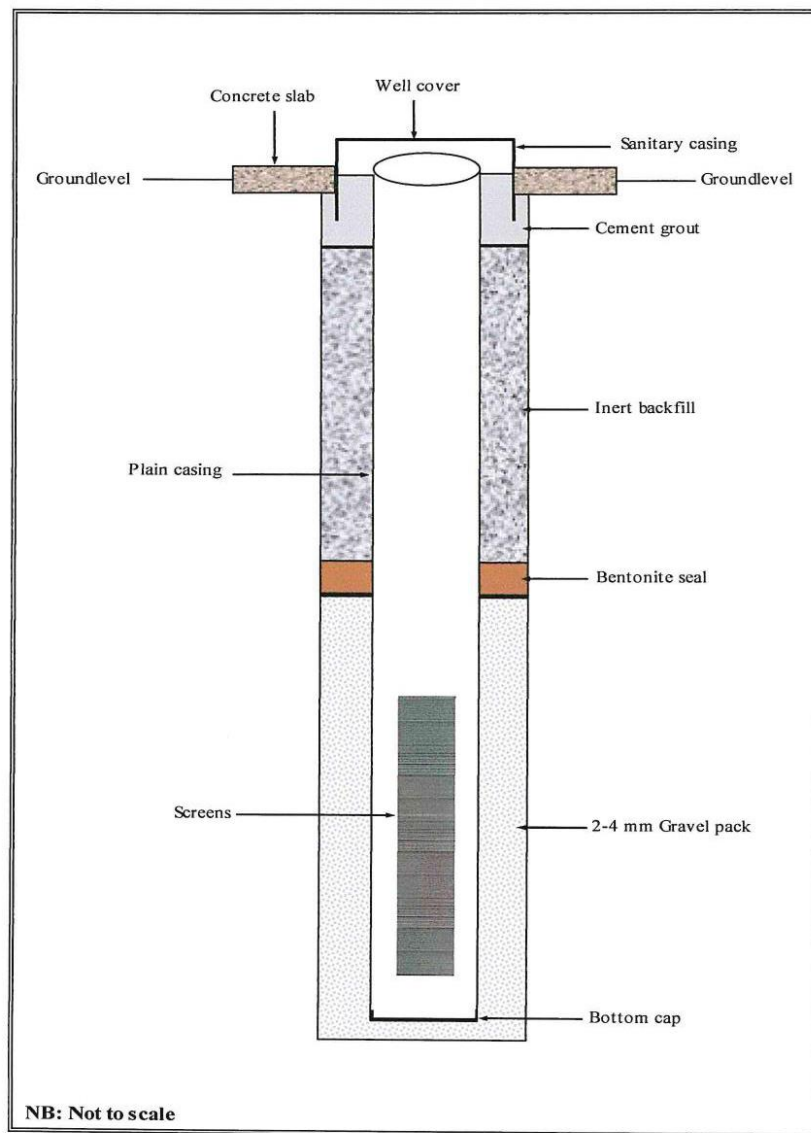
## Well Testing

After development and preliminary tests, a long-duration well test should be carried out. Well tests have to be carried out on all newly completed wells, because apart from giving an indication of the quality of drilling, design and development, it also yields information on aquifer parameters, which are vital to the hydrogeologist.

A well test consists of pumping a well from a measured start level (Water Rest Level - (WRL) at a known or measured yield, and simultaneously recording the discharge rate and the resulting drawdown as a function of time. Once a dynamic water level (DWL) is reached, the rate of inflow to the well equals the rate of pumping. Usually the rate of pumping is increased stepwise during the test each time equilibrium has been reached (Step Drawdown Test). Towards the end of the test a water sample of 2 liters should be collected for chemical analysis.

The duration of the test should be 24 hours, followed by a recovery test for a further 24 hours, or alternatively until the initial WRL has been reached (during which the rate of recovery to WRL is recorded). The results of the test will enable a hydrogeologist to calculate the optimum pumping rate, the pump installation depth, and the drawdown for a given discharge rate.





Schematic Design for Borehole Completion



## Appendix 2: Licensed Borehole Contractors

The list below (in alphabetical order) gives all licensed drilling contractors:

Name	License No.	Address	Tel/Mobile No.	Email Contact
A.I.C Pokot Outreach Ministries	400/182	134-30600, Kapenguria	-	-
Aaran Drilling Company Ltd.	1300	103789-00100, NRB	0722720887	aarandrillingcompany@gmail.com
Adsuma Drilling & Borehole Services	68	795-00902, Kikuyu	0722668280	adsumadrilling@yahoo.com
Afaha Water Ltd	30	14612-00800, NBI	0722781845	afahawaterltd@yahoo.com
African Boreholes Initiative Ltd	175	64360-00620, NRB	0724322539	info@africanboreholes.com
African Water Drilling Co. Ltd	249	46-00100, NRB	0723021095	-
Agape Fellowship Centre	1562	5181-00506, NRB	0722884460	afcmadara@gmail.com
Agro-Irrigation and Pump services	20	32111-00600, NBI	0726991991	agroirrigation@wananchi.com
Al-Awil Livestock Trading Ltd.	1429	168-00606, NRB	0704210894	al-awil@yahoo.com
Alliance Control Ltd.	304	137-00515, NRB	0710672136	-
Almak Aqua Drillers Ltd.	648	1639-90100, Machakos	0738040042	info@almakaquadrillers.com
Al-Miraj Enterprises	3	81670-80100, MSA	0722410551	-
Aqua Drilling and Civil Works Ltd	46	39146-00623 NBI	0723925607	info@aquadrillingcw.com
Artesian (K) Ltd	26	12619-00400 NBI	0723707571	wacchege_maji@yahoo.com
Balcony Construction Cop. Ltd.	786	10726-00100, NRB	0723131405	aminafarahjpn@gmail.com
Beneda Enterprises	726	72295-00200, NRB	0721972993	-
Berlin Equipment Ltd.	820	2522-40100, Kisumu	0722746999	hemal79@hotmail.co.uk
Bon Borehole Drillers	692	7009-20100, Nakuru	0722382139	info@boreholes.com
Booker Investment Group Ltd.	1102	59393-00200, NRB	0721209966	bookerinvestment@yahoo.com
Bridge Water Project	282	1698-50100, Kakamega	0729080638	bridgewaterproject@gmail.com
Casca Traders Ltd.	155	29-80100, Mombasa	0722260452	cascalimited@yahoo.com
Catholic Diocese of Nakuru	84	938-20100, Nakuru	0721807766	ednwaterquality@yahoo.com
Central Water Company Ltd.	676	38340-00623, NRB	0714617517	amesh@centralwater.co.ke
Charwins Ltd.	1519	2238-00100, NRB	0723440789	charwinltd@gmail.com
Chepunyo Building Contractors Ltd.	306	557-30600, Kapenguria	0712974650	loseMSAmuel@yahoo.com
China Jiangxi International (K) Ltd.	580	21802-00505, NRB	0714903646	kenya@cjic.cn
Clearspan Construction (A) Ltd.	32	83767-80100, MSA	0722706347	clearspan@swiftmombasa.com
Delta Contractors Ltd.	1040	172-70101, Hola	0721834497	bbolesa2009@yahoo.com
Desert Dew Enterprises Ltd.	537	100658-00100, NRB	90722822959	desertdew91@yahoo.com
Dockside Plumbers & General Contractors	94	3695-80100, Mombasa	0721891808	hashimgen@yahoo.com
Drilling & Prospecting International	64	30991-00100	0733624839	dpi@africaonline.co.ke
Drilling Spares and Services	42	40859-00100 NBI	0722881128	drilling@epsdriller.co.ke
E. A. Aquatech Drilling	96	75110-00200, NRB	0721445106	drillingea_aquatech@yahoo.com
Edge Borehole Drilling & P.S. Ltd.	872	15126-00100, NRB	0722707612	simonaquawell@yahoo.com
Eldodril Holdings Ltd.	918	5557-30100, Eldoret	0727406650	info@eldodril.com
Electrical & Carbon Products Marketing Ltd	188	3091-00100, NRB	0722777122	electricalcarbon@yahoo.com
Elza General Merchants	759	6180-00100, NRB	0722525639	elzageneral@gmail.com
Euro Water Services Ltd	120	44303-00100, NRB	0722202940	eurowaterservices@yahoo.com
Export-Hydro P & Services (A) Ltd.	611	712-00600, NRB	0729406869	info@export-hydro.com
Fountain Ventures Ltd	178	1550-20100, Nakuru	0721990237	maji_uhai@yahoo.com
Gaamey Construction Co. Ltd.	764	153-70200, Wajir	0721267045	-
Geofarthom Drilling Co. Ltd	117	4870-00506 NBI	0722522633	gitaujm@swiftkenya.com
Geoscience Product & Services Ltd.	58	1327-20117, Naivasha	0722893338	info@wottahaus.com
Gichocho Building Contractors Co. Ltd.	1449	25335-00100, NRB	0722516430	gichocho@yahoo.com
Giks Rewinders Ltd.	1066	699-00600, NRB	0722528409	gr.limited@yahoo.com
Ground W.A. in Kenya (GWAKO)	218	19521-40123, Kisumu	0721826904	gwakoministries@yahoo.com
Haikal Investments	7	344-50100, Kakamega	0727660344	haikal@yahoo.com
Hydrosolutions Ltd.	1647	28409-00200, NRB	0722272957	-
Ilovi Terrazzo & G. Contractors Ltd.	773	750-90400, Mwingi	0727341114	-
Impress Contractors & Supp Ltd.	853	884-20100, Nakuru	0721395513	-
Indepth Water Services and Management Ltd	33	74263-00200, NRB	0733801424	epsdriller@yahoo.com
Insta-Pumps Engineering Ltd	73	33248-00600 NBI	0722804250	insta-pumps@todaysonline.com
Jagla Agencies Ltd.	1422	512-00605, NRB	0721250432	jaglasharp@gmail.com
Jalenda Mining & Engineers Ltd.	754	457-00252, Kitengela	0722286928	jaleminers@yahoo.com
Jitahidi Constr & Civil Eng. Services	688	57919-00200, NRB	0733775397	-
Jordan Water Solutions & Tech Ltd.	1009	9535-40141, Kisumu	0711897583	info@jordanwatersolutions.com
Joyland Villa Systems Ltd.	1074	808-90300, Makueni	0715660494	-
Jumbo Interlinks Ltd.	1460	98488-80100, MSA	0722725544	info@jumbointerlinks.com
Kajiado Arid Lands Development Org Ltd	45	8-01100, Kajiado	0735869871	mrtc@africaonline.co.ke
Karlssons & Finne Ltd.	286	73413-00200, NRB	0722792658	karlssonsfinne@yahoo.com
Kasyala Investments Ltd.	1512	11109-00100, NRB	0721897097	-
Kawa Engineering Workshop	1114	3930, Thika	0722385610	kawa.eng@gmail.com
Kenfam Hydromech Maintenance	486	1945-80100, Mombasa	0720272881	hydromech.kefam@yahoo.com



# ESIA Study for the Proposed World Trade Centre Hospital

## Hydrogeological and Geophysical Investigations

## Nairobi Business Park (Site II) –Ngong Road

Name	License No.	Address	Tel/Mobile No.	Email Contact
Kenya Water Institute	74	60013-00200, NBI	020-607425	-
Kiburu Enterprises Ltd.	267	84894-80100, MSA	0702827607	mmm@plussipping.com
Kisima Drilling (E.A) Ltd	52	4141-00100 NBI	0723456935	kisimadrilling@hotmail.com
Kisima Electro-Mechanicals Ltd.	861	4141-00100, NRB	0701017470	info@kisima.com
Les Amis Construction Co. Ltd	1709	10844-00100, NRB	0733243111	engineering@kesamis.co.ke
Living Water International	27	50839-00200, NRB	0721728874	info@lwkenya.or.ke
Luta Enterprises	53	40831-80100, MSA	0721796738	n-amdo@yahoo.com
Masai Stores Ltd.	56	14-01100, Kajiado	0722224225	masaistore@hotmail.com
Masilk Services Ltd.	1199	624-00300, NRB	0722399992	masilkservices@gmail.com
Maven Ltd.	1433	3518-00200, NRB	0721907701	-
Mbaruk Holdings (K) Ltd.	658	43388-00100, NRB	0722708727	martincheg@gmail.com
Merena Basin Services	630	304-50509, Nambale	0728010896	-
MI Design Build Eng. Works Ltd	583	9588-00100, NRB	0722510157	-
Movers Construction & Services Ltd	830	57298-00200, NRB	0722724810	moversconstructionltd@gmail.com
Naivasha Water Drilling Company	77	868-20117, Naivasha	0722755138	kimukora@yahoo.com
Ndeiya Construction Ltd	1518	51735-00200, NRB	0722725195	ndeiya@gmail.com
NGM Company Ltd.	1027	68144-00200, NRB	02798000	mail@mastermindkenya.co.ke
Njaka-Njega (East Africa) Ltd	1170	42426-80100, MSA	0724901846	njakanjega@yahoo.com
Nurseif Ltd	211	88073-80100, MSA	0734410409	-
Nyana Engineering Co. Ltd	300	60957-00200, NRB	0727200505	info@nyanaengineering.com
P.L.L. Pump and Power	280	9757-20112, Lanet	0722344460	pilwan35@yahoo.com
Pass Africa Ltd	24	38937-00623, NRB	0722708222	passajay@wananchi.com
Pat-Africa Drilling Ltd	150	59533-00200 NBI	02738200	africa@pat-drill.com
Physpi Water Services Ltd	198	2219-50100, Kakamega	0714382441	johnodongo@yahoo.com
Platinum Afrique Enterprises Ltd	527	18150-20100, Nakuru	0722832402	afriquep@yahoo.com
Premier Water Solutions Ltd.	182	38560-00623, NRB	0710970243	waiganjo@premierwater.co.ke
Qara Agencies Ltd	605	26501-00100, NRB	0722200997	-
Renrose Traders	843	66352-00800, NRB	0722760551	renrosetraders@gmail.com
Ring Technical Services Ltd	265	62155-00200 NBI	0733726533	teckring@yahoo.com
Samakard Ltd	800	10726-00100, NRB	0723131405	aminafarahjpn@gmail.com
Sarman Engineering Co. Ltd	61	3871-40200, Kisii	0733554357	mohamaduali@yahoo.com
Seven Seas Building & Rd Const	233	303-80300, Voi	0722684152	sevenseasbuilding.construction
Sinohydro Tianjin Eng. Co. Ltd	1514	24446-00100, NRB	0786546587	eastafrika@tianjin.sinhydro.com
Smart Systems Consultants	90	601-80108, Kilifi	0726125836	smartsystemco@gmail.com
Solar World (E.A) Ltd	875	78516-00507, NRB	0203599699	solar@wananchi.com
Sparr Drilling co. Ltd	65	40590 NBI	0722517433	info@sparr.co.ke
Star 'N' Investments Ltd	1704	7467-00100, NRB	0722761248	-
Tamani Drilling Services	1190	116-80503, Mpeketoni	0710100047	wimenya@gmail.com
Team & Team International, Kenya	43	25225-00603, NRB	0725456908	teamandteamke@gmail.com
Tolando Agencies Ltd	1443	2474-50100, Kakamega	0707860648	tolando4@gmail.com
Trail western Drilling Co. Ltd	603	78254-00507, NRB	0722895231	trailwestern@gmail.com
Turkana Salama Enterprises Ltd	1389	583-30500, Lodwar	0726560666	yussufsalama@yahoo.co.uk
Turn-O-Metal Engineers Ltd	18	74074-00200, NRB	0734512236	-
Urban Tone Corporation	37	38356-00623, NRB	0715690863	yashimuro@urbantone.co.jp
Uzima Drilling Services Ltd	1488	9133-30100, Eldoret	0724896256	davidyego@gmail.com
Vajra Drill Ltd	136	18883-00500 NBI	0725283762	vajradrill@gmail.com
Vineyard Holdings Ltd	714	12760-00100, NRB	0722703585	drinyamu@yahoo.com
Wachu Construction Co. Ltd	186	11061-00400, NRB	0726635313	-
Water Lord Ltd	170	1280-0100, Thika	0729222266	-
Water Resources Inter Co. Ltd	1621	1766-00606, NRB	0722798000	info@waterresourcesint.com
Waterlogic Engineering Ltd	1595	28507-00200, NRB	0723598124	waterlogic.eng@gmail.com
Waterloo Agencies Ltd	845	15877-00100, NRB	0722506386	-
Waterman Drilling Africa Ltd	55	344-00242, Kitengela	0722860960	pmtiyagi2002@yahoo.com
Welbrah Constructions Ltd	252	817-40300, Homabay	0724797962	welbrah@yahoo.com
West Engineering Ltd	350	20197-00200, NRB	0722514638	cmurila@gmail.com
Wotech Kenya Ltd	311	14837-00800, NRB	0722206309	dhaval@wotechkenya.com
Wotta Haus Ltd	41	57516-00200, NRB	0733877482	-



### Appendix 3: Fluoride in Groundwater

#### Fluoride in Groundwater

(Source: Endemic Fluorosis in Developing Countries, 1991, J.E. Frenken, editor, TNO Institute for Preventive Health Care, The Netherlands)

#### Introduction

Fluoride is an essential constituent of the human body where it concentrates mainly in bones and teeth. A deficiency as well as an excess of fluorine may have negative effects on someone's health. Excessive intake of fluorine may lead to Fluorosis, a disease associated with dental and skeletal deterioration.

Especially for drinking water purposes these high concentrations form a limitation. In this appendix the aspects of fluoride in groundwater e.g., the source of fluoride, the health hazard of high fluoride concentrations and fluoride removal methods, will be discussed briefly.

#### Sources of Fluoride

Fluoride (F<sup>-</sup>) is an ion of the chemical element fluorine (F). The elemental form does not occur in nature due to the electro-negativity and high chemical reactivity. The geochemical behavior of fluoride is similar to that of the hydroxyl ion (OH<sup>-</sup>).

Fluorine bearing minerals are found in igneous, sedimentary and metamorphic rock. Especially in contact metamorphic rocks high concentrations are found. The main fluorine bearing minerals are listed in the Table below.

**Table Fluorine bearing minerals**

Group	Examples
Silicates	Amphiboles, Micas
Halides	Fluorite, Villiaumite
Phosphates	Apatite
Others	Aragonite

The most important mineral containing fluorine is fluorite (CaF<sub>2</sub>). Furthermore volcanic gases may contain fluorine; examples are HF, SiF<sub>4</sub> and H<sub>2</sub>SiF<sub>6</sub>.

