ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT REPORT FOR THE PROPOSED CONSTRUCTION OF SEVEN FORKS SOLAR PLANT LOCATED IN MBEERE SOUTH SUB-COUNTY, EMBU COUNTY

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CERTIFICATION

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This ESIA report has been prepared by MOTT MACDONALD and ECO PLAN MANAGEMENT LIMITED Company a firm of NEMA registered EIA experts. We the undersigned certify that the content of this report is righteous and correct to the best of our knowledge.

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BRIEF PROJECT DESCRIPTION

The Kenya Electricity Generating Company Limited (KenGen or the Project Proponent) has identified a need to expand and diversify its generation portfolio. It has engaged K&M Advisors LLC, Mott MacDonald LLC USA and EcoPlan Management Limited (EcoPlan) to develop the proposed Seven Forks Solar Project, a solar photovoltaic (PV) power project with capacity of approximately 45MWAC[1]in Embu County, Kenya. It is intended that the electricity generated by the Project will be fed into the Kenya National Transmission System (KNTS). It is against this background that the proposed development of the Seven Folks Solar Power Plant Project has been subjected to an Environmental Impact Assessment in compliance with the requirements of Environmental Management and Coordination Act (EMCA) 1999 and Environmental (Impact Assessment and Audit) regulations 2003.The Kenya Government policy on all new projects requires that an Environmental Impact Assessment (EIA) study be carried out at the project planning phase in order to ensure that significant impacts on the environment are taken into consideration at the construction, operational and decommissioning stages.

The following document contains four sections, namely;

1) Non-Technical Summary (NTS)
2) Environmental and Social Impact Assessment Study Report (ESIA)
3) Environmental and Social Monitoring Plan (ESMP)
4) Stakeholder Engagement Plan (SEP)

Conclusions and Recommendations

The consulting team's opinion is that the project is important for the economic development of the area and for its success; the proponent is advised to balance environmental and social considerations and benefits through implementation of the proposed mitigation measures. It is recommended that preventive measures be given first and due consideration in order to reduce costs of undertaking the mitigation measures and at the same time reduce the overall project impacts. It is also recommended that, the project impacts be continuously monitored, and the monitoring results be documented, analyzed and reviewed against recommended standards to enable take appropriate action in good time.

KenGen
Kenya Electricity Generating Company Ltd.

Seven Forks Solar Project

Volume I Non-Technical Summary

December 22, 2017

Kenya Electricity Generating Company Ltd
Final

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Seven Forks Solar Project

Volume I Non-Technical Summary

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Glossary of terms

Table 1: Glossary of terms

Term	Definitions
Area of Influence (AOI)	The area over which the impacts of the Project are likely to be felt as well as any reasonably foreseen unplanned developments induced by the Project or cumulative impacts
Associated facilities	Facilities that are not funded as part of the project and that would not have been constructed or expanded if the project did not exist and without which the project would not be viable
Baseline surveys	Gathering of data to describe the existing physical, biological, socioeconomic, health, labour, cultural heritage, or any other variable considered relevant before project development
Biodiversity	Variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are a part; this includes diversity within species, between species, and of ecosystems
Chance find	Archaeological or cultural sites and artefacts, including such items as ceramics, tools, buildings, burials, etc., previously unrecognized in baseline studies that are discovered during exploration activities
Consultation	Consultation is a two-way process of dialogue between the project company and its stakeholders. Stakeholder consultation is about initiating and sustaining constructive external relationships over time
Critical habitat	Either modified or natural habitats supporting high biodiversity value, such as habitat required for the survival of critically endangered or endangered species
Cultural heritage	Defined as resources with which people identify as a reflection and expression of their constantly evolving values, beliefs, knowledge and traditions
Cumulative impacts	The combination of multiple impacts arising from existing projects or activities, and/or anticipated future projects or activities
Direct area of influence	Considers the physical footprint of the projects such as the right of way, construction sites, work staging area and area affected during operational works (e.g. traffic patterns)
Ecosystem	The interacting system of a biological community and its non-living environmental surroundings
Effluent	Wastewater - treated or untreated- that flows out of a treatment plant, sewer, or industrial outfall
Emission	Pollution discharged into the atmosphere from smokestacks, other vents, and surface areas of commercial or industrial facilities; from residential chimneys; and from motor vehicle, locomotive, or aircraft exhausts
Environmental and Social Impact Assessment (ESIA)	A forward-looking instrument that can proactively advise decision-makers on what might happen if a proposed activity is implemented. Impacts are changes that have environmental, political, economic, or social significance to society. Impacts may be positive or negative and may affect the environment, communities, human health and well-being, desired sustainability objectives, or a combination of these
Environmental and Social Management Plan (ESMP)	Summarises the company's commitments to address and mitigate risks and impacts identified as part of the ESIA, through avoidance, minimization, and compensation/offset, and monitor these mitigation measures
Environmental and social management system (ESMS)	Part of the Project's overall management system that includes the organizational structure, responsibilities, practices and resources necessary for implementing the project-specific management program developed through the environmental and social assessment of the Project
Good International Industry Practice (GIIP)	Exercise of professional skill, diligence, prudence, and foresight that would reasonably be expected from skilled and experienced professionals engaged in the same type of undertaking under the same or similar circumstances globally or regionally. The outcome of such exercise should be that the project employs the most appropriate technologies in the project-specific circumstances
Greenhouse gases	The following six gases or class of gases: carbon dioxide (CO2), nitrous oxide (N2O), methane (CH4), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulphur hexafluoride (SF6)
Grievance	Procedure provided by a project to receive and facilitate resolution of affected communities'

Term	Definitions
mechanism	concerns and grievances about the project's environmental and social performance
Habitat	Terrestrial, freshwater, or marine geographical unit or airway that supports assemblages of living organisms and their interactions with the non-living environment
Hazardous waste	By-products of society that can pose a substantial or potential hazard to human health or the environment when improperly managed. Substances classified as hazardous wastes possess at least one of four characteristics—ignitability, corrosivity, reactivity, or toxicity— or appear on special lists
Indigenous peoples	Defined by the World Bank E&S Framework as a distinct social and cultural group possessing the following characteristics in varying degrees: (a) Self-identification as members of a distinct indigenous social and cultural group and recognition of this identity by others; (b) Collective attachment to geographically distinct habitats, ancestral territories, or areas of seasonal use or occupation, as well as to the natural resources in these areas; (c) Customary cultural, economic, social, or political institutions that are distinct or separate from those of the mainstream society or culture; and (d) A distinct language or dialect, often different from the official language or languages of the country or region in which they reside
Indirect area of influence	Includes area which may experience project related changes in combination with activities not under the direct control of the project
Information disclosure	Disclosure means making information accessible to interested and affected parties (stakeholders). Communicating information in a manner that is understandable to stakeholders is an important first and ongoing step in the process of stakeholder engagement. Information should be disclosed in advance of all other engagement activities, from consultation and informed participation to negotiation and resolution of grievances. This will make engagement more constructive
Intangible cultural heritage	According to the 2003 UNESCO convention for the safeguarding of intangible cultural heritage, manifestations of intangible cultural heritage include: Oral traditions and expressions, including language; Performing arts; Social practices, rituals and festive events; Knowledge and practices concerning nature and the universe
Invasive alien species	Non-native species of flora and fauna that are a significant threat to biodiversity due to their ability to spread rapidly and out-compete native species
KenGen	Kenya Electricity Generating Company Limited, the Project Proponent
Land acquisition	All methods of obtaining land for project purposes, which may include outright purchase, expropriation of property and acquisition of access rights, such as easements or rights of way
Livelihood	Full range of means that individuals, families, and communities utilize to make a living, such as wage-based income, agriculture, fishing, foraging, other natural resource-based livelihoods, petty trade, and bartering
Magnitude	The assessment of magnitude is undertaken in two steps. Firstly, the magnitude of potential impacts associated with the Project are categorised as beneficial or adverse. Secondly, the beneficial or adverse impacts are categorised as major, moderate, minor or negligible based on consideration of several parameters
Modified habitat	Land and water areas where there has been apparent alteration of the natural habitat, often with the introduction of alien species of plants and animals, such as agricultural areas
Natural habitat	Land and water areas where the biological communities are formed largely by native plant and animal species, and where human activity has not essentially modified the area's primary ecological functions
Occupational health and safety	The range of endeavours aimed at protecting workers from injury or illness associated with exposure to hazards in the workplace or while working
Pollution	Refers to both hazardous and non-hazardous pollutants in the solid, liquid, or gaseous forms, and is intended to include other forms such as nuisance odours, noise, vibration, radiation, electromagnetic energy, and the creation of potential visual impacts including light
Project affected people	Individuals, workers, groups or local communities which are or could be affected by the project, directly or indirectly, including through cumulative impacts
Renewable energy	Energy sources derived from solar power, hydro, wind, certain types of geothermal, and biomass
Sensitivity	The sensitivity of a receptor is determined based on the review of the population (including proximity / numbers / vulnerability), presence of biological features of the site and the surrounding area, soil, agricultural suitability, geology and geomorphology, proximity of aquifers and watercourses, existing air quality, presence of any archaeological features etc
Significance	Significance of impact considers the interaction between the magnitude and sensitivity criteria
Solid waste	Material with low liquid content, sometimes hazardous. Include municipal garbage, industrial