Other sources of fluorine are related to pollution caused by agricultural and industrial activity (use of phosphatic fertilizers, processing of phosphatic raw materials).

Furthermore fluoride concentrations in water are determined by weathering processes (CO<sub>2</sub> pressure, hydrothermal activity), evaporation and calcium concentration. At low calcium concentrations (in environments with high alkalinity and when calcite limits calcium concentrations) fluoride cannot be equilibrated by fluorite solubility and can reach very high concentrations.

In volcanic areas without hydrothermal activity the fluoride concentrations are mainly determined by the weathering of amphiboles or volcanic glass. Both are important



constituents of phonolites. Volcanic tuffs on an average have a higher content of soluble volcanic glass than phonolites.

### Health hazard of fluoride

The prevalence and severity of dental and skeletal fluorosis is depending on many factors but the most important risk indicator will be fluoridated drinking water. Results of several investigations show that especially children are susceptible to fluorosis if they depend on (drinking) water with high fluoride concentrations. The results indicate that mild dental fluorosis can occur when concentrations of 0.4 ppm are considered. More serious problems occur at fluoride concentrations of 2.1 ppm (100 % prevalence of dental fluorosis in age group 10 - 15 years) and 3.6 ppm (skeletal changes in 11 - 15 years old). Above 10 ppm skeletal deformities may occur in children.

The World Health Organization uses the guideline limit of 1.5-ppm fluoride. This limit is based on the assumption that people consume only 2 liters of water per day. This assumption seems to be rather low since people, especially in countries with hot climates, consume more than 2 liters per day. The recommended WHO concentration limits together with the possible effects are listed in the Table below.

**Table Fluoride contents in drinking water and possible effects (WHO)**

Concentration Fluoride ppm	Possible effects
0.5 - 1.5	Fluoride in water has no adverse effects, incidence of caries decreases
> 1.5	Mottling of teeth may occur to an objectionable degree e.g. dental fluorosis
3.0 - 6.0	Association with skeletal fluorosis
> 10.0	Crippling skeletal fluorosis

Results of investigations in tropical areas suggest a maximum recommended level of 0.6 ppm more appropriate for tropical regions. Above this value mottling of teeth may occur.

Some countries however use higher permissible or maximum recommended levels, simply because of the absence of water with lower concentrations. The maximum permissible level in Tanzania is 8 ppm, while the Kenyan maximum permissible level is set at 1.5 ppm.

### Removal of fluoride from groundwater.

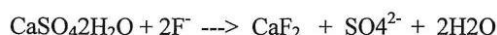
Especially during the last decade several methods have been developed to remove or reduce the fluoride concentration in drinking water. However most of the methods are rather complicated and expensive and are still in the laboratory or experimental stage. The methods are mainly based on:

- Precipitation (use of lime, alum, sulphate, gypsum, etc)
- Adsorption / ion exchange (use of bones, charcoal, clays, etc)
- Osmosis
- Electrochemically stimulated coagulation
- Electro dialysis

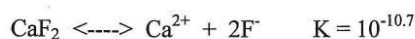


Although the methods are still in the laboratory phase, the application potential for the bone char, gypsum / fluorite and clay method are rather good. These methods are simple and the raw materials are often available at the site. The methods can be applied at household and community level.

The *gypsum / fluorite* method can reduce the fluoride concentrations to 4 ppm only. More advanced steps are necessary to reduce the concentrations below 1.5 ppm. The basic principle of the method is the dissolution of gypsum in drinking water with high fluoride concentrations. Fluoride concentrations will be reduced due to the precipitation of fluorite according the following reaction:



Fluorite will precipitate as soon as the water is saturated with fluorite. The equilibrium constant for fluorite:



The water is saturated as soon as :

$$\text{SI} = \log ([\text{Ca}] * [\text{F}]^2 / K) \geq 1$$

*Bone media* have been used successfully to remove fluoride. Reductions of the fluoride concentration to less than 1.0 mg/lit are reported.

The principle of the method is based on the fact that the bone media is reacting with fluoride in a similar way as bones and teeth of the human body. The fluoride is immobilized in the filter medium through the process of ion exchange.

The equipment used in laboratory and field tests is rather simple. The defluoridator unit consists of a container and a filter. The filter has a bottom layer of 300 gr crushed charcoal for adsorption of color and odor. The middle layer consists of 1000 gr bone media. At the top 200 gr of pebbles are used to prevent the middle layer of floating. The bone media can be either granulated bone media or bone char. In both cases the material has to be pretreated carefully to optimize the results. For the granulated bone media, the bones selected have to be clean, non-porous and crushed into chippings of 1 to 2 mm. For the bone char the bones have to be activated by heating to a temperature of 600°C. For both methods it is advised to treat the bone media with sodium hydroxide before it is used.

The time over which the filtering material remains active depends on the amount of water, which has been treated, and the initial fluoride content. In experiments in Argentina (contact time necessary to allow fluoride to chemically combine with granulated bone media amounted to 0.5 hours) the filter had to be replaced every 3 months at a production of 20 l/day and an initial concentration of 10 ppm.

Different *types of clay* have been used in laboratories to reduce the fluoride contents. Kaolinite, serpentinite, china clay and clay pot are used as natural adsorbents. Reductions from 10 ppm to 1.5 ppm and lower are reported.

For this methods pH, temperature and/or salt content should be maintained at a level predetermined through laboratory experiments.



## Conclusions and recommendations

High fluoride concentrations in drinking water may cause dental and / or skeletal fluorosis. The maximum recommended levels differ per country; the recommended WHO limit is 1.5 ppm. In fact the maximum advisable level depends on factors such as diet, climate and age. Nevertheless it can be concluded that especially children are susceptible to fluorosis. Therefore it is recommended not to use borehole water with fluoride concentrations exceeding 0.5 ppm as drinking water for children. The recommended maximum level for adults is 1.0 ppm. These levels only have to be considered when the borehole water is used as a permanent source for drinking water.

The equipment for the removal of fluoride from drinking water is not yet available for domestic purposes but future prospect are good.



# ESIA Study for the Proposed World Trade Centre Hospital

Hydrogeological and Geophysical Investigations

Nairobi Business Park (Site II) –Ngong Road

## Appendix 4: Borehole in the Vicinity of the Investigated Area

BH No.	OWNER	37 M	X	Y	TD	WSL 1	WS L 2	WRL (m)	Yie ld	Pwl
4013	N.C.C.		246080	9860000	191			66.15	10. 27	-
18040	Childrens Garden & School		245100	9859800	280	53,185		126	8	206.4
3257	E.W, Mathu		244250	9858700	122.5	115.8		7.8	2.7 2	-
12786	Esenco		245120	9859000	182	12,160		6	6	90
12822	Dept of Metrology		250500	9856425	304	102	150	151.9	9	181.5
11018	Sterling Craft		248600	9856075	280	32	104	94	7.2	
13267	Jockey Club of Kenya		250800	9855500					4	
11323	Wanjiru Kigundu		248750	9856380	200	24	96	11	4	
5357	Wehu Kenyatta		248250	9856250	100	4		10	2.4	
12809	Kenya Power		250500	9856800	304	96	234	145.2	6	
14383	John Gichome		250700	9857000	289	214,23 8		169.8	18	212
14124	The Junction LTD		250950	9856800	325	276,30 4		162.3	8	194
18432	CHRISTOPHER M MARLTA		250480	9856500	329	150,29 4		149.0 4	15	240.3 7
11493	OTIENO ONDINGI		251140	9856820	246	156,19 2,231		137	4.8	192
4926	KENYA SCIENCE		251100	985625	204	132,14 9		111.3 9	4	155.0 4
C-12874	silver Springs Hotel		248150	9857200	290	192, 258		176	6	
C-13844	nairobi Baptist Church		247800	9856800	320	88, 198		175	10	
C-13434	St. Nicholas Sch.		247600	9856600	286	172, 230		170	11. 5	
C-12470	Jambo Holdings		247600	9857600	251	83, 215		140.9	0.3	
C-12245	Mimosa Holdings		247050	9856050						
C-14175	Khorda Investment		248650	9856650	300	240, 272		182.8	10	
C-9762	Nairobi Hospital		248600	9856600	246	193, 231		164.7	3	
C-11887	Medical Centre		248650	9857350						
C-15318	Russian Embassy		248300	9857700	265	200, 238		172.5 6	10. 2	
	ceytun		253352	9858311	-	-		-	-	
	Total Filling Station,Hurlingam		254819	9857205						
	Marianist Brothers		250371	9856598						
	Wood Avenue,Kilimani		253637	9857236						
	Royal Golfs Club		254200	9855500						
	Peony Estate BH.		250135	9857457	305	180		163	1.0 8	
	Jesuit fathers		252013	9856100	300	12, 228		168	4.8	

Earth Water Ltd

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# ESIA Study for the Proposed World Trade Centre Hospital

Hydrogeological and Geophysical Investigations				Nairobi Business Park (Site II) –Ngong Road						
	Hekima college	251870	9856510	300	96, 260		167	10		
	Otieno Odongo	251200	9856480	246	21, 96, 156,	192, 231	137	4.8		
	WaiganjoInv	252013	9856360	230	86, 128		119.8	2		
	The Junction Ltd	250570	9856670	325	276, 304		162	8		
	Swedish School	250230	9856670	79	15, 20		10.75	2.3		
	KSTC	250500	9856300	204	132, 149		111.3 9	4		
B/1523	JMD Enterprises	250244	9857443	260	233		148	10. 9		
C-17242	Kabiro Water Project	249794	9858018	280	236,28 0		146.6 3	16		
	Gimco Ltd	250227	9857122							
	Fredrick M Gichuki	249733	9857341							
	Braeburn School	250269	9857875							
	Riara Group of Schools	250269	9856958							
	Martin KamauKungu	249684	9857729							
	Riara Meadows	250321	9856922							
	Casalaizer	250458	9857865							
	Vincentian Cogregation Registered Trustees	250741	9857707							
C-952		254980	9856990	243	144	165	108	2.7		
C-4609		253250	9856000	300	68, 153, 195	14.4	5.46			
C-9764		253980	9856360	181	136	179	86	6.6		
C-10438		254280	9858510	210	140	188	106	8.4		
C-10755		254460	9857180	230	10, 50, 148	142	2.04			
C-11249		254750	9855250	250	16	160	71.5	5.4		
C-11513		255490	9856510 0	262	83	208	169	7.2		
C-11591		256170	9856360	-	-	-	-	-		
C-11592		253996	9856700	250	50, 192, 248	143. 5	4.6			
C-1532	Jockey Club of Kenya	248400	9855600	152	54	137	111.6	7.2		
C-5204		247300	9856400	118	30	84	43.9	3.6		
C-2919	Royal National Parks	248600	9855430	153	106	143	86.9	4.5		
C-2373		250150	9855650	269	250		21.3	6.8		
C-2032	NCC	250400	9856250	274	232		89.6	5.2		



Appendix 5: Test pumping data Analysis for Borehole in the Vicinity of the Investigated Area

i) Dagoretti Pumping test Data and Graphs

a. Step Drawdown Test Data

Step Drawdown No. 1				Step Drawdown No. 2			Step Drawdown No. 3			Step Drawdown No. 4		
Time (min)	W.L (m)	D.D (m)	Yield (m <sup>3</sup> /hr)	W.L (m)	D.D (m)	Yield (m <sup>3</sup> /hr)	W.L (m)	D.D (m)	Yield (m <sup>3</sup> /hr)	W.L (m)	D.D (m)	Yield (m <sup>3</sup> /hr)
0	152.12	0	5	154.19	0	10	154.95	0	15	155.18	0	19
1	154.4	2.28	5	154.43	0.24	10	155.06	0.11	15	155.3	0.12	19
2	154.5	2.38	5	154.45	0.26	10	155.08	0.13	15	155.31	0.13	19
3	154.29	2.17	5	154.46	0.27	10	155.09	0.14	15	155.32	0.14	19
4	154.29	2.17	5	154.47	0.28	10	155.11	0.16	15	155.3	0.12	19
5	154.29	2.17	5	154.48	0.29	10	155.13	0.18	15	155.31	0.13	19
6	154.29	2.17	5	154.49	0.3	10	155.15	0.2	15	155.31	0.13	19
7	154.29	2.17	5	154.5	0.31	10	155.18	0.23	15	155.31	0.13	19
8	154.21	2.09	5	154.51	0.32	10	155.19	0.24	15	155.31	0.13	19
9	154.21	2.09	5	154.55	0.36	10	154.2	0.25	15	155.31	0.13	19
10	154.2	2.08	5	154.56	0.37	10	150.2	0.25	15	155.31	0.13	19
11	154.19	2.07	5	154.55	0.36	10	155.21	0.26	15	155.31	0.13	19
12	154.17	2.05	5	154.56	0.37	10	155.21	0.26	15	155.31	0.13	19
13	154.17	2.05	5	154.57	0.38	10	155.23	0.28	15	155.31	0.13	19
14	154.17	2.05	5	154.58	0.39	10	155.25	0.3	15	155.31	0.13	19
15	154.19	2.07	5	154.59	0.4	10	155.25	0.3	15	155.31	0.13	19
16	154.2	2.08	5	154.6	0.41	10	155.26	0.31	15	155.31	0.13	19
17	154.21	2.09	5	154.61	0.42	10	155.25	0.3	15	155.32	0.14	19
18	154.22	2.1	5	154.62	0.43	10	155.25	0.3	15	155.33	0.15	19
19	154.23	2.11	5	154.63	0.44	10	155.25	0.3	15	155.34	0.16	19
20	154.24	2.12	5	154.64	0.45	10	155.24	0.29	15	155.34	0.16	19
22	154.26	2.14	5	154.66	0.46	10	155.23	0.28	15	155.34	0.16	19
24	154.28	2.16	5	154.68	0.48	10	155.22	0.26	15	155.35	0.17	19
26	154.28	2.16	5	154.7	0.5	10	155.2	0.25	15	155.36	0.18	19
28	154.28	2.16	5	154.72	0.52	10	155.2	0.25	15	155.37	0.19	19
30	154.24	2.13	5	154.74	0.54	10	155.2	0.25	15	155.42	0.24	19
32	154.24	2.13	5	154.77	0.57	10	155.2	0.25	15	155.42	0.24	19
34	154.24	2.12	5	154.77	0.57	10	155.2	0.25	15	155.44	0.26	19
36	154.22	2.1	5	154.79	0.59	10	155.19	0.24	15	155.46	0.28	19
38	154.21	2.09	5	154.8	0.6	10	155.18	0.23	15	155.49	0.31	19
40	154.2	2.08	5	154.82	0.62	10	155.19	0.24	15	155.56	0.38	19
42	154.19	2.07	5	154.94	0.64	10	155.19	0.24	15	155.58	0.4	19
44	154.18	2.06	5	154.96	0.66	10	155.19	0.24	15	155.6	0.42	19
46	154.2	2.08	5	155.32	1.13	10	155.18	0.23	15	155.61	0.43	19
48	154.17	2.05	5	155.52	1.33	10	155.18	0.23	15	155.63	0.45	19
50	154.16	2.04	5	155.52	1.33	10	155.18	0.23	15	155.66	0.48	19
55	154.15	2.03	5	154.94	0.75	10	155.18	0.23	15	155.71	0.53	19
60	154.19	2.07	5	154.95	0.76	10	155.18	0.23	15	155.74	0.56	19



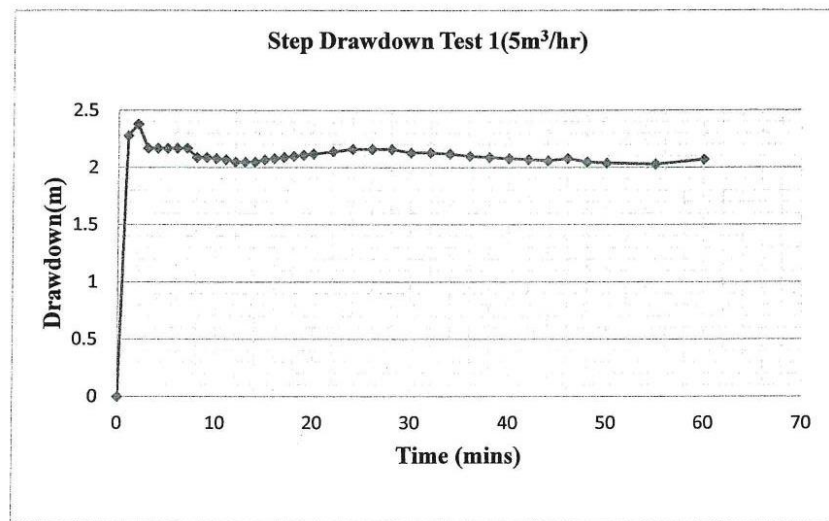


Figure 1: Step Draw down Test Graph at 5m³/hr

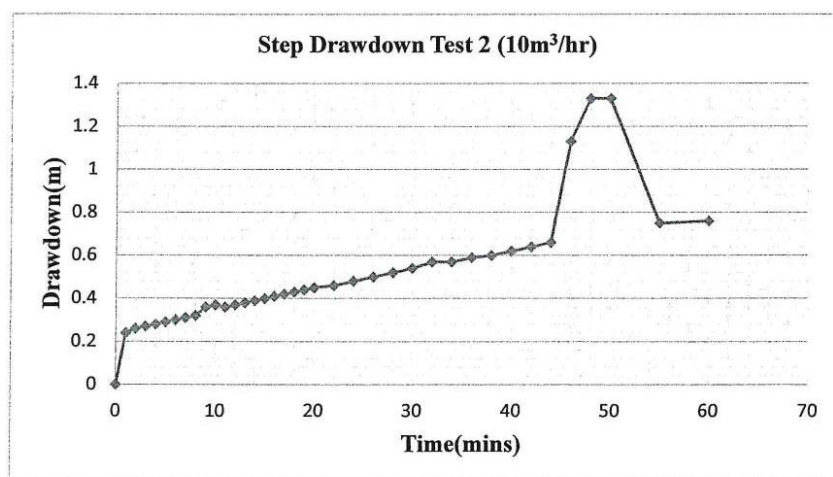
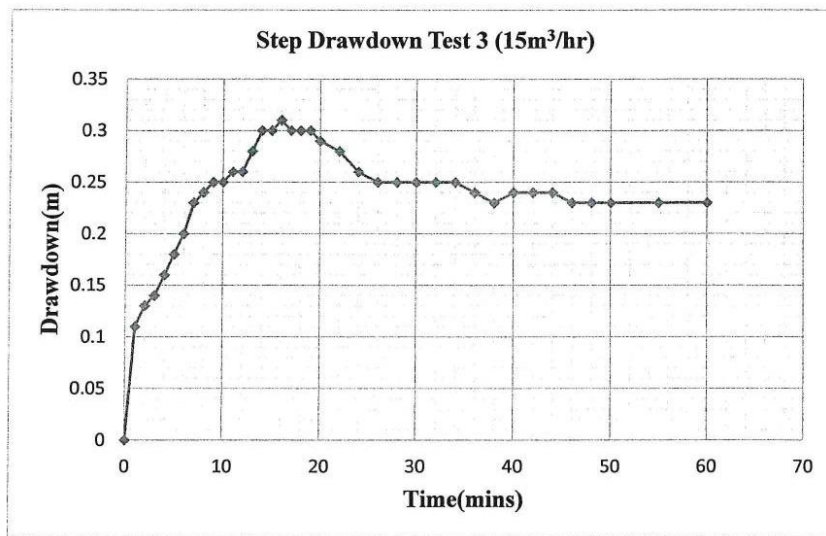


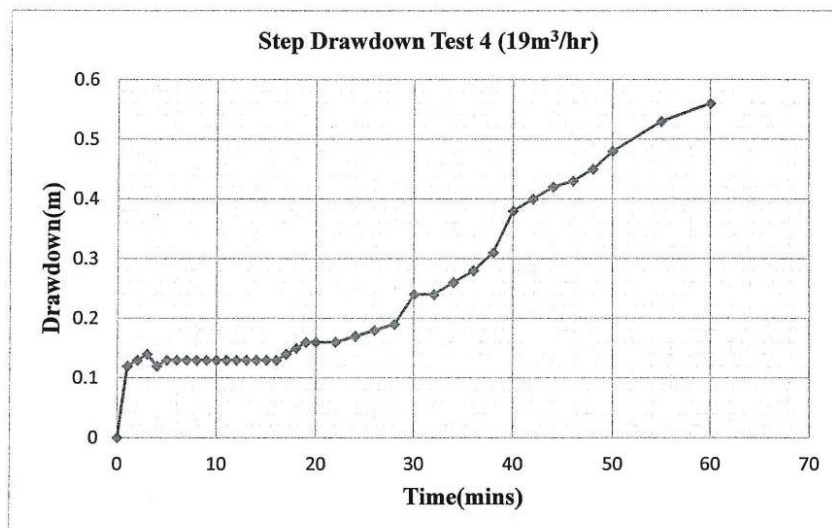
Figure 2: Step Draw down Test Graph at 10m³/hr

The anomalous readings in the above curve from 45mins to 55mins could be brought by the dipper failure.