Term	Definitions
	and commercial waste, sewage sludge, wastes resulting from agricultural and animal husbandry operations and other connected activities, demolition wastes and mining residues
Stakeholders	Stakeholders are persons or groups who are directly or indirectly affected by a project, as well as those who may have interests in a project or the ability to influence its outcome, either positively or negatively
World Bank Group EHS Guidelines	Technical reference documents for environmental protection and set out industry-specific examples of 'international good practice'. Projects are expected to comply with the levels and measures identified in the General EHS Guidelines where host country requirements are less stringent or do not exist

Acronyms

Acronym	Term
AC	Alternating current
AC	Affected communities
AOI	Area of Influence
CAPEX	Capital Expenditures
CLO	Community Liaison Officer
CO_2	Carbon Dioxide
CWMP	Community Waste Management Plan
DC	Direct current
EA	Environmental Assessment
ECIA	Ecological Impact Assessment
EcMP	Ecological Management Plan
ECO	Environmental Control Officer
EHS	Environment, Health and Safety
EIA	Environmental Impact Assessment
EMCA	Environmental Management and Control Act
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
ESMS	Environmental and Social Management System
GHG	Greenhouse gases
GIIP	Good International Industry Practice
GIS	Geographical Information System
GoK	Government of Kenya
HFO	Heavy Fuel Oil
HR	Human resources
HRRP	Habitat Removal and Restoration Plan
IFC	International Finance Corporation
ILO	International Labour Organisation
IP	Indigenous peoples
IUCN	International Union for Conservation of Nature
K&M	K&M advisors (feasibility consultant)
KCAA	Kenya Civil Aviation Authority
KFS	Kenya Forest Service
KeRRA	Kenya Rural Roads Authority
KeNHA	Kenya National Highways Authority
KNTS	Kenya National Transmission System
KPLC	Kenya Power and Lighting Company
KWS	Kenya Wildlife Service
LRP	Livelihood Resettlement Plan
MMLLC	Mott MacDonald LLC
NEMA	National Environment Management Authority
NGO	Non-Governmental Organisation
NMK	National Museums of Kenya
NTS	Non-Technical Summary
OHL	Overhead lines
OHS	Occupational Health and Safety
O&M	Operations and Maintenance
OP	Operational Policy
PAPs	Project Affected Peoples
PIT	Project Implementation Team
PS	Performance Standards
PSC	Project Stakeholder Committee
PV	Photovoltaic
SEP	Stakeholder Engagement Plan
SIA	Social Impact Assessment
TMP	Traffic Management Plan
ToR	Terms of Reference
UN	United Nations
WBG	World Bank Group
WHO	World Health Organisation
WMP	Waste Management Plan

Preface

This document provides a Non-Technical Summary (NTS) of the Environmental and Social Impact Assessment Report (ESIA) of the Seven Forks Solar Project (the "Project"). The purpose of this NTS is to present the main findings of the ESIA process including the predicted impacts and key management, mitigation and enhancement measures related to the Project. This NTS is part of the larger package of ESIA documents.

Hard copies of this NTS and the final versions of the ESIA documents are available to view at the following locations:

- National Environment Management Authority (NEMA) regional office, Embu, Embu County
- NEMA Website www.NEMA.go.ke
- KenGen website: www.kengen.co.ke

Electronic copies are also available upon request from KenGen at the address in Table 2.

The following stakeholder meetings with the affected community and stakeholders were undertaken in December 2017 to consult on the findings of the draft ESIA:

- Stakeholder meeting - KenGen Matendeni Camp, Kamburu, Embu County
- Community meeting – Machang'a community hall, Embu County

You may comment on any of the information included in this document using the contact information below.

You can also contact the KenGen team directly via the following means:

Table 2: Contact details

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1 Introduction and background

1.1 Overview

The purpose of this non-technical summary (NTS) is to present in a clear and simple manner the main findings and conclusions of the environmental and social impact assessment (ESIA) process undertaken for the Seven Forks Solar Project (the Project). The Project is being developed by Kenya Electricity Generating Company Limited (KenGen or the Project Proponent) in Embu County, Kenya.

KenGen has identified a need to expand and diversify the generation portfolio of Kenya. Supported by consultants K&M Advisors (K&M), Mott MacDonald LLC USA (Mott MacDonald) and EcoPlan Management Limited (EcoPlan), KenGen plans to develop the "Seven Forks Solar Project" a solar photovoltaic (PV) power project with capacity of approximately 45MW_{AC}. It is intended that the electricity generated by the Project will be fed into the Kenya National Transmission System (KNTS).

Mott MacDonald and EcoPlan have been commissioned to undertake an ESIA in accordance with the requirements of the Environmental Impact Assessment / Environmental Assessment (EIA/EA) regulations 2003, pursuant to the Environmental Management and Control Act (EMCA) 1999 and EMCA (amendment) 2015 Act and in accordance with international lending guidelines as defined by the International Finance Corporation (IFC) Performance Standards (PSs) 2012.

1.2 What is the objective and scope of the ESIA?

The objective of this ESIA is to:

- Identify and assess the potential environmental and social impacts that the Project may have on the environment and communities within its area of influence (AOI)
- To help avoid, or where avoidance is not possible, minimise, mitigate or compensate for adverse impacts on the environment and communities
- To ensure that the affected communities[1] are appropriately engaged on issues that could potentially affect them
- To promote improved social and environmental performance through the development and effective use of management systems

The ESIA is organised as follows:

- **Volume I** - Executive (Non-Technical) Summary (NTS) (this document)
- **Volume II** - Environmental and Social Impact Assessment (ESIA)
- **Volume III** - Technical Appendices
- **Volume IV** - Environmental and Social Management Plan (ESMP)
- **Volume V** - Stakeholder Engagement Plan (SEP)

This NTS summarises the findings of the ESIA, as presented in Volume II and III; and key management and mitigation requirements as set out in Volume IV to VI.