Step Draw down Test Graph at 15m<sup>3</sup>/hr



Step Draw down Test Graph at 19m<sup>3</sup>/hr

**Constant Discharge data**

GEOFFEREY WANDETO MWANGI - BOREHOLE CONSTANT DRAWDOWN TEST	
Date: 20 <sup>th</sup> Dec 2017	Testing SPARR DRILLING CO. LTD
Location: Riruta-Dagoretti	Driller: SPARR DRILLING CO. LTD
BH Depth: 245m	Pump Level: 198m
SWL: 152.84	PWL: 152.95m



# ESIA Study for the Proposed World Trade Centre Hospital

Hydrogeological and Geophysical Investigations

Nairobi Business Park (Site II) –Ngong Road

Power Source: Generator			Discharge: 18m <sup>3</sup> /hr		
Type of pump: SP17-20					
Time	Elapsed Time(mins)	Water Level(m bdl)	Draw down (m)	Yield (m3/day)	Remarks
9.40Pm	0	152.84	0	18 m <sup>3</sup> /hr	Clear water Gate valve fully opened
	1	152.88	0.04		
	2	152.9	0.06		
	3	152.93	0.09		
	4	152.95	0.11		
	5	152.98	0.14		
	6	153.01	0.17		
	7	153.03	0.19		
	8	153.05	0.21		
	9	153.07	0.23		
	10	153.10	0.26		
	12	153.13	0.29		
	14	153.17	0.33		
	16	153.19	0.35		
	18	153.21	0.37		
	20	153.23	0.39		
	25	153.26	0.42		
	30	153.29	0.45		
	35	153.33	0.49		
	40	153.40	0.56		
	45	153.45	0.61		
	50	153.50	0.66		
	55	153.55	0.71		
10.40	60	153.64	0.8		
	75	153.80	0.96		
	90	153.92	1.08		
	105	153.98	1.14		
11.40	120	154.08	1.24		
	150	154.14	1.3		
00.40	180	154.23	1.39		
	210	154.27	1.43		
1.40	240	154.51	1.67		
2.40	300	154.66	1.82		
3.40	360	155.14	2.3		
4.40	420	155.39	2.55		
5.40	480	155.46	2.62		
6.40	540	155.63	2.79		
7.40	600	155.90	3.06		
8.40	660	156.12	3.28		
9.40	720	156.24	3.4		
10.40	780	156.76	3.92		

Earth Water Ltd

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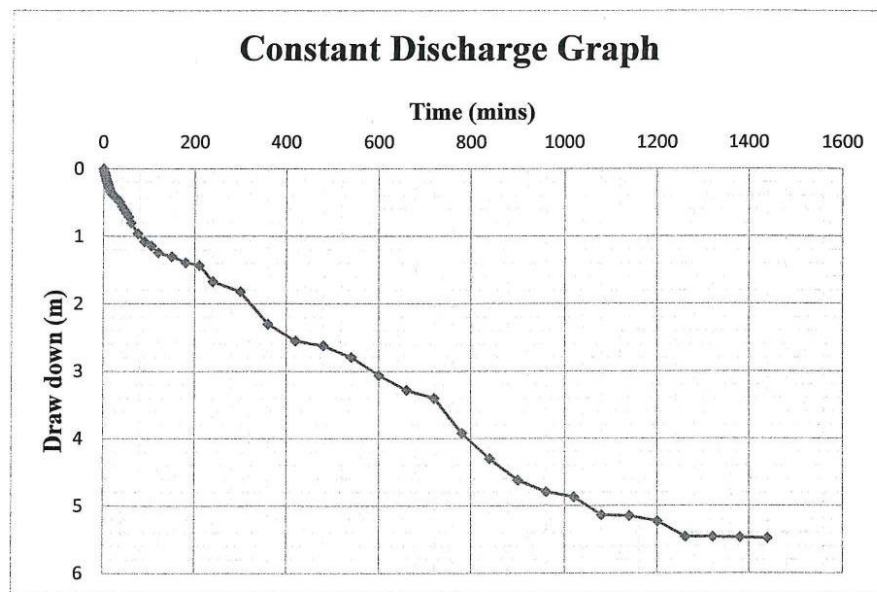


## ESIA Study for the Proposed World Trade Centre Hospital

### Hydrogeological and Geophysical Investigations

### Nairobi Business Park (Site II) –Ngong Road

11.40	840	157.14	4.3		
12.40	900	157.46	4.62		
1.40	960	157.63	4.79		
2.40	1020	157.71	4.87		
3.40	1080	157.92	5.14		
4.40	1140	157.93	5.15		
5.40	1200	158.07	5.23		
6.40	1260	158.30	5.46		
7.40	1320	158.30	5.46		
8.40	1380	158.31	5.47		
9.40 Pm	1440	158.32	5.48		



### b. Borehole Recovery Test Data

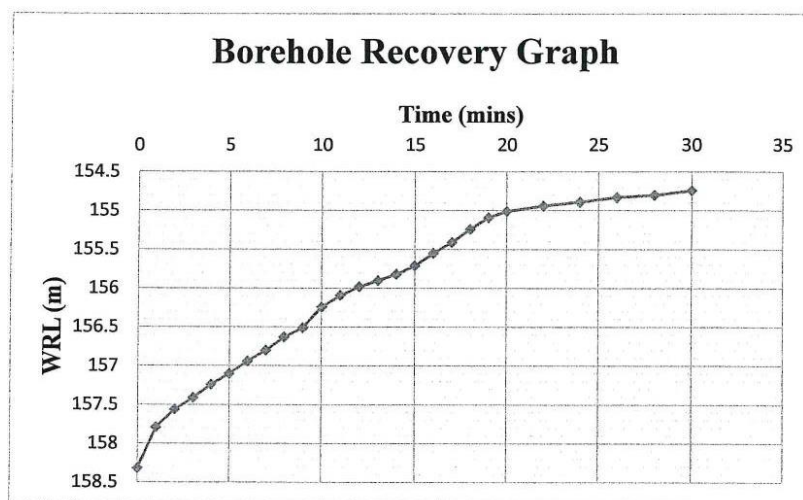
GEOFFEREY WANDETO MWANGI – RECOVERY TEST					
Date: 20 <sup>th</sup> Dec 2017			Testing Contractor: SPARR DRILLING CO. LTD		
Location: Riruta-Dagoretti			Driller: SPARR DRILLING CO. LTD		
BH Depth: 245m			Pump Level: 198m		
SWL: 152.84			PWL: 152.95m		
Power Source: Generator			Discharge: 18m <sup>3</sup> /hr		
Type of pump: SP17-20					
Time	Elapsed Time	Water Level(bdl)	Residual Drawdown (m)	Recovery %	Remarks
9.40Pm	0	158.32	0	0	
	1	157.79	0.53	9.67	
	2	157.56	0.76	13.87	
	3	157.41	0.91	16.61	
	4	157.24	1.08	19.71	



Hydrogeological and Geophysical Investigations

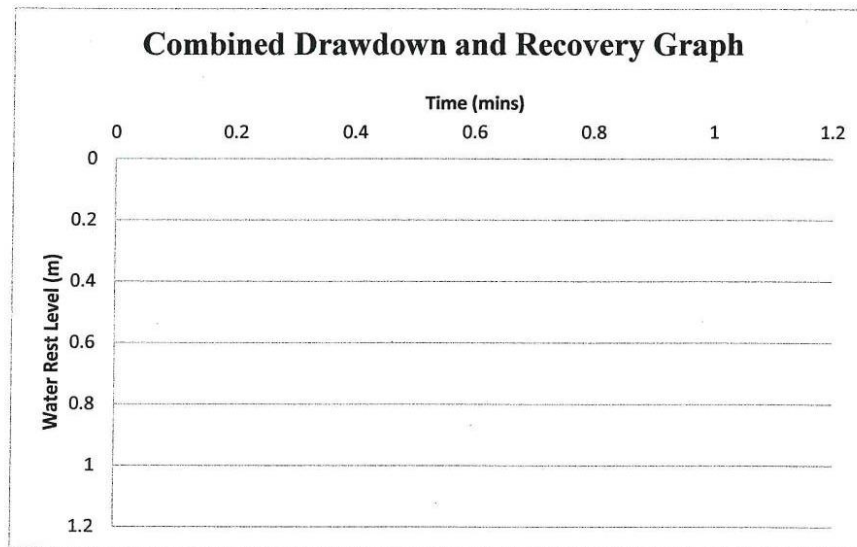
Nairobi Business Park (Site II) –Ngong Road

	5	157.1	1.22	22.26
	6	156.94	1.38	25.18
	7	156.8	1.46	26.62
	8	156.63	1.69	30.84
	9	156.51	1.81	33.03
	10	156.24	2.08	37.96
	11	156.09	2.23	40.69
	12	155.98	2.34	42.7
	13	155.9	2.42	44.16
	14	155.82	2.5	45.62
	15	155.71	2.61	47.63
	16	155.55	2.77	50.05
	17	155.41	2.91	53.1
	18	155.24	3.08	56.2
	19	155.09	3.23	58.94
	20	155.01	3.31	60.4
	22	154.94	3.38	61.68
	24	154.89	3.43	62.59
	26	154.83	3.49	63.69
	28	154.8	3.52	64.23
10.10 Pm	30	154.74	3.58	65.32





**Combined Constant Discharge and Recovery**



**ii) Rugby Football Union of East Africa Grounds:**

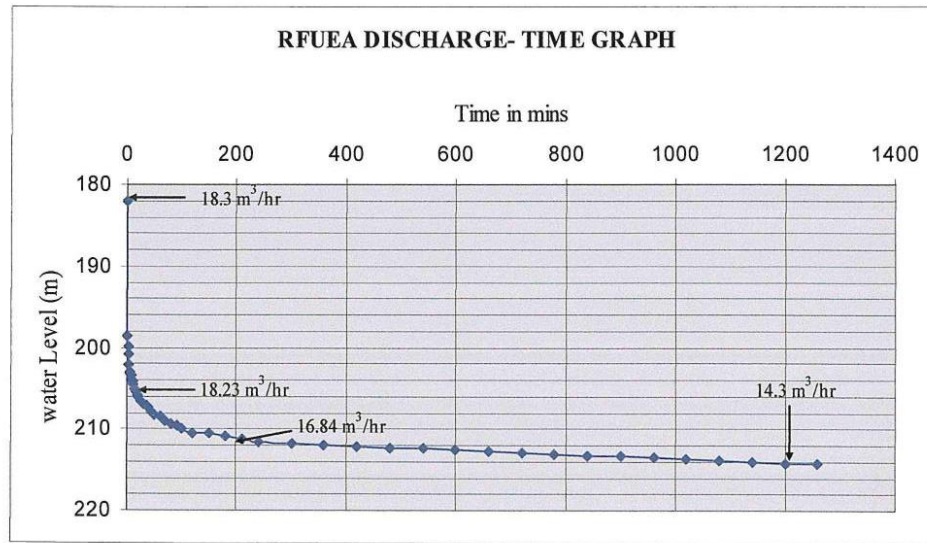
RUGBY FOOTBAL UNION OF EAST AFRICA (RFUEA)						
DISCHARGE TEST:SHEET				Type of pump: Grundfos SP 30-26		
PROJECT				Total Depth of Well: 330m		
Well No:				Static Water Level: 182 m		
Location: RFUEA ALONG NGONG ROAD				Pump intake: 220 m		
Date of Test: 12-13/11/2009				Dynamic Water Level: 214.21m		
Well Type: DRILLED						
Time	Elapsed Time(min)	Water Level (m bgl)	Draw down	Yield	EC (uS/cm)	Remarks
	0	182	0	18.3		
	1	198.58	16.58			
	2	199.9	17.9			
	3	200.92	18.92			
	4	202.23	20.23			
	5	203.09	21.09			
	6	203.31	21.31			
	7	203.52	21.52	18.23		
	8	204.01	22.01			
	9	204.1	22.1			
	10	204.27	22.27			
	12	204.61	22.61			
	14	205.2	23.2			
	16	205.51	23.51			
	18	205.94	23.94			



# ESIA Study for the Proposed World Trade Centre Hospital

Hydrogeological and Geophysical Investigations				Nairobi Business Park (Site II) –Ngong Road		
	20	206.13	24.13	18.08		
	25	206.62	24.62			
	30	206.97	24.97			
	35	207.14	25.14			
	40	207.4	25.4			
	45	207.84	25.84			
	50	208.23	26.23			
	60	208.5	26.5			
	70	208.96	26.96			
	80	209.32	27.32	18.02		
	90	209.61	27.61			
	100	209.93	27.93			
	120	210.45	28.45			
	150	210.6	28.6	16.84		
	180	210.83	28.83			
	210	211.32	29.32			
	240	211.62	29.62			
	300	211.83	29.83			
	360	211.94	29.94			
	420	212.17	30.17			
	480	212.29	30.29			
	540	212.44	30.44			
	600	212.61	30.61			
	660	212.82	30.82			
	720	212.97	30.97			
	780	213.13	31.13			
	840	213.26	31.26			
	900	213.39	31.39			
	960	213.55	31.55			
	1020	213.67	31.67			
	1080	213.85	31.85			
	1200	213.97	31.97	14.3		
	1320	214.14	32.14			
	1440	214.21	32.21			





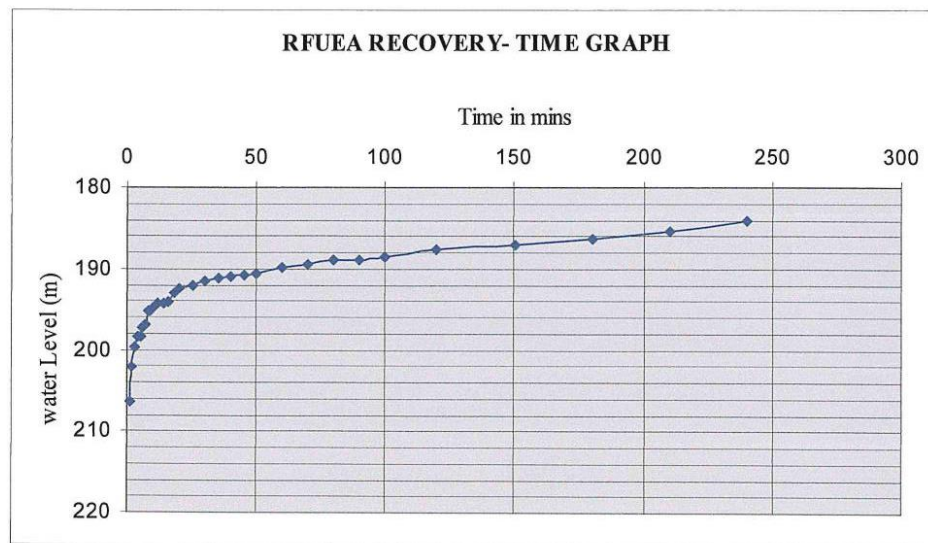
RFUEA Test Pumping Graph

RECOVERY TEST DATA				
Client Name: RFUEA		Date pump:12/11/2009		
Borehole C-No:		Static Water Level: 182		
Borehole Loc: RFUEA		Depth Pump Set At:220m		
Total Depth 330m		Pumping Water level: 214.21 m		
Date	Time since pump Stopped (Mins)	Water Level Management (m bgl)	Residual drawdown (m)	Comments on factors affecting test Data
12/11/2009	1	214.61	32.61	
	2	206.46	24.46	
	3	202.1	20.1	
	4	199.73	17.73	
	5	198.42	16.42	
	6	198.46	16.46	
	7	197.22	15.22	
	8	196.86	14.86	
	9	195.3	13.3	
	10	195.22	13.22	
	12	194.91	12.91	
	14	194.34	12.34	
	16	194.25	12.25	
	18	194.05	12.05	
	20	193.01	11.01	
	25	192.45	10.45	
	30	192.03	10.03	
	35	191.47	9.47	
	40	191.11	9.11	
	45	191.01	9.01	
	50	190.82	8.82	
	60	190.67	8.67	



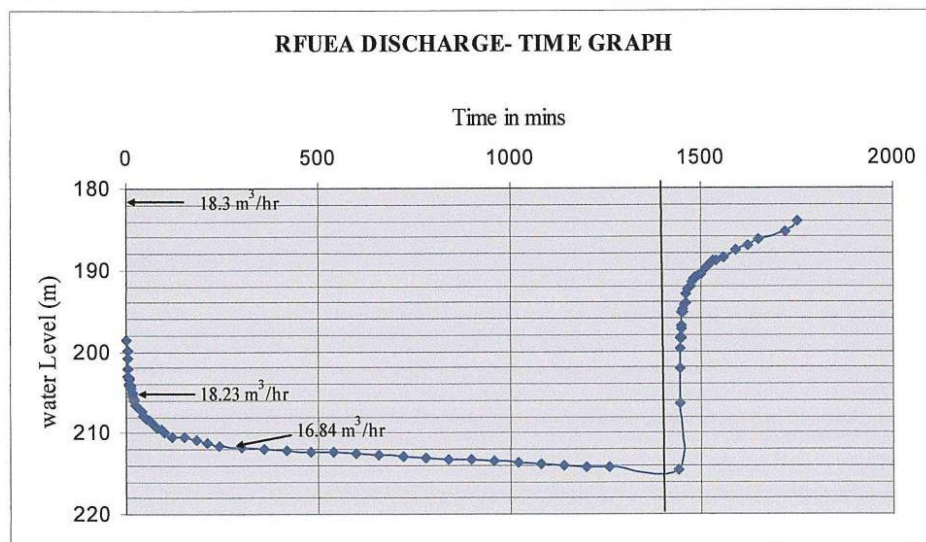
Hydrogeological and Geophysical Investigations Nairobi Business Park (Site II) –Ngong Road

	70	189.93	7.93
	80	189.43	7.43
	90	189.02	7.02
	100	188.93	6.93
	120	188.62	6.62
	150	187.72	5.72
	180	187.13	5.13
	210	186.36	4.36
	240	185.44	3.44



**RFUEA Recovery Graph  
Combined Test Pumping and Recovery Graph**





iii) Hekima College Test Pumping and Recovery Data

Date	Time	Elapsed Time	Water Level	Drawdown	Yield M3/hr	Remarks
13/09/05		0	168.2			
		1	169.4			
		2	170.2			
		3	171.1			
		4	171.9			
		5	172.9			
		6	173.7			
		8	175.6			
		10	177.9			
		12	178.4			
		14	178.6			
		16	178.9			
		18	179.1			
		20	179.1			
		25	179.3			
		30	179.4			
		35	179.5			
		40	179.5			
		45	179.8			
	11.55	50	179.8			
	12.1	60	180.1			
	12.2	70	180.1			
	12.3	80	180.3			
	12.4	90	180.4			
	12.5	100	181			
	1.2	120	181.1			
	1.4	150	181.5			



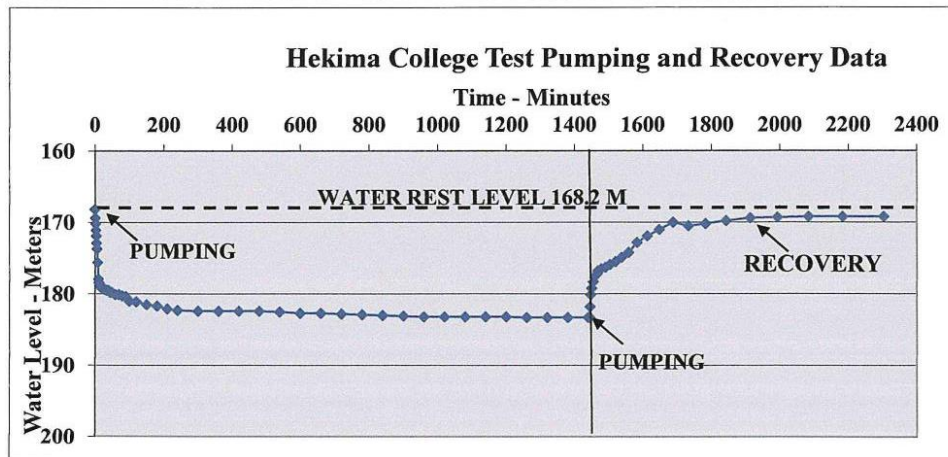
# ESIA Study for the Proposed World Trade Centre Hospital

## Hydrogeological and Geophysical Investigations

## Nairobi Business Park (Site II) –Ngong Road

	2.1	180	181.7			
	2.4	210	182.1			
	3.1	240	182.3			
	4.1	300	182.4			
	5.1	360	182.4			
	6.1	420	182.4			
	7.1	480	182.4			
	8.1	540	182.5			
	9.1	600	182.7			
	10.1	660	182.7			
	11.1	720	182.8			
	12.1	780	182.9			
	1.1	840	183			
	2.1	900	183.1			
	3.1	960	183.2			
	4.1	1020	183.2			
	5.1	1080	183.2			
	6.1	1140	183.2			
	7.1	1200	183.2			
	8.1	1260	183.3			
	9.1	1320	183.3			
	10.1	1380	183.3			
	11.1	1440	183.3			
	11.1	1440	183.3			
		1445	183.3			
		1446	181.8			
		1448	180.1			
		1451	179.2			
		1455	178.3			
		1460	177.5			
		1466	177.2			
		1468	176.8			
	11.2	1478	176.5			
		1490	176.3			
		1504	175.9			
		1520	175.5			
		1538	174.9			
	11.3	1558	174.2			
		1583	172.8			
	11.4	1613	171.9			
		1648	171			
	12	1688	170			
	12.1	1733	170.5			
	12.2	1783	170.2			
	12.3	1843	169.8			
	12.4	1913	169.4			
	12.4	1993	169.3			
		2083	169.2			
		2183	169.2			
		2303	169.2			





iv) Mr. Jesse Ngari Gacharira Borehole

a) Step Drawdown Test Data and Graphs

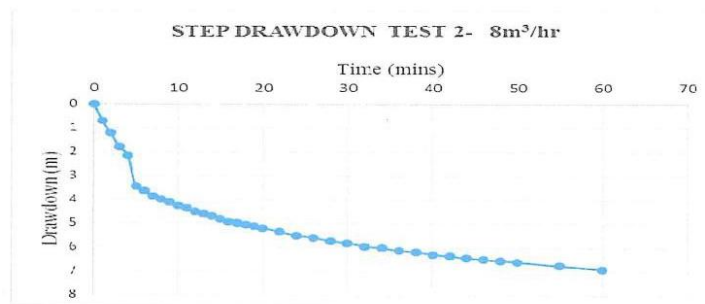
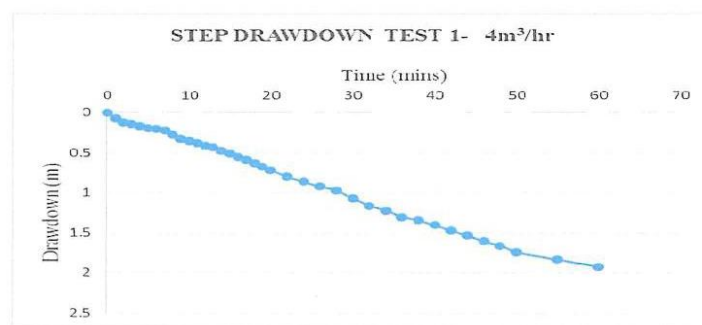
Time (min)	Step Drawdown No. 1- 4m <sup>3</sup> /hr		Step Drawdown No. 2-8m <sup>3</sup> /hr		Step Drawdown No. 3-12m <sup>3</sup> /hr		Step Drawdown No.4-12m <sup>3</sup> /hr	
	W.L (m)	D.D (m)	W.L (m)	D.D (m)	W.L (m)	D.D (m)	W.L (m)	D.D (m)
0	230.98	0	232.9	0	239.8	0	246.35	0
1	231.05	0.07	233.59	0.69	239.9	0.1	246.81	0.46
2	231.1	0.12	234.1	1.2	240.01	0.21	247.21	0.86
3	231.12	0.14	234.7	1.8	241.15	1.35	247.58	1.23
4	231.15	0.17	235.05	2.15	241.65	1.85	248.01	1.66
5	231.17	0.19	236.34	3.44	241.96	2.16	248.34	1.99
6	231.18	0.2	236.55	3.65	242.15	2.35	248.65	2.3
7	231.2	0.22	236.75	3.85	242.4	2.6	248.83	2.48
8	231.25	0.27	236.9	4	242.6	2.8	249.01	2.66
9	231.3	0.32	237.02	4.12	242.76	2.96	249.17	2.82
10	231.33	0.35	237.15	4.25	243.13	3.33	249.36	3.01
11	231.36	0.38	237.27	4.37	243.28	3.48	249.5	3.15
12	231.39	0.41	237.4	4.5	243.4	3.6	249.68	3.33
13	231.41	0.43	237.48	4.58	243.46	3.66	249.9	3.55
14	231.45	0.47	237.6	4.7	243.51	3.71	250.1	3.75
15	231.49	0.51	237.7	4.8	243.55	3.75	250.3	3.95
16	231.53	0.55	237.82	4.92	243.6	3.8	250.48	4.13
17	231.57	0.59	237.89	4.99	243.69	3.89	250.53	4.18
18	231.61	0.63	237.96	5.06	243.78	3.98	250.61	4.26
19	231.65	0.67	238.03	5.13	243.89	4.09	250.69	4.34
20	231.7	0.72	238.1	5.2	243.98	4.18	250.83	4.48
22	231.78	0.8	238.25	5.35	244.11	4.31	251.02	4.67
24	231.84	0.86	238.4	5.5	244.25	4.45	251.3	4.95
26	231.9	0.92	238.5	5.6	244.36	4.56	251.48	5.13
28	231.95	0.97	238.62	5.72	244.45	4.65	251.68	5.33
30	232.05	1.07	238.71	5.81	244.6	4.8	251.79	5.44
32	232.14	1.16	238.85	5.95	244.76	4.96	252	5.65
34	232.2	1.22	238.92	6.02	244.9	5.1	252.18	5.83



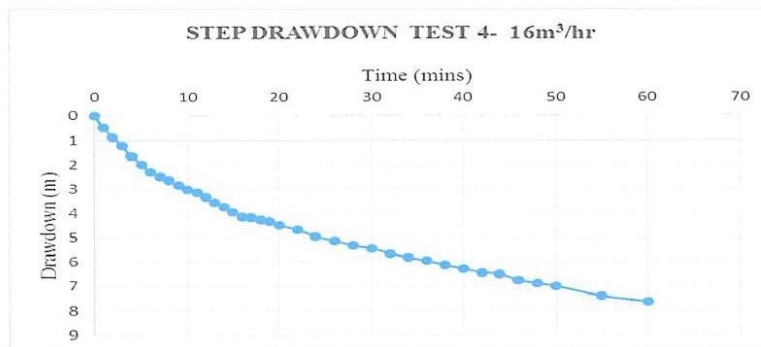
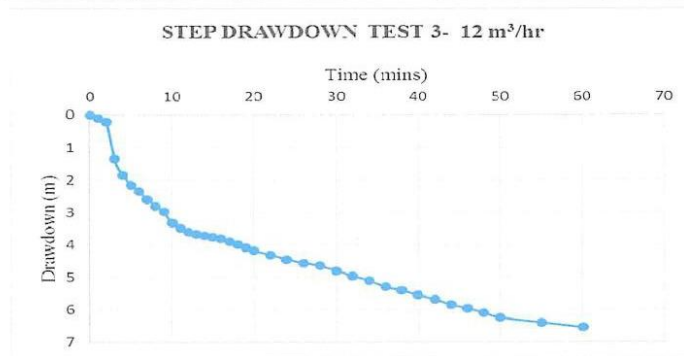
Hydrogeological and Geophysical Investigations

Nairobi Business Park (Site II) –Ngong Road

36	232.28	1.3	239.02	6.12	245.1	5.3	252.3	5.95
38	232.32	1.34	239.09	6.19	245.21	5.41	252.48	6.13
40	232.38	1.4	239.19	6.29	245.35	5.55	252.63	6.28
42	232.45	1.47	239.26	6.36	245.48	5.68	252.79	6.44
44	232.51	1.53	239.33	6.43	245.65	5.85	252.85	6.5
46	232.58	1.6	239.4	6.5	245.76	5.96	253.1	6.75
48	232.64	1.66	239.44	6.54	245.9	6.1	253.24	6.89
50	232.72	1.74	239.5	6.6	246.05	6.25	253.35	7
55	232.81	1.83	239.65	6.75	246.2	6.4	253.76	7.41
60	232.9	1.92	239.8	6.9	246.35	6.55	254	7.65







**b) Constant Drawdown Data and Graph**

Mr. JESSEE GACHARIRA NGARI CONSTANT DISCHARGE MEASUREMENT SHEET						
Date of test(Start):21/03/2019			Date of test(Finish):22/03/2019			
Borehole depth:400m			SWL:227.35			
Location: Lavington			Pump type:17-40			
Well type: Drilled			Datum:0.5			
Contractor: Kisima Electro Mechanicals			PWL:263.12			
Pump Intake:374m			Power Source: Generator			
Date	Time	Elapsed Time(Min)	Water Level (m bgl)	Drawdown(m)	Yield(m <sup>3</sup> /hr)	Remarks
21/03/2019	0840hrs	0	227.35	0		Gate Valve fully opened
		1	241.6	14.25	18.5	
		2	241.93	14.58		
		3	242.2	14.85		
		4	243.15	15.8		
		5	244.2	16.85		
		6	244.8	17.45		
		7	245.4	18.05		
		8	245.85	18.5		



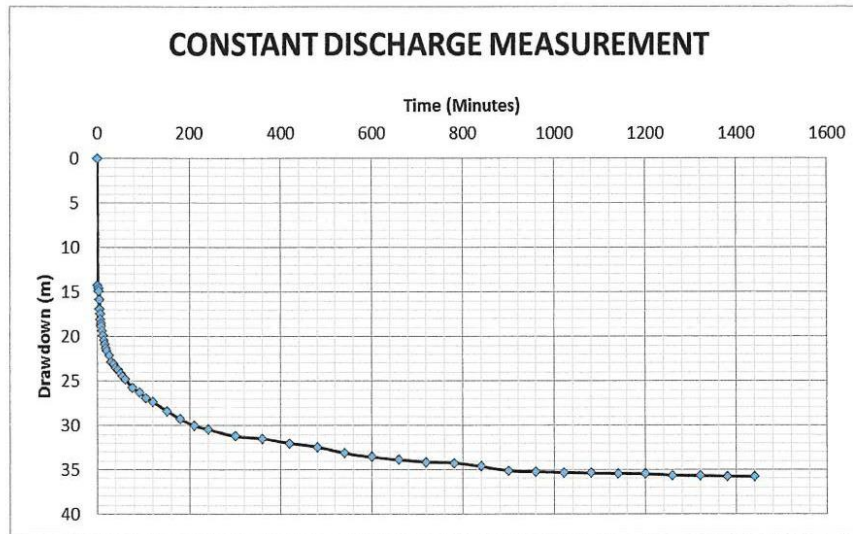
# ESIA Study for the Proposed World Trade Centre Hospital

## Hydrogeological and Geophysical Investigations

## Nairobi Business Park (Site II) –Ngong Road

		9	246.2	18.85		
		10	246.7	19.35		
		12	247.25	19.9		
		14	247.75	20.4		
		16	248.2	20.85		
		18	248.6	21.25	16	
		20	248.92	21.57		
		25	249.5	22.15		
		30	250.2	22.85		
		35	250.45	23.1	16	
		40	250.8	23.45		
		45	251.1	23.75		
		50	251.5	24.15		
		55	251.85	24.5		
	0940hrs	60	252.1	24.75		
		75	253.04	25.69		
		90	253.62	26.27		
		105	254.2	26.85		
	1040hrs	120	254.68	27.33		
		150	255.7	28.35		
	1140hrs	180	256.62	29.27		
		210	257.34	29.99		
	1240hrs	240	257.75	30.4		
		300	258.54	31.19		
	1440hrs	360	258.8	31.45		
	1540hrs	420	259.35	32		
	1640hrs	480	259.75	32.4		
	1740hrs	540	260.45	33.1		
	1840hrs	600	260.9	33.55		
	1940hrs	660	261.2	33.85		
	2040hrs	720	261.45	34.1		
	2140hrs	780	261.55	34.2		
	2240hrs	840	261.95	34.6		
	2340hrs	900	262.45	35.1		
22/03/2019	0040hrs	960	262.55	35.2		
	0140hrs	1020	262.63	35.28		
	0240hrs	1080	262.7	35.35		
	0340hrs	1140	262.75	35.4		
	0440hrs	1200	262.8	35.45		
	0540hrs	1260	262.95	35.6		
	0640hrs	1320	263	35.65		Clear Water
	0740hrs	1380	263.05	35.7	16	
	0840hrs	1440	263.12	35.77		





c) Recovery Data and Graph

MR. JESSE GACHARIRA NGARI –BOREHOLE RECOVERY MEASUREMENT TEST						
Location: Lavington			Borehole depth:400m			
Well type: Drilled			Date of test(Start):22/03/2019			
Testing Contractor: Kisima Electro Mechanicals			SWL:263.12			
Pump Intake:374m			Datum:0.5			
Test Yield:16m <sup>3</sup> /h			Finished:22/03/2019			
Power Source: Generator			PWL:263.12			
3/22/2019	Time	Elapsed Time(Min)	Water Level(m bdl)	Residual Drawdown(m)	Recovery %	Remarks
	0840hrs	0	263.12	0	0	The borehole recovered 81.14% in 6 hours
	0841hrs	1	248.2	14.92	41.71093095	
		2	247.25	15.87	44.36678781	
		3	246.34	16.78	46.91081912	
		4	245.34	17.78	49.70645793	
		5	244.3	18.82	52.61392228	
		6	243.4	19.72	55.1299972	
		7	243.3	19.82	55.40956108	
		8	243.23	19.89	55.6052558	
		9	243.15	19.97	55.82890691	
		10	243.1	20.02	55.96868885	
		12	242.9	20.22	56.52781661	
		14	242.6	20.52	57.36650825	
		16	242.25	20.87	58.34498183	