[1] Reference to communities includes consideration of impacts on laborer's

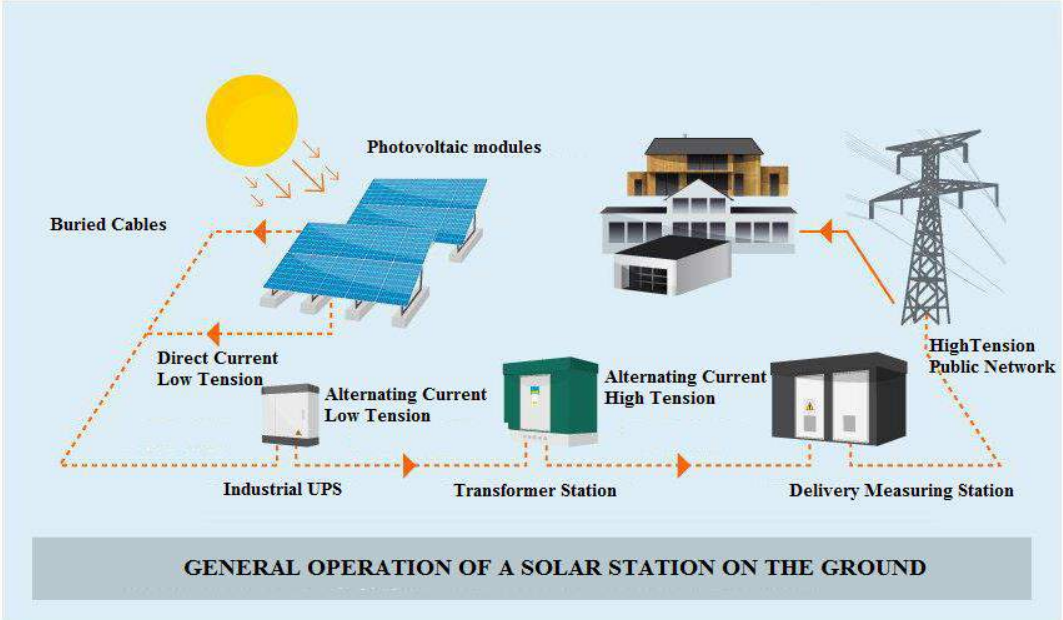
1.3 Who is KenGen?

The Project will be developed by Kenya Electricity Generating Company (KenGen) with support from private investment. KenGen manages all public power generation facilities in Kenya and is the largest power producer in Kenya and East Africa. KenGen owns 26 generation plants throughout Kenya, including 14 hydroelectric plants, six geothermal plants, 3 thermal plants, and 3 wind plants.

1.4 What is photovoltaic (PV) solar power?

Photovoltaic (PV) power uses solar panels to convert sunlight into electricity by converting the solar radiation into electricity. The power plant uses multiple panels, a direct current (DC) / alternating current (AC) convertor, racking system that holds the solar panels, electrical and communications interconnections and supporting infrastructure such as water supply system, drainage systems, security infrastructure, stores and internal roads. Figure 1 illustrates the key components of a solar PV power plant.

Figure 1: General operation of a ground based solar power plant



Source: Mott MacDonald

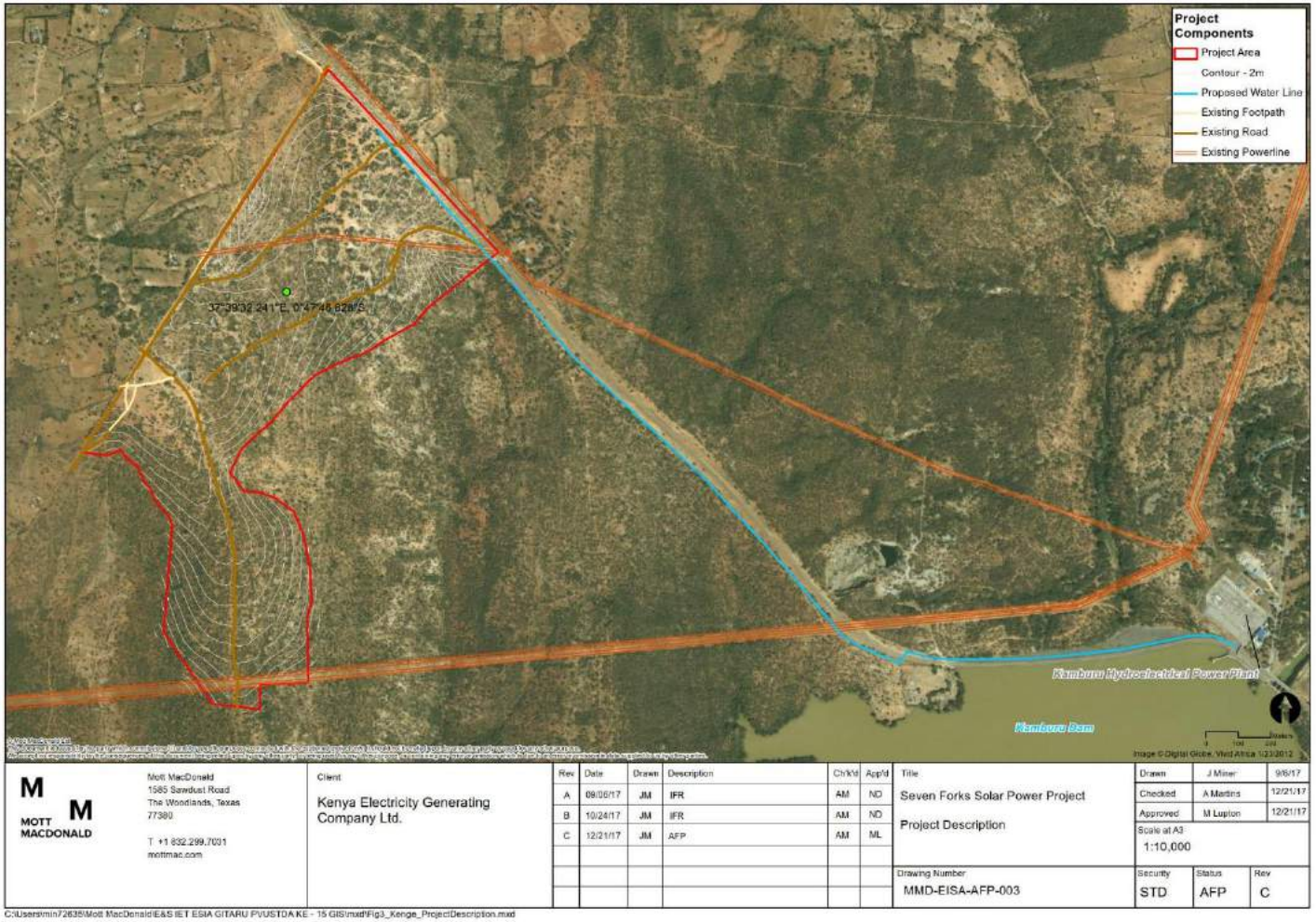
1.5 Where is the Project located?

The Project will be located near the Seven Fork Hydroelectric Power Complex in Mbeere South Sub-County, Embu County, approximately 160km northeast of Nairobi at Latitude 47’48.826” S and Longitude 37 39’32.241” E. The Project site is adjacent to national Highway B7 (Kangonde - Embu Road), approximately 1.5km north of the Kamburu Dam. The Project infrastructure will extend over an area approximately 100 hectares on land that is owned by KenGen. The Project site area is characterized by moderately flat terrain with sandy silty clay and rock slopes at the southern portion of the site close to the Kamburu reservoir. The vegetation is primarily dry and low to medium density, and periodically used by local communities for livestock grazing. The Project site is sometimes used by local communities as a short cut from Route B7 to the reservoir. No loss of access to the reservoir will result from the siting of the solar plant. Refer to Figure 2 to Figure 8 for further illustration.