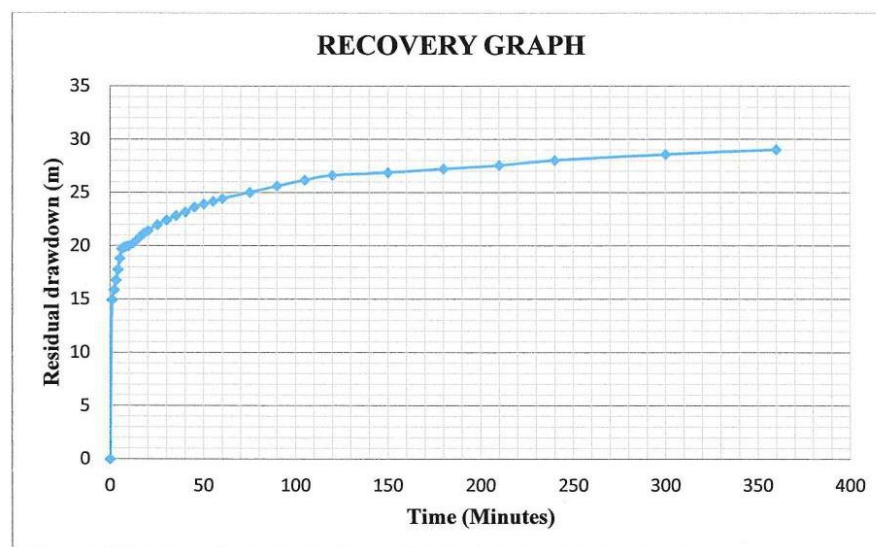


## ESIA Study for the Proposed World Trade Centre Hospital

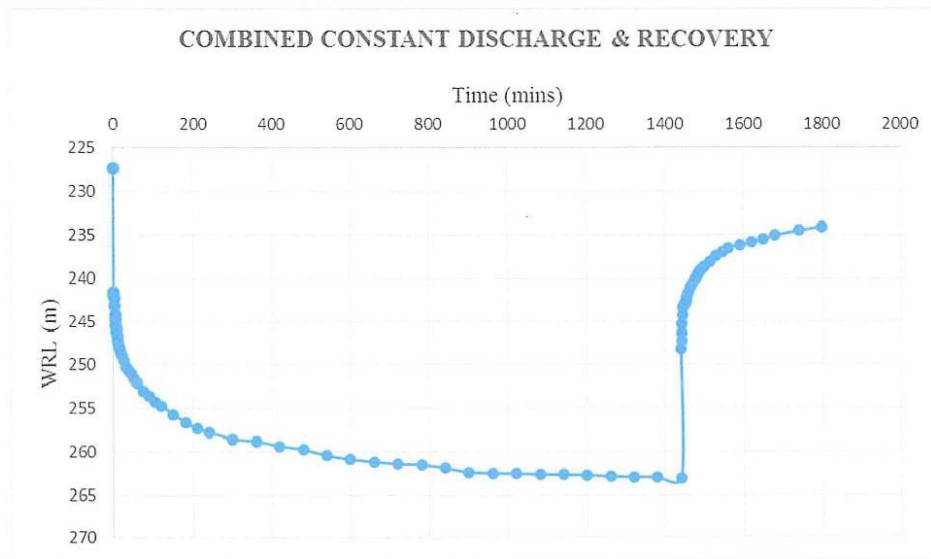
### Hydrogeological and Geophysical Investigations

### Nairobi Business Park (Site II) –Ngong Road

	18	241.92	21.2	59.26754263
	20	241.7	21.42	59.88258317
	25	241.15	21.97	61.42018451
	30	240.7	22.42	62.67822197
	35	240.28	22.84	63.85239027
	40	239.94	23.18	64.80290746
	45	239.49	23.63	66.06094493
	50	239.2	23.92	66.87168018
	55	238.95	24.17	67.57058988
0940hrs	60	238.69	24.43	68.29745597
	75	238.1	25.02	69.94688286
	90	237.5	25.62	71.62426614
	105	236.95	26.17	73.16186749
1040hrs	120	236.5	26.62	74.41990495
	150	236.25	26.87	75.11881465
1140hrs	180	235.9	27.22	76.09728823
	210	235.57	27.55	77.01984904
1240hrs	240	235.1	28.02	78.33379927
1340hrs	300	234.54	28.58	79.899357
			29.02	81.12943808










**Appendix 6: Water Quality Analysis from various sources**

**i) Mr. Geoffrey Wandeto Borehole**

**MINISTRY OF HEALTH**

Telephone: Nairobi 2725806/7  
and 2725873/4 (four lines)  
Fax: 2717567  
When replying please quote  
Ref. No. ....  
and date .....



GOVERNMENT CHEMISTS' DEPARTMENT  
P.O. Box 20753-00200  
NAIROBI

....., 20.....

9<sup>th</sup> January, 2018

P/WAT/VOL.1/17/18/(112)

**REPORT ON CHEMICAL ANALYSIS OF WATER**

Laboratory sample No. W241/17/18      Date Received: 04/01/18

Sender: Spar Drilling Co. Ltd.  
P.O Box 40590, NAIROBI      Date sample taken .....

Source: Borehole:- Geoffery Wandeto Mwangi  
(Dagoreti)

**PHYSICAL TESTS**

Colour: - (Hazen Units)      Turbidity: Clear (J.T.U.'s)  
Deposit: None      Odour: None (T.O.N)  
Taste: -  
pH: 8.1      Electrical Conductivity at 25 °C (microsiemens/cm)  
238.0

**CHEMICAL TESTS**

	Results mg/l(ppm)	Max guideline value mg/l(ppm)
Total Alkalinity as CaCO <sub>3</sub>	130.0	500.0
Phenolphthalein (CO <sub>3</sub> ) =	Nil	-
Methyl Orange (HCO <sub>3</sub> )-	130.0	-
Chloride (Cl)-	60.0	250.0
Sulphate(SO <sub>4</sub> )=	6.0	250.0
Nitrate (NO <sub>3</sub> )-	8.0	-
Nitrite (NO <sub>2</sub> )-	0.05	3.0
Fluoride (F)-	3.3	1.5
Total Anions.		

**ii) Mr. Jesse Ngari Gacharira Borehole**





OFFICE OF THE PRESIDENT  
MINISTRY OF INTERIOR AND CO-ORDINATION OF NATIONAL GOVERNMENT

Mobile: 0723 850 490  
Wireless: +254 20 2336300, +254 20 2336214  
Telephone: +254 20 2725973/4  
E-mail: info@chemistskenya.org  
gc@chemistskenya.org

GOVERNMENT CHEMISTS DEPARTMENT  
P.O. Box 20753-00202 KNH  
NAIROBI

When replying please quote

05<sup>th</sup> April, 2019

P/WAT/VOL.1/19-20 [150]

REPORT ON CHEMICAL ANALYSIS OF WATER

Laboratory sample No. W 179/2019

Date Received: 01/04/2019

Sender: HYDRO WATER  
Source: Jesse Gacharira Ngari, Lavington Area,  
Westlands District

Date sample taken: 21/03/2019

PHYSICAL TESTS

Colour:	<5	(Hazen Units)	Turbidity:	Clear	(J.T.U.'s)
Deposit	None		Odour:	None	(T.O.N)
Taste	-				
pH:	7.7		Electrical Conductivity at 25 °C (microsiemens/cm)		
				590	

CHEMICAL TESTS

	Results mg/l(ppm)	Max guideline value mg/l(ppm)
Total Alkalinity as CaCO <sub>3</sub> .....	250	500.0
Phenolphthalein (CO <sub>3</sub> ) = .....	10	-
Methyl Orange (HCO <sub>3</sub> )= .....	240	-
Chloride (Cl)- .....	50	250.0
Sulphate(SO <sub>4</sub> )- .....	25	250.0
Nitrate (NO <sub>3</sub> )- .....	-	-
Nitrite (NO <sub>2</sub> )- .....	0.08	3.0
Fluoride (F)- .....	1.3	1.5
Total Anions, .....	-	-



**Appendix 7: Photographic section**



**Race Course Dam**



**River Motoini**



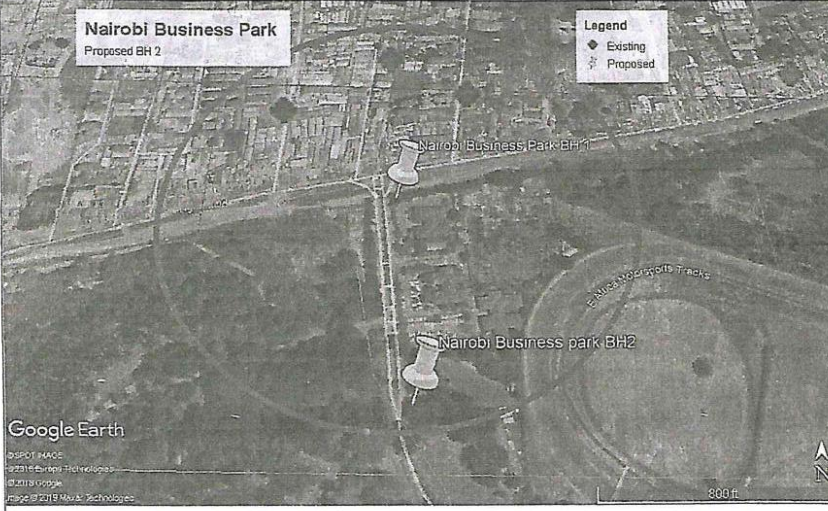


Photos of the surrounding Bhs



Appendix 8: Borehole Data acquisition Documents

FROM :SICTO		TO:ATCM	
ABSTRACTION DATA		2 <sup>ND</sup> AUGUST, 2019	
NAIROBI BUSINESS PARK BH2		NGONG RD RACE COURSE AREA	

S/N O	WRMA NO.	NAME	Distance (Meters)	Depth( M)	STATUS
1	WRMA/30/NRB/3BA/113954/G	Lucy Wanjiru Waweru	200/N	250	Valid Permit
2	Newly Proposed	Nairobi Business park BH 1	250M/N	-	-


  
 John N. Munyao  
**ASSISTANT TECHNICAL CO-ORDINATION MANAGER**



# ESIA Study for the Proposed World Trade Centre Hospital

Hydrogeological and Geophysical Investigations

Nairobi Business Park (Site II) - Ngong Road

	<b>WATER RESOURCES MANAGEMENT AUTHORITY</b>	
	TITLE: Revenue Confirmation Voucher	REF. NO: F/4/2/2
	DEPARTMENT: Finance & Administration	ISSUE NO: 02
	ISSUED BY: CA	REV. NO: 01
	AUTHORIZED BY: FAM	DATE OF ISSUE: 7 <sup>th</sup> January, 2013 PAGE: 1 of 1

## REVENUE CONFIRMATION VOUCHER

Rcv No.: ..... Date: 02/08/2019  
 Client Name & Address: Nairobi Business Park File No.: .....  
 Catchment 3 Region Athi  
 SRO/Dept: ..... Ref/Assmnt/ Order No. ....  
 To: Commercial

Please note that the sum below is the revenue type/charges for services rendered which is due for billing and ultimate payment into the Authority's bank account.

We confirm that the charges have been assessed and duly evaluated and thus hereby recommend for further processing.

No.	Particulars	QTY	Rate Kshs.	Amount Kshs.
1	Data Sales	2 Set	4000/=	4000 / =
				4000 / =

Prepared by: [Signature] Date: 02/08/2019  
 Confirmed by: [Signature] Date: 02/08/2019

**For use by Finance Department**

Invoice No. .... Issued. /Not Issued. Remarks (if not issued) .....


Signed ..... Date .....

Issued by: [Signature]  
 (Chief Accountant)

Approved by: [Signature]  
 (Finance & Administration Manager)



F/4/2/1



**WATER RESOURCES AUTHORITY**  
 Headquarters: NHIF Building, 9th Floor, Wing B | P.O. Box 45250 - 00100, NAIROBI, Kenya  
 Tel: 2732291, 2729048/9 | Fax: 2729950 | E-mail: wra@wra.or.ke  
 Website: www.wra.or.ke

### OFFICIAL RECEIPT

37316

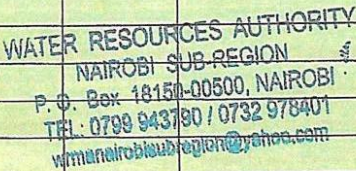
Rct No: AR .....

Date: 02.08.2019

Received from: NAIROBI BUSINESS PARK

Being Payment of: Dkt

Payment Mode: MPESA CASH/LEFT/CHEQUE No: 0728000461

No.	Ref./Cust. A/C No.	GL A/C No.	Description	Amount Kshs.
1.		821	Data	2,000
				
				2,000

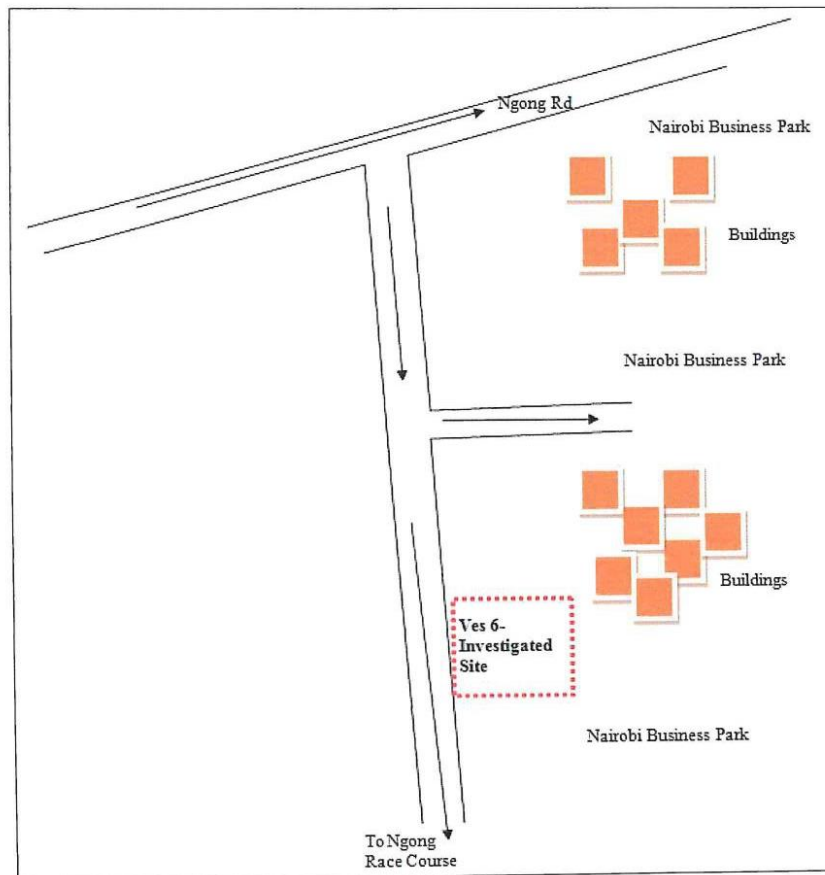
Received with Thanks TWO THOUSAND ONLY

Authorised Signature: [Signature]

Accounting for every drop



Appendix 9: Sketch Map of the investigated site






Appendix 7: Bill of quantities

Proposed WTC Nairobi Hospital  
Nairobi Kenya  
For Gateway Real Estate Africa  
Bills of Quantities



Section No.	Grand Summary	Page No.	Amount (Ksh)
1	Section No. 1: Preliminaries	1/1/1	118,138,672.00
2	Section No. 2: Site Clearance & Bulk Earthworks	2/2/1	167,958,306.00
3	Section No. 3: Basement Construction	3/2/1	264,484,010.00
4	Section No. 4: Structural Frame	4/2/1	418,126,562.00
5	Section No. 5: Façade & Cladding	5/2/1	106,999,223.00
6	Section No. 6: Walling & Partitions	6/2/1	52,379,159.00
7	Section No. 7: Doors	7/2/1	162,334,304.00
8	Section No. 8: Internal Finishes	8/2/1	195,305,741.00
9	Section No. 9: Carpentry and Joinery Works	9/2/1	115,073,707.00
10	Section No. 10: External Works	10/3/1	190,628,800.00
11	Section No. 11: Electrical Installations	11/4/1	482,903,286.00
12	Section No. 12: Mechanical Installations	12/4/1	328,886,824.00
13	Section No. 13: Contingencies	13/5/1	190,002,417.52
	<b>SUB TOTAL</b>	<b>Kshs.</b>	<b>2,793,221,011.52</b>
	<b>Add: Value Added Tax (16%)</b>		<b>446,915,361.84</b>
	<b>TOTAL CONSTRUCTION COST</b>	<b>Kshs.</b>	<b>3,240,136,373.36</b>
	Signed By:  27/06/2023		
	<b>Sekou Dore</b> <b>MacYMR LLP</b>		



Classification - Restricted



Appendix 8: NEMA TOR Approval Letter for the ESIA Study report



nema

mazingira yetu | uhai wetu | wajibu wetu

**NATIONAL ENVIRONMENT MANAGEMENT AUTHORITY**

Telcom Wireless: 020-2183718, 020-2101370  
Mobile Line: 0724 253 398, 0723 363 010, 0735 013 046  
Incident Line: 0786 101 100, 0741 101 100

P.O. Box 67839 - 00200  
Popo Road, Nairobi, Kenya  
Email: dgnema@nema.go.ke  
Website: www.nema.go.ke

**NEMA/TOR/5/2/580**

**6<sup>th</sup> June, 2023**

**Director,**  
Gateway Real Estate Africa  
C/o Gateway CCI SEZ Limited  
P.O. Box 10643-00100  
**NAIROBI**

**RE: TERMS OF REFERENCE (TOR) FOR ENVIRONMENTAL IMPACT ASSESSMENT FOR  
THE PROPOSED WORLD TRADE CENTRE HOSPITAL ON PLOT L.R NO. 24861/1-2  
WITHIN THE NAIROBI BUSINESS PARK ALONG NGONG ROAD, NAIROBI COUNTY.**

We acknowledge the receipt of your TOR for the above subject.

Pursuant to the Environmental Management and Coordination Act, 1999, the Environmental (Impact Assessment and Audit) Regulations 2003 and Legal notice 31 & 32 of 2019, your terms of reference for the Environmental and Social Impact Assessment (EIA) **PROPOSED WORLD TRADE CENTRE HOSPITAL ON PLOT L.R NO. 24861/1-2 WITHIN THE NAIROBI BUSINESS PARK ALONG NGONG ROAD, NAIROBI COUNTY** has been approved on condition that you shall develop and implement a comprehensive stakeholder engagement plan.

You shall submit ten (10) copies of the study report, upon payment of the applicable EIA processing and monitoring fees being 0.1% of the total project cost, a soft copy of the summarised ESMP in **WORD** format for preparation of public notice and one electronic copy of the report prepared by the team of experts to the Authority.