Figure 2: Project Location

Source: KenGen Seven Forks Power Project Draft ESIA, Rev A, Volume II, November 2017, Mott MacDonald and EcoPlan Management

Figure 3: Project Components



Source: KenGen Seven Forks Power Project Draft ESIA, Rev A, Volume II, November 2017, Mott MacDonald and EcoPlan Management

Figure 4: Preliminary representative plant layout

An example of the Project vegetation and an overview of the site are presented in Figure 5 and Figure 6.

Figure 5: Example of site vegetation

Source: Mott MacDonald / EcoPlan site visit 2017

Figure 6: View across the site looking north

Source: Mott MacDonald / EcoPlan site visit 2017

Figure 7: Grazing on land

Source: Mott MacDonald / EcoPlan site visit 2017

Figure 8: Bee hives at site

Source: Mott MacDonald / EcoPlan site visit 2017

2 Project

2.1 Why is the Project needed?

Electricity consumption in Kenya is currently forecasted to grow by an annual average of approximately 7.3% per year over the long term, while annual peak load is forecasted to grow by an annual average of approximately 7.5%[2]. To alleviate poverty, the country needs to stabilize electricity prices while continuing their current rapid expansion of energy across the county to meet current and future energy demand. This can be achieved by diversifying Kenya's energy source portfolio through the development and implementation of geothermal, wind, solar, and natural gas projects. As Kenya's grid is now largely dependent on hydropower, electricity tariffs and surcharges become increasingly volatile during periods of drought.

The following points summarize the need for, and benefits of, this Project:

- Contribute to national energy goals for sustainable development
- Contribute to diversification of Kenya's energy sources
- Provide continuous, reliable, energy that is not adversely impacted by recurrent drought
- Meet local demand, interconnect to the national grid to lower electricity costs and make it more affordable to reduce poverty and stimulate economic growth
- Provide employment opportunities to the community residing in and around the region
- Contribute to the local economy, and local social and technical infrastructure
- Help to meet Kenya's ambitious national target to increase the country's electricity generation from renewable sources to 85%

2.2 What alternatives have been considered?

Those significant alternatives considered for the Project are broadly categorised as follows, and discussed in more detail below:

- 'No project' alternative
- Options for alternative generation technologies
- Options for alternative sites

The 'no project' alternative would result in:

- Slower transition to the target of 85% of electricity generation to be sourced from renewable energy
- Reduced or slowed diversification of Kenya's generation portfolio
- Potential increase in imports of fuel for power plants that use fossil fuels. These plants have less generating capacity and higher energy costs

Other generation sources which could be considered as similar technology alternatives, include:

- Wind energy
- Geothermal
- Hydropower

[2] Power Generation and Transmission Master Plan, Kenya, Long Term Plan 2015 – 2035 Vol. I

- Biomass / biogas

Solar PV was selected instead of the above listed renewable technologies because:

- There are no CO_2 emissions from general operations, carbon dioxide (CO_2) emissions are only considered within the lifecycle assessment of equipment manufacture,
- Solar PV plants are typically, low maintenance
- It is a renewable technology and will contribute to Kenya's goal of 85% renewable energy
- Recent technological advancements result in greater efficiency and lower costs, there is a potential for solar PV to become a major source within Kenya's energy matrix
- There is a potential to combine solar PV with storage as batteries and other storage technologies become commercially competitive

KenGen considered options to develop the Project within their existing property boundaries. Three key sites were identified and compared, the proposed Project site was selected due to its large area of suitable land, relatively small amount of vegetation, and its proximity to transmission lie for connection to the national transmission system.

2.3 What is the Project?

Key components of the Project are:

- PV modules (mono or poly crystalline)
- Inverters, combiner boxes and transformers
- Underground cabling
- Project substation
- Grid connection directly to the existing 132 kilovolt (kV) Kamburu – Masinga overhead transmission line (OHL) at an interconnection point 3.28km northwest of the Kamburu 132 kV substation
- On-site buildings including an operational control centre, office, welfare facilities, security guard house, storage facilities and stores
- Access from highway B7
- Internal access roads and upgrade to northern premier road
- Site drainage system
- Relocation of an existing low voltage electricity line crossing the site (to be performed by Kenya Power and Lighting Company (KPLC))

2.4 What are the main Project activities?

The following activities will be undertaken to develop the Project:

- Site mobilization
- Civil works
- Procurement and transportation of equipment
- Equipment installation
- Waste generation and disposal
- Commissioning
- Operation and maintenance (O&M)
- Decommissioning

2.5 How much will the Project cost?

The total capital expenditures (CAPEX) budget for the Project is approximately US$57 million.

2.6 What is the planned Project schedule?

The Project implementation schedule is envisaged to be 14 months. Site establishment and civil works is expected to take three months, followed by eight months for installation and a further three months for commissioning. Work on-site is planned to start in the first quarter of 2019.

2.7 What standards have been applied to the Project?

The Project has been evaluated against the following standards:

- KenGen Corporate Environmental Policy Statement
- Environmental Management and Coordination Act (EMCA) 1999 & EMCA (Amendment) 2015, Act and supporting regulations
- Relevant county and local laws and regulations (e.g. The Embu County Environment Management Act, 2015)
- Equator Principles 2013
- The International Finance Corporation (IFC) Performance Standards (PS):
  - IFC PS1 – Assessment and Management of Environmental and Social Risks and Impacts
  - IFC PS2 – Labour and Working Conditions
  - IFC PS3 – Resource Efficiency and Pollution Prevention
  - IFC PS4 – Community Health, Safety and Security
  - IFC PS5 – Land Acquisition and Involuntary Resettlement
  - IFC PS6 – Biodiversity Conservation and Sustainable Management of Living Natural Resources
  - IFC PS7 – Indigenous Peoples
  - IFC PS8 – Cultural Heritage
- Relevant World Bank Group EHS Guidelines
- International conventions and treaties for the protection and conservation of the environment
- Core conventions and instruments of the International Labour Organisation (ILO) and United Nations' (UN)
- Good International Industry Practice (GIIP)

2.8 How has the Project been categorised?

Under Kenya national law the Project is categorised as A requiring a full environmental impact assessment. Under the IFC PSs, we consider this Project to be Category B [3].

2.9 Are there any associated facilities?

No associated facilities as defined by IFC PSs are relevant for this Project.

3 International Finance Corporation's Policy on Environmental and Social Sustainability - www. Ifc.org, page 8 - Category B - Business activities with potential limited adverse environmental or social risks and/or impacts that are few in number, generally site-specific, largely reversible, and readily addressed through mitigation measures.

3 Environmental and social assessment

3.1 How was the Project assessed?

A thorough environmental and social impact assessment has been undertaken for the Project including:

- Establishment of a baseline physical and socio-economic environment to understand current conditions at and around the proposed Project sites
- Prediction of impacts
- Identification of mitigation measures to be included in the design, procedures, development and management of the Project

For baseline data collection, environmental and socio-economic information on the existing environment and communities has been collated from a range of sources including studies, document review, publicly available information, and through consultation.