**JOSEPH MAKAU**  
**For: DIRECTOR GENERAL**

*Our Environment, Our Life, Our Responsibility*





Appendix 9: Letters of Invitation and Evidence of Receipt by the stakeholders for the public baraza



**Green by Choice Ltd.**

Seasoned Woman Center, 246A  
O'washika Rd, Lavington

☎: +254 020 242 4114  
☎: +254 722 510 485

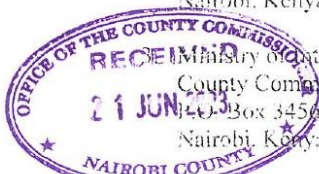
Email: [info@greeneastafrica.com](mailto:info@greeneastafrica.com)

Website: [www.greeneastafrica.com](http://www.greeneastafrica.com)

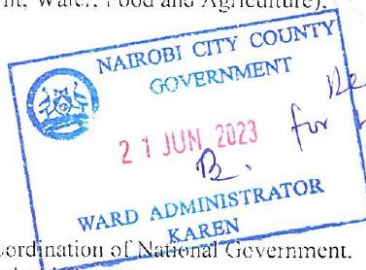
OUR REF: GBC/GREA/ESIA/BARAZA

1. County Government of Nairobi,  
Green Nairobi (Environment, Water, Food and Agriculture),  
P.O. Box 34567 - 00100,  
Nairobi, Kenya.

2. The Ward Administrator,  
Karen Ward,  
P.O. Box 34567 - 00100,  
Nairobi, Kenya.



3. Ministry of Interior and Coordination of National Government,  
County Commissioner - Nairobi County,  
P.O. Box 34567 - 00100,  
Nairobi, Kenya.



4. Ministry of Interior and Coordination of National Government,  
Office of the Area Chief - Karen,  
P.O. Box 34567 - 00100,  
Nairobi, Kenya.



5. Ministry of Interior and Coordination of National Government,  
Office of the Area Chief - Ngando,  
P.O. Box 34567 - 00100,  
Nairobi, Kenya.

6. Member of County Assembly - Karen Ward,  
Nairobi City County Assembly  
P.O. Box 45844 - 00100  
Nairobi, Kenya.

Received by Ted  
B.

7. Member of County Assembly - Ngando Ward,  
Nairobi City County Assembly  
P.O. Box 45844 - 00100  
Nairobi, Kenya

MOSES MUGENY 072 359129

8. Kenya Forest Service,  
P.O. Box 36513 - 00100,  
Nairobi, Kenya.



9. Nairobi Business Park,  
P.O. Box 43233-00100,  
Nairobi, Kenya.





## ESIA Study for the Proposed World Trade Centre Hospital

10. Ngong' Road Forest Association,  
Email: office@ngongforestsanctuary.com  
Tel: 020 211 3358 / 0104 141475

ESTHER GITAKHA  
0721631211



11. Ngong' Racecourse and Golf Park,  
P.O. Box: 40373 - 00100,  
Nairobi, Kenya.

DUNCAN OBHAI  
0722 414598

THE JOCKEY CLUB OF KENYA  
P. O. BOX 40373  
NAIROBI

12. Nyumba Kumi Representatives  
Nairobi, Kenya

13. Karen and Langata District Association,  
P.O. Box 15226-00509,  
Nairobi, Kenya.



olenkaatet  
0723 855 817

14. Nairobi Chapel,  
P.O. Box 53635 - 00200,  
Nairobi, Kenya.

UDHIAMBO  
07422 66560

15. Citadelle Security,  
C/o FEP Foundation  
Email: info@fep-group.com  
Tel: + (254) 718 630 001

Dear Sir/Madam,

### RE: INVITATION TO ATTEND A PUBLIC BARAZA FOR THE PROPOSED WORLD TRADE CENTRE HOSPITAL ALONG NGONG' ROAD, NAIROBI COUNTY

The above subject refers.

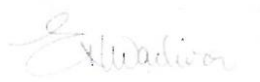
We have been contracted by Gateway Real Estate Africa to prepare an Environmental and Social Impact Assessment (ESIA) Study for the proposed multi-specialty hospital. The proposed hospital will be located on Plot L.R. No. 24861/1-2 within the Nairobi Business Park along Ngong' Road, Nairobi County.

The ESIA study is prepared pursuant to Section 69 (1d) of the Constitution of Kenya 2010 and Regulation 17 of the Environmental Management and Coordination (Impact Assessment and Audit) Regulations, 2003. The potentially project affected persons are required to participate in the EIA process.

The purpose of this letter is therefore to invite you to a stakeholder consultative meeting on 4<sup>th</sup> July 2023 starting at 10:00 am at the proposed project site within the Nairobi Business Park.

We look forward to your participation in the meeting.

Yours faithfully,

  
Elizabeth N'zani Wachira  
Director







Green by Choice Ltd.

Seasoned Woman Center, 246A  
O'washika Rd, Lavington  
☎ : +254 020 242 4114  
☎ : +254 722 510 485  
Email: [info@greeneastafrica.com](mailto:info@greeneastafrica.com)  
Website: [www.greeneastafrica.com](http://www.greeneastafrica.com)

OUR REF: GBC/GREA/ESIA/BARAZA

20<sup>th</sup> June, 2023

Member of County Assembly – Woodley Ward,  
Nairobi City County Assembly  
P.O. Box 45844 - 00100  
Nairobi, Kenya.

Dear Sir/Madam,

**RE: INVITATION TO ATTEND A PUBLIC BARAZA FOR THE PROPOSED WORLD  
TRADE CENTRE HOSPITAL ALONG NGONG' ROAD, NAIROBI COUNTY**

The above subject refers.


We have been contracted by Gateway Real Estate Africa to prepare an Environmental and Social Impact Assessment (ESIA) Study for the proposed multi-specialty hospital. The proposed hospital will be located on Plot L.R. No. 24861/1-2 within the Nairobi Business Park along Ngong' Road, Nairobi County.

The ESIA study is prepared pursuant to Section 69 (1d) of the Constitution of Kenya 2010 and Regulation 17 of the Environmental Management and Coordination (Impact Assessment and Audit) Regulations, 2003. The potentially project affected persons are required to participate in the EIA process.

The purpose of this letter is therefore to invite you to a stakeholder consultative meeting on 4<sup>th</sup> July 2023 starting at 10:00 am at the proposed project site within the Nairobi Business Park.


We look forward to your participation in the meeting.

Yours faithfully,

  
Elizabeth N'zani Wachira  
**Director**

CC

1. County Government of Nairobi – Green Nairobi (Environment, Water, Food and Agriculture)
2. The Ward Administrator, Karen Ward
3. County Commissioner – Nairobi County
4. Office of the Area Chief – Karen
5. Office of the Area Chief – Ngando
6. Member of County Assembly – Karen Ward
7. Kenya Forest Service
8. Nairobi Business Park
9. Ngong' Road Forest Association
10. Ngong' Racecourse and Golf Park
11. Nyumba Kumi Representatives
12. Karen and Lang'ata District Association
13. Nairobi Chapel

Received by: Tracy Ngugi  
Secretary  
0126006454  






**Green by Choice Ltd.**

Seasoned Woman Center, 246A  
O'washika Rd, Lavington  
☎: +254 020 242 4114  
☎: +254 722 510 485  
Email: [info@greeneastafrica.com](mailto:info@greeneastafrica.com)  
Website: [www.greeneastafrica.com](http://www.greeneastafrica.com)

OUR REF: GBC/GREA/ESIA/BARAZA

29<sup>th</sup> June, 2023

1. County Government of Nairobi,  
Green Nairobi (Environment, Water, Food and Agriculture),  
P.O. Box 34567 – 00100,  
Nairobi, Kenya.



*Received for Head Administration*

2. The Ward Administrator,  
Karen Ward,  
P.O. Box 34567 – 00100,  
Nairobi, Kenya.

3. Ministry of Interior and Coordination of National Government,  
County Commissioner – Nairobi County,  
P.O. Box 34567 – 00100,  
Nairobi, Kenya.

4. Ministry of Interior and Coordination of National Government,  
Office of the Area Chief – Karen,  
P.O. Box 34567 – 00100,  
Nairobi, Kenya.

*George Rodgers Nyachir Received*

5. Ministry of Interior and Coordination of National Government,  
Office of the Area Chief – Ngando,  
P.O. Box 34567 – 00100,  
Nairobi, Kenya.

*ZACHARI CHAGE*

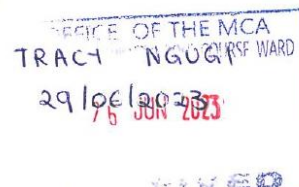
6. Member of County Assembly – Karen Ward,  
Nairobi City County Assembly  
P.O. Box 45844 – 00100  
Nairobi, Kenya.

*Received by Geda*

7. Member of County Assembly – Ngando Ward,  
Nairobi City County Assembly  
P.O. Box 45844 – 00100  
Nairobi, Kenya.

*ZACHARI CHAGE*

8. Member of County Assembly – Woodley Ward,  
Nairobi City County Assembly  
P.O. Box 45844 – 00100  
Nairobi, Kenya.



9. Kenya Forest Service,  
P.O. Box 30513 – 00100,  
Nairobi, Kenya.

*Received by Peter M. Mule  
Jesse 29/6/23*



## ESIA Study for the Proposed World Trade Centre Hospital

10. Nairobi Business Park,  
P.O. Box 43233-00100,  
Nairobi, Kenya.
11. Ngong' Road Forest Association,  
Email: office@ngongforestsanctuary.com  
Tel: 020 211 3358 / 0104 141475
12. Ngong' Racecourse and Golf Park,  
P.O. Box: 40373 – 00100,  
Nairobi, Kenya.
13. Nyumba Kumi Representatives,  
Nairobi, Kenya.
14. Karen and Lang'ata District Association,  
P.O. Box 15226-00509,  
Nairobi, Kenya.
15. Nairobi Chapel,  
P.O. Box 53635 – 00200,  
Nairobi, Kenya.
16. Citadelle Security,  
C/o FEP Foundation  
Email: info@fep-group.com  
Tel: + (254) 718 630 001

V/K/ KENYA LTD.  
P.O. Box 43233-00100  
Tel: 020-211-3358  
Tel: 020-211-3358

NGONG' ROAD FOREST ASSOCIATION  
Date: 29/06/2023  
Tel: 020-2113358  
office@ngongforestsanctuary.com  
P.O. Box 688-00502, NAIROBI

WANSIRU WACHIRA  
THE JOCKEY CLUB OF KENYA  
P.O. BOX 40373

RECEIVED  
29 JUN 2023  
Tel: 0718 923 861  
0733 654 973  
P.O. Box 15226-00509 NAIROBI

Heidi  
075555 7711

29/06/2023

Dear Sir/Madam,

**RE: CHANGE IN DATE FOR PUBLIC BARAZA FOR THE PROPOSED WORLD TRADE CENTRE HOSPITAL ALONG NGONG' ROAD, NAIROBI COUNTY**

Further to our letter dated 20<sup>th</sup> June 2023, we would like to inform you that due to unavoidable circumstances, the date of the public baraza has changed from the 4<sup>th</sup> of July 2023 to the 6<sup>th</sup> of July 2023.

**Venue:** The Nairobi Business Park  
**Time:** 10:00 am  
**Topic:** Environmental and Social Impact Assessment Study for the proposed multi-specialty hospital

We look forward to your participation in the meeting.

Yours faithfully,



Elizabeth N'zani Wachira

**Director**



## ESIA Study for the Proposed World Trade Centre Hospital



Green by Choice Ltd.

Seasoned Woman Center, 246A  
O'washika Rd, Lavington  
☎ : +254 020 242 4114  
☎ : +254 722 510 485  
Email: info@greeneastafrica.com  
Website: www.greeneastafrica.com

OUR REF: GBC/GREA/ESIA/BARAZA

Chief Officer  
Environment & Forestry  
Nairobi City Government  
Received: ..... Date: 29/6/23

29<sup>th</sup> June, 2023

County Government of Nairobi,  
Green Nairobi (Environment, Water, Food and Agriculture),  
P.O. Box 34567 - 00100,  
Nairobi, Kenya.

Dear Sir/Madam,

RE: CHANGE IN DATE FOR PUBLIC BARAZA FOR THE PROPOSED WORLD  
TRADE CENTRE HOSPITAL ALONG NGONG' ROAD, NAIROBI COUNTY

Further to our letter dated 20<sup>th</sup> June 2023, we would like to inform you that due to unavoidable circumstances, the date of the public baraza has changed from the 4<sup>th</sup> of July 2023 to the 6<sup>th</sup> of July 2023.

Venue: The Nairobi Business Park  
Time: 10:00 am  
Topic: Environmental and Social Impact Assessment Study for the proposed multi-specialty hospital

We look forward to your participation in the meeting.

Yours faithfully,

Elizabeth N'zani Wachira  
Director



## ESIA Study for the Proposed World Trade Centre Hospital



Green by Choice Ltd.

Seasoned Woman Center, 246A  
O'washika Rd, Lavington  
☎ : +254 020 242 4114  
☎ : +254 722 510 485  
Email: [info@greeneastafrika.com](mailto:info@greeneastafrika.com)  
Website: [www.greeneastafrika.com](http://www.greeneastafrika.com)



OUR REF: GBC/GREA/ESIA/BARAZA

29<sup>th</sup> June, 2023

Ministry of Interior and Coordination of National Government,  
County Commissioner – Nairobi County,  
P.O. Box 34567 - 00100,  
Nairobi, Kenya.

Dear Sir/Madam,

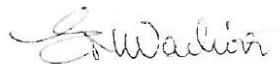
**RE: CHANGE IN DATE FOR PUBLIC BARAZA FOR THE PROPOSED WORLD  
TRADE CENTRE HOSPITAL ALONG NGONG' ROAD, NAIROBI COUNTY**

Further to our letter dated 20<sup>th</sup> June 2023, we would like to inform you that due to unavoidable circumstances, the date of the public baraza has changed from the 4<sup>th</sup> of July 2023 to the 6<sup>th</sup> of July 2023.

Venue: The Nairobi Business Park  
Time: 10:00 am  
Topic: Environmental and Social Impact Assessment Study for the proposed multi-specialty hospital

We look forward to your participation in the meeting.

Yours faithfully,

  
Elizabeth N'zani Wachira  
Director



Appendix 10: Public Participation and Neighbours' Consultation questionnaires



Green by Choice Ltd.

Seasoned Woman Center, 246A  
O'washika Rd, Lavington  
☎: +254 020 242 4114  
☎: +254 722 510 485  
Email: [info@greeneastafrica.com](mailto:info@greeneastafrica.com)  
Website: [www.greeneastafrica.com](http://www.greeneastafrica.com)

06<sup>th</sup> July, 2023

Dear Respondent,

**RE: ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT STUDY REPORT  
FOR THE PROPOSED WORLD TRADE CENTRE HOSPITAL ON PLOT L.R. NO.  
24861/1 WITHIN THE NAIROBI BUSINESS PARK ALONG NGONG ROAD, NAIROBI  
COUNTY**

Legal Notice Nos. 31 and 32 of 2019 (amendment of the second schedule) stipulates that high risk projects due to their potential environmental and social impacts should undergo an ESIA Study Report. This is to ensure that environmental management is incorporated in all project operations. By law, public participation is of paramount importance.

The Proponent, **Nairobi Business Park Holdings Limited**, proposes to set up a multi-specialty hospital on Plot L.R. No. 24861/1 within the Nairobi Business Park along Ngong' Road, Nairobi County. The proposed hospital will have a bed capacity of 150 and will feature two basement floors, ground floor and first to fifth floors.

As an interested and/or affected party, your comments are of great significance in informing decision-making by the relevant lead agency, National Environment Management Authority (NEMA), with regard to the planning, implementation and operation of the proposed project.

You are therefore kindly requested to provide your comments on the proposed activity by filling the questionnaire attached to this letter. Your response is highly appreciated.

Yours faithfully,

Elizabeth N'zani Wachira  
**Director**





QUESTIONNAIRE FOR THE ENVIRONMENTAL AND SOCIAL IMPACT  
ASSESSMENT STUDY REPORT FOR THE PROPOSED WORLD TRADE  
CENTRE HOSPITAL ON PLOT L.R. NO. 24861/1 WITHIN THE NAIROBI  
BUSINESS PARK ALONG NGONG ROAD, NAIROBI COUNTY

Personal Information

1. Name: DISPER HORISHA
2. Address: 26632
3. Mobile: 0700163749
4. ID NO. / Passport NO. (Optional):  
30158294

(A) Neighbourhood information

5. How long have you lived/worked in this area?  
Over 5yrs
6. What is the distance (estimate) between your residence/enterprise and the proposed site? (Tick where applicable).  
(A). Less than 100m. ☒ (B). Between 100-500m.  
(C). Between 500-1000m. (D) Over 1km.
7. What is your opinion on the proposed project?  
Good idea and am fully supporting the project

(B) Environmental Impact

8. Do you think that the project will lead to any environmental impacts on your neighbourhood?  
☒ YES/NO (Tick one please)

If yes, please list them

Noise



9. Is there anything you would suggest to ensure the project has minimal impact on the environment?

YES/NO (Tick one please)

If yes, please state:

.....  
.....  
.....

**(C) Social-Economic Impacts**

10. Do you think that the project will have any socio-economic impacts on the neighbourhood? YES/NO (Tick one please)

- (a) If YES, what positive socio-economic and environmental impacts do you anticipate during the operation phase?

.....  
Job Creating  
.....  
.....

11. Make suggestions on the measures the developer needs to continually put in place during the *operation stage* for this project

.....  
Make sure there is minimum Noise  
.....  
Create jobs to the local people / residents  
.....  
.....

Signature/Stamp:.....

Date: 6/7/2025

THANK YOU FOR YOUR FEEDBACK.



QUESTIONNAIRE FOR THE ENVIRONMENTAL AND SOCIAL IMPACT  
ASSESSMENT STUDY REPORT FOR THE PROPOSED WORLD TRADE  
CENTRE HOSPITAL ON PLOT L.R. NO. 24861/1 WITHIN THE NAIROBI  
BUSINESS PARK ALONG NGONG ROAD, NAIROBI COUNTY

Personal Information

1. Name: CECILIA WANJIRE NJUGUNA
2. Address:
3. Mobile: 0726019350
4. ID NO. / Passport NO. (Optional):  
25704282

(A) Neighbourhood information

5. How long have you lived/worked in this area?  
15 yrs
6. What is the distance (estimate) between your residence/enterprise and the proposed site? (Tick where applicable).  
☒ (A). Less than 100m.                      ☐ (B). Between 100-500m.  
☐ (C). Between 500-1000m.                      ☐ (D). Over 1km.
7. What is your opinion on the proposed project?  
is good

(B) Environmental Impact

8. Do you think that the project will lead to any environmental impacts on your neighbourhood?  
YES/NO (Tick one please)

If yes, please list them

at least there will be job  
opportunity in the area



9. Is there anything you would suggest to ensure the project has minimal impact on the environment?

YES/NO (Tick one please)

If yes, please state:

..... job opportunity .....

**(C) Social-Economic Impacts**

10. Do you think that the project will have any socio-economic impacts on the neighbourhood? YES/NO (Tick one please)

- (a) If YES, what positive socio-economic and environmental impacts do you anticipate during the operation phase?

.....  
.....  
.....

11. Make suggestions on the measures the developer needs to continually put in place during the *operation stage* for this project

.....  
.....  
.....  
.....  
.....

Signature/Stamp:  .....

Date: .....

THANK YOU FOR YOUR FEEDBACK.



QUESTIONNAIRE FOR THE ENVIRONMENTAL AND SOCIAL IMPACT  
ASSESSMENT STUDY REPORT FOR THE PROPOSED WORLD TRADE  
CENTRE HOSPITAL ON PLOT L.R. NO. 24861/1 WITHIN THE NAIROBI  
BUSINESS PARK ALONG NGONG ROAD, NAIROBI COUNTY

Personal Information

1. Name: Timothy Magu  
2. Address:  
3. Mobile: 072 258591  
4. ID NO. / Passport NO. (Optional): 11444080

(A) Neighbourhood information

5. How long have you lived/worked in this area?  
40 years
6. What is the distance (estimate) between your residence/enterprise and the proposed site? (Tick where applicable).
- (A). Less than 100m. (B). Between 100-500m.  
(C). Between 500-1000m. (D) Over 1km.
7. What is your opinion on the proposed project?  
They should consider the locals  
for job opportunities

(B) Environmental Impact

8. Do you think that the project will lead to any environmental impacts on your neighbourhood?  
YES/NO (Tick one please)

If yes, please list them

.....  
.....  
.....



9. Is there anything you would suggest to ensure the project has minimal impact on the environment?

YES/NO (Tick one please)

If yes, please state:

.....  
.....  
.....

**(C) Social-Economic Impacts**


10. Do you think that the project will have any socio-economic impacts on the neighbourhood? YES/NO (Tick one please)

- (a) If YES, what positive socio-economic and environmental impacts do you anticipate during the operation phase?

.....  
.....  
.....

11. Make suggestions on the measures the developer needs to continually put in place during the *operation stage* for this project

..... WP are required excavators  
..... pre-so consider vs  
.....  
.....  
.....

Signature/Stamp: 

Date: 6/07/23

THANK YOU FOR YOUR FEEDBACK.



QUESTIONNAIRE FOR THE ENVIRONMENTAL AND SOCIAL IMPACT  
ASSESSMENT STUDY REPORT FOR THE PROPOSED WORLD TRADE  
CENTRE HOSPITAL ON PLOT L.R. NO. 24861/1 WITHIN THE NAIROBI  
BUSINESS PARK ALONG NGONG ROAD, NAIROBI COUNTY

Personal Information

1. Name: *FAUSTIN ITANGINEZA*
2. Address: *KABIRIA*
3. Mobile: *0711 980995*
4. ID NO. / Passport NO. (Optional): *0P0131344*

(A) Neighbourhood information

5. How long have you lived/worked in this area?  
*6 years*
6. What is the distance (estimate) between your residence/enterprise and the proposed site? (Tick where applicable).  
(A). Less than 100m. (B). Between 100-500m.  
(C). Between 500-1000m. *X* (D) Over 1km.
7. What is your opinion on the proposed project?  
*The project is very good in  
our society*

(B) Environmental Impact

8. Do you think that the project will lead to any environmental impacts on your neighbourhood?  
YES/NO (Tick one please)

If yes, please list them

*N/A*



9. Is there anything you would suggest to ensure the project has minimal impact on the environment?

YES/NO (Tick one please)

If yes, please state:

..... *no* .....  
.....  
.....

**(C) Social-Economic Impacts**

10. Do you think that the project will have any socio-economic impacts on the neighbourhood? YES/NO (Tick one please)

- (a) If YES, what positive socio-economic and environmental impacts do you anticipate during the operation phase?

..... *no any socio-economic impact* .....  
.....

11. Make suggestions on the measures the developer needs to continually put in place during the *operation stage* for this project

..... *we will need to get the jobs* .....  
..... *in the project* .....  
.....

Signature/Stamp: .....



Date: .....

*6/7/2023*

THANK YOU FOR YOUR FEEDBACK.



QUESTIONNAIRE FOR THE ENVIRONMENTAL AND SOCIAL IMPACT  
ASSESSMENT STUDY REPORT FOR THE PROPOSED WORLD TRADE  
CENTRE HOSPITAL ON PLOT L.R. NO. 24861/1 WITHIN THE NAIROBI  
BUSINESS PARK ALONG NGONG ROAD, NAIROBI COUNTY

Personal Information

1. Name: Peter Obwaciu
2. Address: 79474 00200 Nairobi
3. Mobile: 0720219144
4. ID NO. / Passport NO. (Optional): 22461970

(A) Neighbourhood information

5. How long have you lived/worked in this area?  
38 yrs
6. What is the distance (estimate) between your residence/enterprise and the proposed site? (Tick where applicable).  
☒ (A). Less than 100m.                      (B). Between 100-500m.  
(C). Between 500-1000m.                      (D) Over 1km.
7. What is your opinion on the proposed project?  
I support the project fully due to the benefits to be gained

(B) Environmental Impact

8. Do you think that the project will lead to any environmental impacts on your neighbourhood?  
☒ YES/NO (Tick one please)

If yes, please list them

Health based agendas  
And employment



9. Is there anything you would suggest to ensure the project has minimal impact on the environment?

YES/NO (Tick one please)

If yes, please state:

More public participations and  
involvements

(C) Social-Economic Impacts


10. Do you think that the project will have any socio-economic impacts on the neighbourhood? YES/NO (Tick one please)

- (a) If YES, what positive socio-economic and environmental impacts do you anticipate during the operation phase?

Employment  
involvement on further being busy

11. Make suggestions on the measures the developer needs to continually put in place during the operation stage for this project

access roads and commitment in  
involvement in all stages

Signature/Stamp: 

Date: 6/06/2023

THANK YOU FOR YOUR FEEDBACK.



QUESTIONNAIRE FOR THE ENVIRONMENTAL AND SOCIAL IMPACT  
ASSESSMENT STUDY REPORT FOR THE PROPOSED WORLD TRADE  
CENTRE HOSPITAL ON PLOT L.R. NO. 24861/1 WITHIN THE NAIROBI  
BUSINESS PARK ALONG NGONG ROAD, NAIROBI COUNTY

Personal Information

1. Name: DANIEL MACHARIA KIHAMWA  
2. Address: danmashfabricators@gmail.com  
3. Mobile: 0728813330  
4. ID NO. / Passport NO. (Optional):

24437690

(A) Neighbourhood information

5. How long have you lived/worked in this area?  
15 years
6. What is the distance (estimate) between your residence/enterprise and the proposed site? (Tick where applicable).
- ☒ (A). Less than 100m. (B). Between 100-500m.  
(C). Between 500-1000m. (D) Over 1km.
7. What is your opinion on the proposed project?  
we are excited about it

(B) Environmental Impact

8. Do you think that the project will lead to any environmental impacts on your neighbourhood?  
YES/NO (Tick one please)

If yes, please list them

there will be more traffic of people



9. Is there anything you would suggest to ensure the project has minimal impact on the environment?

YES/NO (Tick one please)

If yes, please state:

to ensure there is enough  
access to of people to have  
proceed and wish for construction  
of a foot bridge

(C) Social-Economic Impacts

10. Do you think that the project will have any socio-economic impacts on the neighbourhood? YES/NO (Tick one please)

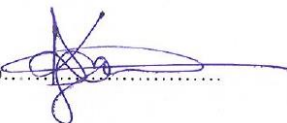
- (a) If YES, what positive socio-economic and environmental impacts do you anticipate during the operation phase?

Job creation  
accessibility of Health  
Care

11. Make suggestions on the measures the developer needs to continually put in place during the *operation stage* for this project

the developer to involve  
the local as metal  
artisan during the project  
in metal fabrication

Signature/Stamp



Date:

6/07/2023

THANK YOU FOR YOUR FEEDBACK.



QUESTIONNAIRE FOR THE ENVIRONMENTAL AND SOCIAL IMPACT  
ASSESSMENT STUDY REPORT FOR THE PROPOSED WORLD TRADE  
CENTRE HOSPITAL ON PLOT L.R. NO. 24861/1 WITHIN THE NAIROBI  
BUSINESS PARK ALONG NGONG ROAD, NAIROBI COUNTY

### Personal Information

1. Name: Harrison Mbogwe  
2. Address: \_\_\_\_\_  
3. Mobile: 0728868319  
4. ID NO. / Passport NO. (Optional): \_\_\_\_\_

### (A) Neighbourhood information

5. How long have you lived/worked in this area?  
..... 5 plus 1000 .....
6. What is the distance (estimate) between your residence/enterprise and the proposed site? (Tick where applicable).
- (A). Less than 100m. (B). Between 100-500m.  
(C). Between 500-1000m. ☒ (D). Over 1km.
7. What is your opinion on the proposed project?  
..... Great Initiative .....

### (B) Environmental Impact

8. Do you think that the project will lead to any environmental impacts on your neighbourhood?  
YES/NO (Tick one please)

If yes, please list them



9. Is there anything you would suggest to ensure the project has minimal impact on the environment?

☒ YES/NO (Tick one please)

If yes, please state:

— Consider noise cancellation for those working around the business park

(C) Social-Economic Impacts

10. Do you think that the project will have any socio-economic impacts on the neighbourhood? ☒ YES/NO (Tick one please)

- (a) If YES, what positive socio-economic and environmental impacts do you anticipate during the operation phase?

— Employment — Income for locals  
— Affordable health for locals & any other people

11. Make suggestions on the measures the developer needs to continually put in place during the *operation stage* for this project

— Entry & Exits to be addressed to avoid the traffic jams

Signature/Stamp:.....

Date:.....

THANK YOU FOR YOUR FEEDBACK.



QUESTIONNAIRE FOR THE ENVIRONMENTAL AND SOCIAL IMPACT  
ASSESSMENT STUDY REPORT FOR THE PROPOSED WORLD TRADE  
CENTRE HOSPITAL ON PLOT L.R. NO. 24861/1 WITHIN THE NAIROBI  
BUSINESS PARK ALONG NGONG ROAD, NAIROBI COUNTY

Personal Information

1. Name: Brendah Onnunga
2. Address:
3. Mobile: 0727633938
4. ID NO. / Passport NO. (Optional): 27409801

(A) Neighbourhood information

5. How long have you lived/worked in this area?  
2 years
6. What is the distance (estimate) between your residence/enterprise and the proposed site? (Tick where applicable).

- (A). Less than 100m. ☒ (B). Between 100-500m.  
(C). Between 500-1000m. (D). Over 1km.

7. What is your opinion on the proposed project?

It is a good initiative to support the community around Ngong road once finalised. It will be good practice to ensure the environment & safety safeguards are regard during the construction phase to allow smooth continuity of surrounding activities

(B) Environmental Impact

8. Do you think that the project will lead to any environmental impacts on your neighbourhood?  
YES/NO (Tick one please)

If yes, please list them

Noise pollution  
Dust pollution (from movement of trucks)



9. Is there anything you would suggest to ensure the project has minimal impact on the environment?

YES/NO (Tick one please)

If yes, please state:

- ① Set minimum speed limit for incoming trucks  
② Well serviced trucks + reduced exhaust fumes emission

**(C) Social-Economic Impacts**

10. Do you think that the project will have any socio-economic impacts on the neighbourhood? YES/NO (Tick one please)

- (a) If YES, what positive socio-economic and environmental impacts do you anticipate during the operation phase?

- ① Easy access + hospital amenity  
② Creation of jobs + the nearby community  
③

11. Make suggestions on the measures the developer needs to continually put in place during the operation stage for this project

- ① Enhance security at the entrance since it will be a shared property  
② Consider a separate entrance from the main MBP entrance

Signature/Stamp: 

Date: 6/7/2023

THANK YOU FOR YOUR FEEDBACK.



QUESTIONNAIRE FOR THE ENVIRONMENTAL AND SOCIAL IMPACT  
ASSESSMENT STUDY REPORT FOR THE PROPOSED WORLD TRADE  
CENTRE HOSPITAL ON PLOT L.R. NO. 24861/1 WITHIN THE NAIROBI  
BUSINESS PARK ALONG NGONG ROAD, NAIROBI COUNTY

**Personal Information**

1. Name: Dominic Mutie
2. Address: P.O.BOX 38120 - NAIROBI
3. Mobile: 0720290176
4. ID NO. / Passport NO. (Optional):

**(A) Neighbourhood information**

5. How long have you lived/worked in this area?  
2 years
6. What is the distance (estimate) between your residence/enterprise and the proposed site? (Tick where applicable).

- (A). Less than 100m. (B). Between 100-500m.  
(C). Between 500-1000m. (D) Over 1km.

7. What is your opinion on the proposed project?

The project is most welcome as it will  
solve health challenges to the  
resident

**(B) Environmental Impact**

8. Do you think that the project will lead to any environmental impacts on your neighbourhood?  
YES/NO (Tick one please)

If yes, please list them

Increased traffic and congestion  
- Noise pollution  
- congestion/increased human traffic in the  
area as patients seek health services



9. Is there anything you would suggest to ensure the project has minimal impact on the environment?

YES/NO (Tick one please)

If yes, please state:

- ✓ security arrangement to be made in the area. - work with the local police station
- ✓ police officers may be advised to control traffic in the area - along main road

(C) Social-Economic Impacts

10. Do you think that the project will have any socio-economic impacts on the neighbourhood? YES/NO (Tick one please)

- (a) If YES, what positive socio-economic and environmental impacts do you anticipate during the operation phase?

- Employment opportunities
- Decrease disease burden

11. Make suggestions on the measures the developer needs to continually put in place during the *operation stage* for this project

- Control traffic
- Ensure there is adequate security
- or rather enhanced security

Signature/Stamp: *[Signature]*

Date: 01/7/2023

THANK YOU FOR YOUR FEEDBACK.



QUESTIONNAIRE FOR THE ENVIRONMENTAL AND SOCIAL IMPACT  
ASSESSMENT STUDY REPORT FOR THE PROPOSED WORLD TRADE  
CENTRE HOSPITAL ON PLOT L.R. NO. 24861/1 WITHIN THE NAIROBI  
BUSINESS PARK ALONG NGONG ROAD, NAIROBI COUNTY

Personal Information

1. Name: Edward Mburu Gattoni
2. Address: NGONG RD
3. Mobile: 0706 026 447
4. ID NO. / Passport NO. (Optional): 24229127

(A) Neighbourhood information

5. How long have you lived/worked in this area?  
32 YEARS
6. What is the distance (estimate) between your residence/enterprise and the proposed site? (Tick where applicable).  
(A). Less than 100m. (B). Between 100-500m.  
(C). Between 500-1000m. ✓ (D) Over 1km.
7. What is your opinion on the proposed project?  
No Problem with the project

(B) Environmental Impact

8. Do you think that the project will lead to any environmental impacts on your neighbourhood?  
YES ☒ NO ☐ (Tick one please)  
If yes, please list them



9. Is there anything you would suggest to ensure the project has minimal impact on the environment?

YES/NO (Tick one please)

If yes, please state:

.....  
.....  
.....

**(C) Social-Economic Impacts**

10. Do you think that the project will have any socio-economic impacts on the neighbourhood? YES/NO (Tick one please)

- (a) If YES, what positive socio-economic and environmental impacts do you anticipate during the operation phase?

.....  
.....  
.....

11. Make suggestions on the measures the developer needs to continually put in place during the *operation stage* for this project

Keep up the good job during  
and after the project

.....  
.....  
.....

Signature/Stamp: .....

Edwin Banda

Date: .....

6/07/2023

THANK YOU FOR YOUR FEEDBACK.



Appendix 11: Attendance List of the stakeholders at the Public baraza

ATTENDANCE LIST OF THE CONSULTATIVE PUBLIC PARTICIPATION MEETING FOR THE PROPOSED WORLD TRADE CENTRE HOSPITAL ON PLOT L.R. NO. 24861/1 WITHIN THE NAIROBI BUSINESS PARK ALONG NGONG' ROAD, NAIROBI COUNTY ON 6<sup>TH</sup> JULY 2023

NO.	NAME	AFFILIATION	TELEPHONE NO/ EMAIL	SIGNATURE
1.	Ochutsi Mnyendo	Jockey club	0727955640 / jmnendo@jockeyclub.co.ke	
2.	Lillian Odoko	GREA	lillian@greafrica.group	
3.	BEN WAWERANCE	Jockey club	0740175694	
4.	Pumi Lukhele	GREA	0740175694	
5.	Daniel Lihanga	Jua Kali	0728813330	
6.	James Karanja	Jua Kali		
7.	Peter Kyalo	Jua Kali	0721717747	
8.	FAUSTIN ITANGINETA	Jua Kali	0711980991	
9.	Cecilia Njuguna	Florist	0726019350	
10.	Kedar Limaye	Nairobi Properties Ltd	0719892711909	
11.	Leah Dun	Knight Frank	0715854135	
12.	SACHIT SHAM.	RENTHOUSE	0727860888	
13.	Pius Wambua	Spurway Kenya	0720981085	
14.	MURUN MUTUKU		0722785484	

NO.	NAME	AFFILIATION	TELEPHONE NO/ EMAIL	SIGNATURE
15.	LUCAS MOTIA	NGANDO	0705969291	
16.	Hamson Mbugua	Block C - HAND	0728868319	
17.	Michael Mwangi	Ngong RD	0703681318	
18.	Mokaya Edwin	Ngong RD Business	0735287711	
19.	Edward Mburu	NGANDU BUSINESS	0706026447	
20.	Timothy Mugo	NGANDU Land owners	0721258591	
21.	PETER Mwangi	NGANDU Land owners	072029144	
22.	Amha Kingi	D. Ughu	0726686539	
23.	Moses Tagat	NBP	0725301211	
24.	Ruper Lomahat	NBP	0700163749	
25.	Benson Mwangi	NBP	0783909284	
26.	ROBERTA Mwangi	Ngong RD: BUSINESS	0724808897	
27.	TITOMAS MWANU	NBP	0769785153	
28.	RUPER KANJUKU	Ngong Racecourse	0712349140	
29.	Brendah Onunga	Block B flight	0721633938	
30.	DOMINIC MUTIC	DCC Langata	0720290170	



# ESIA Study for the Proposed World Trade Centre Hospital

NO.	NAME	AFFILIATION	TELEPHONE NO./ EMAIL	SIGNATURE
31.	WON. DNG	MCA-WOODLEY	0721279819	D.N.
32.	Jackline Adhiambo	Green by Choice Limited	0729706698	<i>[Signature]</i>
33.	Elizabeth Nzani Wachuira	Green by Choice Limited	info@greeneastafrica.com	<i>[Signature]</i>
34.				
35.				
36.				
37.				
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41.				
42.				
43.				
44.				
45.				
46.				