The following activities were performed:

- 17 to 21 April 2017: Kick off meeting and site selection visit (narrowed down to three preferred sites and subsequent selection of the current site as the preferred site)
- 10 to 16 September 2017: Scoping site visit (objective: preliminary consultation in the community and counties and scoping of issues, site reconnaissance visit)
- September / October 2017: Prepare draft Scoping report and Terms of Reference (TOR)
- 25 September 2017: Submit TOR for ESIA to NEMA
- 27 September 2017: NEMA approve ESIA TOR
- 02 to 06 October 2017: ESIA site visit (objective: consultation, focus groups, baseline data collection)
- 06 and 07 December 2017: Consultation on the ESIA findings

The significance of an impact is evaluated based on sensitivity of Project affected persons / environment and the size of the impact. Where the ESIA found that the Project could cause moderate to substantial impacts then actions or procedures (referred to as mitigation measures) have been developed to avoid, reduce or otherwise mitigate the effects and reduce their significance.

3.2 What consultation and participation has been performed?

The ESIA has been prepared based on consultation with Project-affected persons (PAPs), government departments, non-governmental organisations (NGOs) and community representatives, amongst others.

Primary data was collected through focus groups with PAPs which has been used to inform the social impact assessment (SIA).

The ESIA has a section detailing the consultation that has taken place for the Project during the ESIA phase as well as the key issues raised by stakeholders, which have been considered by specialist contributors.

The key issues raised centred around requests for the Project to consider:

- Options to provide power to the neighbouring communities and how this may be achieved
- Options to improve water infrastructure opportunities
- How the Project may support infrastructure improvements that might support future secondary development in the area (e.g. an industrial park)
- Continuation of livelihood practices in the vicinity of the site
- Opportunities for the Project to reduce risk from crocodiles because of local community need to access water directly from the reservoir
- To consider local area within Mbeere South and Masinga for employment opportunities and empowerment of youth

These have all been addressed in the ESIA and summarised below.

A stakeholder engagement plan (SEP) has been prepared to manage stakeholder and community relations, expectation, and grievances through participation, consultation and disclosure mechanisms.

The SEP includes a community complaints procedure. A Project community liaison officer (CLO) will be identified whose role and responsibilities will include logging and tracking the resolution of grievances.

A dedicated Project Stakeholder Committee (PSC) will be established to liaise between the community and the KenGen Project Implementation Team (PIT) and the CLO who is responsible for implementing the Project.

Figure 9: Bodies consulted during performance of the ESIA

Source: ESIA consultation Seven Forks power project, 2017

4 Findings of the environmental and social impact assessment

4.1 Project enhancement projects

The ESIA identified a need to enhance Project benefits and opportunities and has committed to the following enhancement projects as an integral part of the Project scope of work.

KenGen will formally agree the specific terms of the enhancement programme with the community through the Project Stakeholder Committee (PSC) which will be formed prior to the start of works and before the appointment of the engineering, procurement and construction (EPC) contractor.

- Improved access to electricity (up to two transformers, to be donated / provided to Kenya Power for accelerating the last mile project)
- One community water storage project
- KenGen will seek to partner with local government institutions to support a technical empowerment program to enhance technical education for local youth on low - medium skilled activities prior to the start of construction. This would likely include such skills as electrical work, brick laying, foundations works and welding
- Set up a local hiring / business database (individual and business) (at least 2 months prior to start of construction) and share with the EPC Contractor / append to the EPC contract
- Solar street lighting (Machanga main street) to support small businesses in the area to enhance opportunity for secondary business opportunities from extended operational hours
- Livelihoods restoration, including a training program (grazing / bee keeping / firewood collection) for local community
- Visitor centre including solar power exhibit and historical land use exhibit referring to land use change in the region to date, to established within the existing Hydro Plaza Complex.
- Improvement to Machang'a Health Centre to provide better health, emergency and maternity services
- Buffer zone replanting (reforestation project at 10:1 replanting ratio in line with GIIP)

In addition to the above Project enhancement projects, the community will be eligible for corporate social responsibility programs implemented through the KenGen Corporate social investment fund and the KenGen Foundation as is currently the case. This is separate and in addition to the above projects which are part of the direct project scope of works.

Careful monitoring of these activities will be undertaken to verify implementation.

4.2 What are the potential risk and impacts?

The risks and impacts of the Project have been summarised in the section below;

4.2.1 Positive Risks and impacts by phase of the Project

The ESIA identified the following potential positive impacts for further assessment as set out in the ESIA report:

Construction (including site mobilisation)

- Temporary job creation
- Indirect creation / expansion of business opportunities (food delivery, driving, accommodation, sale of locally available materials (cement, hardware)

Operation

- Improved access to the Kamburu reservoir and around the site
- More stable and diversified electricity network
- Clean energy generation / reduction in national greenhouse gas (GHG) emissions
- Improved visibility and security from Project lighting in the immediate site location
- Job creation

Decommissioning

- Rehabilitation of site to previous land use
- Temporary job creation

4.2.2 Negative Risks and impacts by phase of the Project

The ESIA identified the following potential temporary and permanent negative impacts for further assessment as set out in the ESIA report:

Construction (including site mobilisation)

- Community health and safety risks during construction including the need to consider emergency and abnormal working situations
- Project induced in-migration from outside the local area with potential to impact community health and safety (communicable diseases) and worker conflicts due to competition for jobs
- Abuse against labour rights of local workers
- Possible impacts during emergency situations
- Occupational health and safety impacts on local workforce
- Restriction to informal access rights to land for grazing, bees keeping and access to the reservoir for fishing
- Nuisance effects on local community resulting in:
  - Increase in local traffic movements and wear and tear
  - Increase in ambient environmental noise levels (noise pollution)
  - Increase in ambient dust levels and vehicle emissions around the site
- Biodiversity impacts including:
  - Accidental introduction and dispersal of invasive species
  - Disturbance to terrestrial animal species (e.g. noise, artificial light, vibration)
  - Injury or death of terrestrial animals
  - Permanent habitat loss and habitat fragmentation
  - Hunting and poaching of wildlife due to improved access road
- Temporary or permanent changes to surface water flow and drainage patterns

- Increased water abstraction for construction water requirements resulting in potential conflict with existing local users)
- Contaminated surface water runoff from construction site into nearby surface water bodies (permanent and ephemeral)
- Foul water discharges
- Loss of medicinal shrubs
- Increased soil erosion due to loss of land cover leading to increased sediment run off
- Increased solid waste (non-hazardous) e.g. soil, wood, timber, packaging
- Land use change and economic displacement (no structures of temporary or permanent buildings are noted on the site)

Operation

- Occupational health and safety (OHS) impacts on local workforce
- Increased water abstraction for operational domestic water use and panel cleaning resulting in potential conflict with existing local users)
- Contaminated surface water runoff (during panel cleaning, and other abnormal events)
- Foul water discharges
- Hazardous waste disposal (including end of life disposal for panels and batteries)
- Release of hazardous material (in the case of abnormal operations e.g. module fire, oil spills)
- Potential glint and glare impacts to road users and nearby residential receptors (impact on airfields has been scoped out due to distance to nearest airfield)
- Permanent change in landscape character and visual intrusion (deforestation and introduction of panels)

Decommissioning

- As construction phase but most notably: nuisance (traffic, noise, dust)
- Generation of solid waste (general and hazardous waste) including infrastructure, materials used during construction, and panels

No impacts on indigenous peoples, tribal groups and ethnic minorities are anticipated as the communities in the Project area do not meet the IFC PS 7 criteria to be defined as a distinct social and cultural group and there are no declared[4] indigenous peoples in the Project AOI. In Kenya, the peoples who identify with the indigenous movement are mainly pastoralists and hunter-gatherers, as well as some fisher peoples and small farming communities. They live in other counties and will not be affected by the Project. Pastoralists include the Turkana, Rendille, Borana, Maasai, Samburu, Ilchamus, Somali, Gabra, Pokot, Endorois and others and mostly occupy the arid and semi-arid lands of northern Kenya and towards the border between Kenya and Tanzania in the south. Hunter-gatherers include the Ogiek, Sengwer, Yiaku, Waata and Aweer (Boni)[5].

4.3 Risks and impacts of the Project by topic

4.3.1 Socio-economic

The ESIA identified potential for significant impacts in the following areas:

[4] The Indigenous World 2017. The International Work Group for Indigenous Affairs (IWGIA), 2017. Available at: https://www.iwgia.org/images/documents/indigenous-world/indigenous-world-2017.pdf

[5] Ibid

- Community relations
- Below standard labour rights and working conditions
- Influx of workers
- Lack of opportunities for unskilled workforce
- Loss of livelihoods (grazing animals, bees, firewood)
- Negative perceptions related to existing community access to electricity
- Severance or restriction of access to the reservoir

Some other possible impacts related to this type of project are; accidents, transmission of disease, social conflict, changes in gender relations, and heritage findings. While it is not predicted that any of these impacts will occur, the construction of the Project does raise the potential for their occurrence and hence these risks as well as the predicted impacts require mitigation measures.

Key mitigation measures include:

- Prepare a workers educational awareness and training plan
- Prepare a livelihood resettlement plan (LRP) with community grievance mechanism
- Define and publicize recruitment criteria and procedures (contracts)
- Use village employment committees (as part of the PSC)
- Raise awareness locally and regionally concerning exact opportunities and limitations of employment on the Project
- Ensure community liaison representatives for the PSC are nominated, grievance mechanism is operational
- Prepare a chance finds procedure / consultation with National Museums of Kenya (NMK)

4.3.2 Biodiversity and ecology

The ESIA identified potential for significant impacts in the following areas:

- Terrestrial habitat and flora loss and degradation (permanent and temporary)
- Accidental introduction and dispersal of invasive species
- Disturbance to terrestrial animal species (e.g., noise, artificial light)
- Injury or death of terrestrial animals
- Habitat fragmentation
- Increase in road kills and injuries to wildlife

No impact is expected on Mwea National Reserve, and no significant impact to species of conservation importance or Kenya priority species has been identified. The potential for elephants to stray into the Project area was noted, although the risk is low as this is not a main migratory route, and measures have been identified to address this possibility. Key mitigation measures include:

- Prepare an ecological management plan (EcMP) to address clearance of the site in relation to birds, bats, mammals
- No net loss in natural habitats and compensation planting at a 10:1 replanting ratio
- Compensation planting for loss of medicinal shrubs
- Identify means for the community to clear the site and receive benefits from felled trees

- Plan for the translocation and restoration of bee hives prior to clearance (to be elaborated in the LRP)
- Prepare a habitat removal and restoration plan (HRRP) to restore vegetation at the site as quickly as possible through the use of indigenous plants and to minimise risk from invasive species

Site restoration activities set out in the HRRP include the replanting of temporarily affected areas with dry deciduous tropical forest that replicates the structure and composition of natural forests in the Nature Reserve. Effects on microclimate under the panels may be realised, these will be mitigated by planting slow growing plants under the panels that will help regulate the environment (temperature, humidity and moisture).

Monitoring will start six months after the completion of habitat restoration or creation at each site. Monitoring and maintenance of restored areas will be undertaken for 10 years including measurements of:

- Habitat condition
- Health and survival rate of planted trees

4.3.3 Resources and water quality

The ESIA identified potential significant impacts in the following areas:

- Surface water run-off (normal)
- Extreme run off during high rain events

Key measures to be employed to address potential impacts will include:

- Water abstraction from Kamburu Dam within current permitted allowance
- Use water from other sources if additional water is required for activities such as concrete batching (construction) or panel cleaning (operation)
- Install a rainwater capture system on the plant buildings to capture rainwater for use in vegetation irrigation and landscaping during the dry season (this will also have the secondary benefit of reducing dust and soil erosion impacts)
- Design and specify low water consumption specifications in buildings for low water consumption (e.g. bathrooms)
- Design borrow pits and other engineering infrastructure to minimize alteration of drainage paths and generation of sediment load
- Locate construction compounds away from sensitive water features
- Adopt best practice to minimize risk of pollution during construction and operation
- Storm water treatment system e.g. detention ponds or infiltration basins to be incorporated into the drainage design to manage extreme rainfall events
- Implement a surface water management plan when constructing within 50 m of a surface water body
- Specify best practice construction and site management methods in contractor construction contract and the ESMP
- Retain impermeable surface under the panels and promote sheet run off rather than concentrated run-off to minimise impact on surface water and infiltration patterns

4.3.4 Air quality

The ESIA identified the following potential significant impacts on air quality are:

- Emissions associated with on-site construction plant and vehicles (combustion of fuel) within 200m from the proposed work site
- Emissions associated with construction traffic on the local road network (combustion of fuel)

On-site dust emissions arising from construction activities. No operational impacts are envisaged and will be significantly reduced by requirement to re-vegetate under the solar panels (to minimize dust connected with soil erosion)

Management of construction activities will be based on good international practice and include the following:

- Minimize dust from material handling sources and from open area sources, including storage piles, by using control measures such as covering, seeding or fencing stockpiles to prevent wind whipping
- Use of dust suppression techniques
- Minimize dust from vehicle movements by ensuring that road surfaces used for the Project are tightly compacted to ensure minimal surface break-up
- Avoid open burning of solid waste
- Carry out periodic visual inspection at sites near to receptors
- Carry out tool box talks to all construction workers in relation to dust raising activities
- Minimize fugitive emission from vehicles by requiring engines to be turned off when not in use

Daily visual observations during construction for air quality impacts will be undertaken.

4.3.5 Solar reflection (glint and glare)

The term ‘solar reflection’ is used to refer to both reflection types i.e. glint and glare.

The reflective properties of solar PV panels vary from different manufacturers. Solar panels vary in their reflectivity and include ‘anti-glare’ properties, there is potential that solar panel may not absorb 100% of the incoming light. Therefore, any solar PV panel has the potential to produce a solar reflection.

Glint and glare is defined as follows:

- Glint – a momentary flash of bright light
- Glare – a continuous sources of bright light

Glint is generally a problem for moderate or fast-moving receptors (e.g. road users) while glare is a potential impact for static or slow-moving receptors. It has been determined through review of proximity to the site and consultation that no impact to aviation and in particular air traffic control towers is expected. The nearest airfield is more than 5km from the site. No migratory flyway across the site has been identified.

The determined AOI for glint and glare with refence to best practice is:

- Dwellings within approximately 1km of the development that may have a view of the solar panels
- Roads within approximately 1km of the development that may have a view of the solar panels

The ESIA has identified that there may be a moderate impact from glint and glare to some receptors to the north of the site and road users. Receptors to the east and south are considered outside the AOI. Even if a solar reflection is possible, an impact will only be received

if the panels are visible and based on the changing elevations, it is considered that there are few receptors at the right elevation. In addition, impacts to stationary receptors are typically intermittent and change based on the time of day, cloud cover, orientation and the time of year. Furthermore, the PV design will be required to maximise absorbance and will be required to be coated with anti-glare surface to reduce the sun's reflection from PV panels to below 5%. Nevertheless, the ESIA recommends the following actions to address potential impacts:

- Erect signage on road to warn road users of the potential risk from glint
- Communicate the community grievance mechanism so that receptors that may experience issues can record the impact with KenGen
- Receive a commitment by KenGen to investigate potential complaints and to evaluate mitigation options and where confirmed implement an adaptive mitigation strategy that may include options such as tree planting at receptor location, or minor housing modification.