**Appendix 12: Minutes of the Public baraza**

**Environmental and Social Impact Assessment Study for the proposed World Trade Centre Hospital on Plot L.R. No. 24861/1 (Nairobi Block 149/1351) within the Nairobi Business Park along Ngong' Road, Nairobi County.**

Minutes of the public baraza held on 7<sup>th</sup> July 2023 within the Nairobi Business Park along Ngong' Road, Nairobi County.



**Prepared by:**

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## **1 Public baraza program**

The stakeholder consultative meeting was held as per the provisions of the Environmental Management and Coordination Act Cap 387 of the Laws of Kenya. It was convened by Green by Choice Limited on 6<sup>th</sup> July 2023, within the Nairobi Business Park along Ngong' Road, Nairobi County. The agenda of the meeting was as follows:-

- i. Introduction**
- ii. Introductory remarks by the consultants**
- iii. Address by the Proponent and co-developers**
- iv. Plenary session**
- v. Way forward**

### **12.1 Introduction**

The meeting was called to order by the Lead Expert, Mrs. Elizabeth N'zani Wachira, at 10:30am. Ms. Cecilia Njuguna, a florist along Ngong' Road, then gave a word of prayer. After the prayers, Mrs. Elizabeth welcomed the stakeholders and briefly introduced the Proponent, the Project Management team Gateway Real Estate Africa (GREA) and the Environmental and Social Impact Assessment (ESIA) study implementing team Green by Choice (GBC).

### **12.2 Introductory remarks by the consultants**

Mrs. Elizabeth informed the stakeholders that Green by Choice Limited has been registered by the National Environment Management Authority (NEMA) and has eighteen (18) years of experience. She mentioned that the firm has been involved in a number of construction projects within the country including the construction of hospitals.

Ms. Jackline Adhiambo, an Associate Expert, stated that public and stakeholder participation in the ESIA process is a legislative requirement under Article 69 of the Constitution of Kenya 2010 and Regulation 17 of the Environmental Management and Coordination (Impact Assessment and Audit) Regulations, 2003. She mentioned that several key stakeholders were invited stemming from the State Agencies, Non-Governmental Organizations to the general public who are neighbours to the proposed project site. She outlined the agenda of the public baraza as follows:-

- 1) To inform stakeholders about the proposed project,
- 2) To canvass their inputs, views and concerns,
- 3) To enable their views to be taken into account during decision making and
- 4) To increase public confidence in the ESIA Study report.

### **12.3 Address by the Proponent and co-developers**

Mr. Kedar Limaye stated that the NBP Holdings Limited owns approximately thirty-two acres of land and have a Masterplan in place. The Masterplan has in place affordable housing, hospital, hotels among other projects. He mentioned that they are currently proposing to utilize 2.5 acres for the development of the proposed hospital. He assured the stakeholders that the proposed hospital aims to offer affordable healthcare for all. The Nairobi Business Park comprises part of the Masterplan of NBP Holdings Limited.



Mr. Pius Wambua, the local architect (Symbion), gave a comprehensive description of the hospital development and design. He added that a slip road will be provided for emergency use from Ngong' Road. Ms. Pumi Lukhele from Gateway Real Estate Africa, informed the stakeholders on the development status of the proposed project. She mentioned that after obtaining all approvals, the construction of the proposed hospital will take approximately twenty four months. She further stated that the proposed hospital is envisioned to commence its operations in the year 2026 – with construction scheduled to end by Quarter 4 of 2025. She stressed that approximately four hundred (400) jobs will be created whereby 60% will be skilled workforce and 40% unskilled. She assured the stakeholders that 60% of the total jobs that will be created during the construction phase will be offered to the youths. She added that they will be empowering women in the construction industry through Buildher, a non-profit social enterprise. She concluded by stating that they will ensure sustainability during the construction phase by incorporating International Codes and Standards and reducing their energy and water consumption.

### **12.4 Plenary session**

Mr. Ben Lawrence, the General Manager of the Jockey Club of Kenya, wanted to know the measures put in place to mitigate noise emanating from the Racecourse activities during the operation of the proposed hospital. He stated that the patients may be uncomfortable with the noise intrusion. Mr. Ben suggested that the Proponent should provide an access road directly from the Ngong' Road instead of using the main entrance to the Nairobi Business Park. This, he said, would reduce the traffic snarl-ups to those accessing the business park and the racecourse area. His sentiments were echoed by Ms. Anita Kingi from D.light and Mr. Peter Ndwaru the secretary of Ngando landowners.

In response to the above, Mr. Kedar stated that the hospital will be some distance from the racecourse and that acoustic consultants will be involved to ensure that the patients are not bothered by any events. On the issue of access road, he said that the contractors will open an entrance/exit directly from Ngong' Road during construction.

Ms. Anita acknowledged that there will be noise pollution during the construction phase. She stated that she is a tenant within the business park and was keen to know the mitigation measures that will be put in place. She also wanted to know the level of the proposed hospital. Ms. Pumi responded and stated that they will close up the site and will issue notices to the neighbours prior to high level noise activities. Moreover, she said that they aim to reduce noise by incorporating technology that will eventually reduce the turnaround time. Mr. Kedar added that the proposed hospital will offer affordable healthcare and will be accepting the National Health Insurance Fund (NHIF).

Mr. Daniel Kihanja, a Juakali artisan, was concerned that the proposed project will displace them (the craftsmen) and requested the Proponent to allow them to continue displaying their wares during the construction period. He added that the craftsmen are skilled and it will be beneficial if they were involved in the metal works and landscaping activities at the proposed



## **ESIA Study for the Proposed World Trade Centre Hospital**

project. Finally, he pointed out that there is an incomplete footbridge where the proposed access road to the project site will be. In response to this, Mr. Sachit Shah from NBP Holdings Limited, mentioned that no one will be affected since where the craftsmen are located is not part of their property. Ms. Pumi assured the stakeholders that the contractors who will be engaged are mandated to engage a workforce from the surrounding area. Mr. Kedar added that they had previously approached Kenya Urban Roads Authority (KURA) and informed them about the proposed hospital and agreed that the footbridge will be relocated.

Mr. Ochutsi Munyendo, an arbitrator, stated that the Jockey Club of Kenya had no objection to the proposed project. He clarified that the proposed project does not interfere with the Jockey's club activities save for the concerns that Mr. Ben raised. He added that the proposed project site does not belong to the Ngong' Road Forest Reserve. He presented a memorandum of no objection to the consultants (Figure 1).



**Figure 13: Mrs. Elizabeth receiving the memorandum of no objection during the public baraza**

Mr. Harrison Mbugua, a resident of Ngong' Road, expressed concern about the increase in human traffic and how it will contribute to insecurity. Mr. Sachit responded and stated that security will be increased and integrated as the proposed project progresses.

Mr. Edward Mburu, a businessman, was grateful that the local community members will be employed but noted that the project might increase HIV/AIDS prevalence in the area (as people will have more disposable income) and the Proponent should be at the forefront of awareness creation. In response to this, Ms. Pumi stated that the Health Safety and Environment experts normally engage the workforce and create awareness on safety, as well as wellness workshops.

Mr. Peter Ndwaru stated that the proposed project will be beneficial, and that he has no objection. He mentioned that as a community they still need the footbridge which will also help the patients to access the facility. He requested the Proponent to construct a Police Post



## **ESIA Study for the Proposed World Trade Centre Hospital**

as part of Corporate Social Responsibility (CSR). Mr. Sachit responded and stated that they will consult with KURA about the footbridge. He added that CSR activities will be done in consultation with the local community leaders.

Ms. Anita was concerned about the increase in traffic during the operation phase of the proposed hospital. In response to this, Ms. Elizabeth stated that a Traffic Impact Assessment will be conducted.

Mr. DNG, the Member of County Assembly - Woodley ward, urged the Proponent to work closely with the elected leaders in order to abate any unforeseen conflicts.

### **12.5 Way forward**

Mrs. Elizabeth Wachira stated that the consultancy team would incorporate all the issues raised by the stakeholders during the preparation of the ESIA study report. She stated that the final ESIA study report will be submitted to NEMA and later advertised twice in Newspapers, in the Kenya Gazette and on a local radio station in order to gather more views and concerns from the general public.

She thanked the stakeholders for attending the public baraza and their invaluable contribution which will inform the ESIA study process.

### **13 Closure of the meeting**

There being no any other business, the meeting ended at 11:50 am.

Signed: \_\_\_\_\_ Date: \_\_\_\_\_

Ms. Jackline Adhiambo,  
Green by Choice Limited  
Meeting Secretary

Signed: \_\_\_\_\_ Date: \_\_\_\_\_

Mrs. Elizabeth N'zani Wachira,  
Green by Choice Limited  
Lead Expert

Signed: \_\_\_\_\_ Date: \_\_\_\_\_

Name: \_\_\_\_\_

NBP Holdings Limited  
Proponent



Date: 4<sup>th</sup> July 2023

MEMORANDUM OF NO OBJECTION BY THE JOCKEY CLUB OF KENYA TO  
THE PROPOSED WORLD TRADE CENTRE HOSPITAL ALONG NGONG ROAD,  
NAIROBI COUNTY

1. The Jockey Club of Kenya (hereafter Jockey Club), is the registered proprietor of the above referenced Titles being L. R NO. 9937/11, contained in the Grant registered at the Registry of Titles in Nairobi as L.R. 17230 and LR NO 24862 contained in the Grant registered at the Registry of Titles in Nairobi as GRANT L.R. 83515. The sizes of the above parcels of land are approximately 407 acres and 36.28 acres, respectively and Certificates of Title were issued as evidence of its ownership thereof.
2. The above parcels of land are contiguous to the Nairobi Business Park as their land and title derived from a sub division of the initial title held by the Jockey Club being L.R No.9937.
3. Jockey Club holds and hosts various activities as are more particularized in its rules and regulations but primarily sporting and recreation events of which horse riding and racing on its race course are the core activities.
4. Jockey club does not object to the development proposed for reason that the same will not in any way interfere with its said activities or its members and patrons accessing its facilities. From the information given the proposed development will be inside the Nairobi Business Park on plot no. L.R No. 24861/1-2 and which land is registered in the name of the said Nairobi Business Park.



5. The said land does not form part of the Ngong forest reserve for reason that the original Grant from where the title thereto derived was held as the private land held by the Jockey Club and which does not form part of the said Ngong Road Forest Reserve.
6. The history of the land held by Jockey Club is as follows;
  - a. On the 10<sup>th</sup> March 1927, a motion was passed by the Kenya Legislative Council with regard to a Race Course site. From the Hansard record of the proceedings, it is clear that at the time, the Jockey Club was already in existence and owned land within the then Municipality of Nairobi and where it used to carry out its activities. The thrust and subject of the said motion was that the colonial government took over the Jockey Club land within the Municipality of Nairobi upon its surrender thereto in consideration of allocating the club 350 acres of land along Ngong Road, in the area then generally referred to as the Ngong Area.
  - b. The said motion that was moved and passed stated expressly that;

*"In accordance with an arrangement with Jockey Club, an agreement has been reached that they would surrender their present lease and accept a lease of 350 acres in its place of land along the Ngong Road but in the forest area on the understanding that the transfer would be subject of no expense to the club. The erection of stands, the preparation of the ground, the erection of fences and other things will*



*involve a certain expenditure, the total cost of which is estimated at 5,000 pounds."*

- c. Pursuant to the passing of the said motion, on the 30<sup>th</sup> March 1927 and quite clearly corresponding to the foregoing, a survey was done and deposited with the Survey Office and registered thereon as FR 53/34. In the said survey, the general race course area is clearly demarcated and identified with clearly marked boundaries that are marked thereon. The area generally described in the said survey as a Forest area is outside the boundaries described in that said survey map and which demonstrates that the general Jockey Club premises allocated for its racecourse and related activities, had been identified, demarcated and alienated from the general forest area.
- d. Ngong Forest area was formally declared as such by way of Proclamation 44 of 1932, which was made under Section 3 of the Forest Ordinance (repealed). The said proclamation declared various areas to be Forest areas as per the first schedule attached to it and where with regard to Ngong Forest it provided for various bearings, beacons and co-ordinates that describe and define it. The said proclamation did not expressly state and provide for the size of the area of land so declared as Ngong Forest and neither did it set out the exact demarcations of the forest area by way of boundaries as the same had not been established at the time.



- e. The said Proclamation No. 44 of 1932 was subsequently amended severally and variously by other subsequent proclamations issued under the Forest Ordinance. These include;
  - i. Proclamation No. 14 of 1933
  - ii. Proclamation No. 122 of 1934
  - iii. Proclamation No. 46 of 1946
  - iv. Proclamation No. 70 of 1949
- f. By way of Government Notice No. 262 of 13<sup>th</sup> March 1946, there was established a Forest Boundary Commission with the express legal mandate to establish the boundaries of all gazette Forest Areas under Sections 4 and 5 of the Forest Ordinance(repealed).The terms of reference thereof clearly show that no forest area had been previously demarcated and its boundaries defined notwithstanding their gazettelement as general forest area under Proclamation 44 of 1932 as amended subsequently by various other Proclamations.
- g. In the said Gazette Notice, the government noted that;
  - “(2) Under Section 5 of the Forest Ordinance, it is provided that after plans have been deposited for public inspection for a period of three months, the Governor in council may proclaim a forest area to be a demarcated forest. No alteration to the boundaries of a demarcated forest is possible except by resolution of the Legislative Council. No forest areas have yet been declared demarcated forests and it is considered that the time had come when the greater*



*legal security afforded by Section 5 of the Ordinance should be accorded to the colony's forests and finality should be reached with regard to their boundaries"*

- h. From the various boundary plans published thereafter and specifically boundary plans no.75/87,175/115,175/23 and 175/105, it is clear that from the location of the Jockey Club premises that it did not fall within the boundaries of the Ngong Forest Area as established and published in those boundary plans and which are deposited in File F/26 at the Survey Office of the Colonial Government.
  - i. Jockey Club was issued with a Grant for the subject premises being GRANT I.R. 17230 (Land Reference No. 9937), for a term of 99 years from 1<sup>st</sup> October 1950. Accordingly, as at this time and date, the subject premises did not fall within the area demarcated as Ngong Road Forest area.
  - j. Upon independence and by way of Legal Notice 174 of 1964, Ngong Forest was declared to be a Central Forest with an estimate size of approximately 3722 acres and which had been initially declared as a forest area vide Proclamation 44 of 1932.
7. On the special conditions to the Grant registered as I.R No. 17230, whereas special condition no. 2 on the Grant specified and restricted the user thereof to a race horse for horses and ancillary purposes only, the Jockey Club of Kenya in the year 2000, applied for and was granted an



approval to sub divide the original parcel of land contained in the Grant and also a change of user. It was subsequent to this sub-division that it sold the land upon which the project is proposed to be done, to the Nairobi Business Park and which has held and used it for the last over twenty (20) years.

8. The Jockey Club of Kenya for the above reasons reiterates that it is not opposed to the intended development.

SIGNED




THE JOCKEY CLUB OF KENYA



## ESIA Study for the Proposed World Trade Centre Hospital

### Appendix 13: NEMA e-citizen payment receipt



**nema**  
mazingira yetu / uhai wetu / wajibu wetu

Payment Receipt

Invoice Number: **SRA\_3010**  
Invoice Status: **PAID**

Applicant Details:  
PIN: P051736990A  
Name: NBP Holdings Limited  
Phone: 0711499151  
Email: jadhiambo254@gmail.com; jackline.adhiambo@greeneastafrica.com

Service	Description	Amount (KES)
EIA Study Report	Payment for EIA Study Report	3,240,186
Total Amount Paid		3,240,186
Balance		0

Payment was made manually(Not through Ecitizen)

**Note** :This document is computer generated and therefore not signed. Present it during licence or permit collection



Appendix 14: EIA/EA Lead Expert/Firm 2023 License

  
**nema**  
mazingira yetu | uhai wetu | wajibu wetu

FORM 7 (r.15(2))

**NATIONAL ENVIRONMENT MANAGEMENT  
AUTHORITY (NEMA)**  
**THE ENVIRONMENTAL MANAGEMENT AND CO-ORDINATION ACT**  
**ENVIRONMENTAL IMPACT ASSESSMENT/AUDIT (EIA/EA) PRACTICING  
LICENSE**

License No : NEMA/EIA/ERPL/19256  
Application Reference No: NEMA/EIA/EL/25240

M/S **ELIZABETH NZANI WACHIRA**  
(individual or firm) of address  
P.O. Box 21212 - 00505 NAIROBI

is licensed to practice in the

capacity of a (Lead Expert/Associate Expert/Firm of Experts) **Lead Expert**

**General**

registration number **0848**

in accordance with the provision of the Environmental Management and Coordination  
Act Cap 387.

Issued Date: 3/30/2023      Expiry Date: 12/31/2023

Signature.....

(Seal)  
**Director General**  
**The National Environment Management Authority**

P.T.O.

  
ISO 9001:2015 Certified



  
**nema**  
mazingira yetu | uhai wetu | wajibu wetu

FORM 7 (r.16(2))

**NATIONAL ENVIRONMENT MANAGEMENT  
AUTHORITY (NEMA)**  
**THE ENVIRONMENTAL MANAGEMENT AND CO-ORDINATION ACT**  
**ENVIRONMENTAL IMPACT ASSESSMENT/AUDIT (EIA/EA) PRACTICING  
LICENSE**

License No : NEMA/EIA/ERPL/19485  
Application Reference No: NEMA/EIA/EL/28597

**M/S GREEN BY CHOICE LIMITED**  
(individual or firm) of address  
P.O. Box 21212 - 00505 NAIROBI

is licensed to practice in the

capacity of a (Lead Expert/Associate Expert/Firm of Experts) **Firm of Experts**  
registration number **7811**

in accordance with the provision of the Environmental Management and Coordination  
Act Cap 387.

Issued Date: **4/27/2023**      Expiry Date: **12/31/2023**

Signature.....

  
(Seal)  
**Director General**  
**The National Environment Management Authority**

P.T.O.  
  
ISO 9001:2015 Certified