4.3.6 Landscape and visual

The ESIA identified the potential for significant impacts in the following areas:

- Removal of vegetation, soil stripping, temporary stockpiling of excavated materials and other earthworks
- Visual impact from the long-term installation of the solar PV cells

Actions planned to minimise visual and landscape impacts include:

- Design lighting associated with the construction phase of the proposed development to minimize the impact of light pollution at night
- Locate construction compounds away from sensitive landscape areas
- Avoid removal of buffer zone trees, as far as reasonably practicable
- Replace any planting lost due to the construction of the proposed development with new planting of a similar species
- Use excess earth to create local screening
- Assess and address grievances of any kind (including visual impacts) raised by the local population

4.3.7 Traffic and transportation

The ESIA identified potential significant impacts in the following areas:

- Increased traffic flow on road network and congestion for local road users
- Deterioration on road infrastructure and transport infrastructure condition
- Impact on local community in the wider area of influence and community health and safety

The assessment found that significance of effects due to traffic and transportation will not be significant, except in relation to traffic movements that may interact with local community traffic movements at the entrance to the site. The main actions planned to minimise impacts include on vulnerable road users (specifically the village of Machang'a) include:

- Erect appropriate signage of site access routes, construction areas and where vehicles may be turning
- Complete route surveys and repair identified infrastructure damage attributable to Project
- Use machinery that is in good condition and fit for purpose

- Develop a Project traffic management plan (TMP) work to address good practice traffic management measures
- Communicate and maintain close liaison with local community representatives including the circulation of information about ongoing activities which could have potential to cause disturbance
- Provide relevant notice to Kenya Rural Roads Authority (KeRRA) / Kenya National Highways Authority (KeNHA) of any abnormal delivery loads (not expected)
- Provide the county government, Police and other relevant authorities written notice of any abnormal load deliveries
- Provide adequate on-site parking facilities or nearby park and shuttle to accommodate site operatives' and visitors' vehicles
- Install a wheel and chassis wash facility at a location(s) approved by the local authorities and operate it throughout the construction period
- Restrict the amount of fuel taken to site to the minimum amount required for the plant and equipment on site

The existing earth road adjacent to the northern boundary of the site and to the reservoir will be upgraded to compensate for loss of access across the site area.

4.3.8 Waste management

The ESIA identified potential significant impacts in the following areas:

- Contamination of receiving environments (particularly soils) due to leakage and spillage of wastes associated with poor waste handling and storage arrangements
- Contamination or leakage relating to hazardous material use and storage
- The use of landfill - where waste re-use or recovery is not feasible - which is a finite resource
- Disposal of spoil, excavation material and the various waste streams

There are no waste provisions in the county and therefore the Project will need to be proactive in its waste management efforts (or requirements on contractors). All waste will be managed in accordance with national requirements as defined by NEMA regulations as a minimum. This includes the segregation of waste, handling, transfer and disposal.

Many standard mitigation measures will be followed by KenGen and their construction sub-contractors during construction. In general, every opportunity will be made to segregate and reuse the materials generated during construction. Any surplus soils will be suitable for reuse during the re-instatement process and for constructing roads and drainage systems. Non-hazardous materials that cannot be used on site will be appropriately managed either in a dedicated landfill or through use of existing facilities regulated by NEMA. Non-hazardous disposal options will be reviewed as part of the Construction Contractor's scope of works to determine the most appropriate method including disposal methods outside the county or even the country.

A site waste management plan will be required outlining specific waste management requirements and provisions. As part of this the construction contractor will be required to action the following:

- Prepare a community waste management strategy for waste re-use – Liaise with the community officials (through the PSC) to identify reuse and recycle options though village leaders / sub-county officials – plan to be agreed by sub-county officials

- Ensure no use of materials or chemicals that are not internationally acceptable as defined by this ESIA
- Define operational waste management procedure (as part of its commitment to develop a Project management system cognizant with ISO14001) – KenGen's responsibility
- Seek options for suppliers to remove their waste (packaging, etc.) during the procurement process (to be included in the procurement contracts) - KenGen's responsibility
- Use locally sourced products (less waste)
- Look for opportunities to re-use waste in the construction process (site levelling), building construction
- Segregate all remaining waste material into non-hazardous and hazardous wastes for consideration for re-use, recycling, or disposal
- Address decommissioning (end of life and end of panel life) through the supplier in the first instance. KenGen will include these preferences in contracts

4.3.9 Noise

The ESIA identified potential significant impacts to nearby receptors during the following activities:

- Perimeter road upgrade
- Internal access road development
- Site preparation, forestry clearance, piling and excavation works
- Transportation of construction plant and Project components
- Assembly of Project components
- Movement of site employee vehicles

The reduction and control of construction noise will be accomplished through the implementation of best practicable means. No specific measures are noted for operation where noise generation is expected to be negligible. Measures to be implemented during construction will include:

- Position plant items as far as practically possible from sensitive receptors along the northern boundary of the site
- Restrict general hours of working to avoid sensitive periods (e.g. night-time and evenings between 7pm and 7am)
- Use the quietest work methods and plant items where practicable
- Use portable screens where possible
- Properly maintain equipment and always fit it with appropriate noise control
- Power down plant items when not in use
- Use broadband reversing alarms always
- Avoid revving vehicle engines always
- Advise site employees of the noise sensitive nature of the area
- Provide a site contact number for residents for further information
- Develop and implement a grievance mechanism that covers noise concerns
- Monitor noise at the site to minimize impacts on local tranquillity during the construction period

4.3.10 Greenhouse gas emissions

Greenhouse gas emissions will both be avoided and generated by the Project from displacement of heavy fuel oil (HFO) generators and the need to employ GHG emitting activities during the construction and operation phase. Based on information calculation in the Seven Forks Development Impact Assessment, June 2017 it is estimated that approximately 267 MWh of HFO / diesel generation would be displaced daily and approximate 97.62 GWh of diesel / HFO generation would be displaced annually. The ESIA indicates 57,257 tCO_2 eq of GHG emission offset by the Project annually, not accounting for direct and indirect GHG emissions resulting from the Project lifecycle carbon count.

Using very conservative assumptions, the combined GHG emission is 4,814 tCO_2 eq / year which is well below the 25,000 tCO_2 eq / year range cited by IFC PS3. The key impacts on GHG emissions are mostly confined to the construction phase, potential measures to reduce those impacts are important in improving performance.

The ESIA identified measure to minimise potential impacts by applying the following principles to the Project:

- Source materials from sustainable sources
- Use local sources of materials
- Ensure efficiency in construction and planning including siting of construction camps, laydown and other work areas
- Use materials which can be reused or repurposed easily

During procurement the Project will seek to source materials from local suppliers wherever possible, use materials which can be recovered locally (other local projects) in preference to remote suppliers and assess the sustainability credentials of potential suppliers as part of the procurement process, for instance the provision of recycled materials, presence of an environmental and social management system. During design where possible, the contractor should specify recycled steel or reuse of other steel in the frames and consider the proposed specification required for roads and consider whether hard surfacing is necessary.

4.4 Will there be cumulative impacts with other projects?

No cumulative impacts have been identified.

4.5 How will KenGen oversee and manage the Project?

As part of this ESIA, KenGen has developed an environmental and social management plan (ESMP) that sets out the management and mitigation framework for implementing the measures outlined above. The ESMP is presented as Volume IV of the ESIA documentation. Responsibilities for implementation are outlined in the ESMP and fall to KenGen and the various contractors. The requirements of the ESMP will be implemented through KenGen environmental and social management system (ESMS) which is accredited to ISO14001 and the contractor ESMS.

KenGen will establish a ***Project Implementation Team (PIT***) to oversee the project development and construction phase. The PIT includes representatives from all relevant disciplines including environment, health and safety and community liaison as well as technical and financial representatives. The PIT will have overall responsibility for overseeing the development of the Project and contractor performance.

In addition, KenGen will establish a ***Project Stakeholder Committee (PSC)*** consisting of KenGen representatives from the PIT, KenGen consultant, community nominated

representatives and when relevant the EPC Contractor. The PSC will be formed early in the development process to coordinate pre-construction, construction and operational links with the community. This project specific committee will be retained for the duration of the Project (pre-construction, construction and operation).

5 Conclusion

5.1 What are the key findings?

The key findings are summarised as follows:

- The Project can be developed in accordance with Environmental Management and Coordination Act (EMCA) 1999 & EMCA (Amendment) 2015, Act and supporting regulations
- Public perception of the Project is good
- Stakeholders require a clear communication program and a project stakeholder committee and this is committed to in the Project stakeholder engagement plan (SEP) developed as part of the ESIA suite of documents
- Land is privately owned by KenGen and although there are historical associations between the local community, today the land is used for grazing, collection of firewood and bee keeping there are no permanent inhabitants on the land and it is deemed this may be manged through livelihood education programs and compensation actions
- Enhancement of socio-economic benefits to bring a moderate to high positive outcome for the community can be achieved through the community enhancement programs proposed including:
  - Improved access to electricity
  - One community water storage project
  - Partner with local government institutions to support a technical empowerment program to enhance technical education for local youth on low - medium skilled activities prior to the start of construction. This would likely include such skills as electrical work, brick laying, foundations works and welding
  - Set up a local hiring / business database (individual and business) (at least two months prior to start of construction)
  - Solar street lighting (Machang'a main street) to support enhanced operating hours for small businesses in the area
  - Livelihoods training program (grazing / bee keeping / firewood collection) for local community
  - Visitor centre including solar power exhibit and historical exhibit referring to land use change in the region to date
  - Youth centre / community meeting hall to be constructed by KenGen under the Project scope of work and operated and maintained by Community
  - Upgrade Machang'a's dispensary to provide better health and emergency and maternity facilities
  - Buffer zone replanting (reforestation project at 10:1 replanting ratio in line with GIIP)
- The Project may generate negative environmental impacts which have been evaluated as non-significant or which can be mitigated or compensated to acceptable levels as set out in the Project environmental and social management plan (ESMP), Volume IV
- The closest receptors are along the northern boundary of the site and environmental impacts to these receptors over the short duration construction period is deemed to be non-significant following implementation of mitigation measures

- The Project is not deemed to have a significant impact on areas or species of conservation significance
- The Project will not result in significant habitat loss of dry forest however the Project will implement a habitat removal and compensation plan that includes a 10:1 compensation replanting program
- Loss of medicinal shrubs (cultural / provisioning) are deemed to be adequately addressed through offset planting and compensation planting
- The Project will have a negligible impact on groundwater levels, surface water levels, water quality and water availability in the local region
- The project is not expected to impact on sites of cultural (tangible or intangible cultural heritage
- A robust archaeological survey and monitoring program will be implemented to address low risk potential for unforeseen archaeological artefacts
- The Project will create opportunities for secondary business opportunities in the area
- The Project will play a key step towards supporting Kenya's objective to meet 73% renewables generation by 2030

5.2 What is the overall outcome of the ESIA?

The ESIA concludes that the Project represents a priority infrastructure for Kenya. The Project is an effective and viable energy generation option for the country.

Key mitigation measures have been identified and measures for implementation are outlined in the ESMP and SEP. These align with national laws and regulations and good practice as required by international standards.

The environmental and social impact assessment process has demonstrated that with the application of these mitigation and compensation measures the Project will not have significant environmental or social impacts.

Opportunities for enhancing positive opportunities have been identified to maximise project benefits. These include projects related to access to water, electricity, employment and improved infrastructure. These form an integral part of the Project scope of work and will support local development objectives.

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KenGen

Kenya Electricity Generating Company Ltd.

Seven Forks Solar Project

Volume II ESIA FINAL

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Preface

This document provides the findings from the Environmental and Social Impact Assessment Report (ESIA) for the Seven Forks Solar Project.

Two public consultation meetings were undertaken to disclose and consider public comments on the draft Project ESIA:

- Community meeting - Machang'a market place - 06 December 2017
- Wider stakeholder forum - Matendeni camp (KenGen) - 07 December 2017

For the public consultation meetings, a presentation of the draft ESIA findings has been made followed by questions and answers. The feedback from the public consultation is incorporated into the final ESIA.

Upon submission of the final report to the National Environment Management Authority (NEMA) copies will be made available for consultation in the following locations:

- KenGen website: http://www.kengen.co.ke/
- Hard copies at chief office in Machang'a
- Hard copies at the Kiritiri sub-County offices
- Electronic copies are also available upon request from KenGen

NEMA will hold a minimum 21-day disclosure period from the date of submission for further comment. The start of this formal disclosure process will be notified by the following means:

- Notice in the newspapers
- Radio adverts

There is also opportunity for public and other interested and affected parties to comment on the final ESIA through the following means:

Table 1: Project proponent and consultant contact details

Project proponent and consultant information

Project Proponent	
Name of Company	KenGen Head Office Attn: Grace Chepkwony
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Consultant information	
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Glossary

Term	Definitions
Area of Influence (AOI)	The area over which the impacts of the Project are likely to be felt as well as any reasonably foreseen unplanned developments induced by the Project or cumulative impacts
Associated facilities	Facilities that are not funded as part of the Project and that would not have been constructed or expanded if the Project did not exist and without which the Project would not be viable
Baseline surveys	Gathering of data to describe the existing physical, biological, socioeconomic, health, labour, cultural heritage, or any other variable considered relevant before Project development
Biodiversity	Variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are a part; this includes diversity within species, between species, and of ecosystems
Chance find	Archaeological or cultural sites and artefacts, including such items as ceramics, tools, buildings, burials, etc., previously unrecognized in baseline studies that are discovered during exploration activities
Consultation	Consultation is a two-way process of dialogue between the Project company and its stakeholders. Stakeholder consultation is about initiating and sustaining constructive external relationships over time.
Critical habitat	Either modified or natural habitats supporting high biodiversity value, such as habitat required for the survival of critically endangered or endangered species
Cultural heritage	Defined as resources with which people identify as a reflection and expression of their constantly evolving values, beliefs, knowledge and traditions
Cumulative impacts	The combination of multiple impacts arising from existing Projects or activities, and/or anticipated future Projects or activities
Direct area of influence	Considers the physical footprint of the Projects such as the right of way, construction sites, work staging area and area affected during operational works (e.g. traffic patterns)
Ecosystem	The interacting system of a biological community and its non-living environmental surroundings
Effluent	Wastewater - treated or untreated- that flows out of a treatment plant, sewer, or industrial outfall
Emission	Pollution discharged into the atmosphere from smokestacks, other vents, and surface areas of commercial or industrial facilities; from residential chimneys; and from motor vehicle, locomotive, or aircraft exhausts
Environmental and Social Impact Assessment (ESIA)	A forward-looking instrument that can proactively advise decision-makers on what might happen if a proposed activity is implemented. Impacts are changes that have environmental, political, economic, or social significance to society. Impacts may be positive or negative and may affect the environment, communities, human health and well-being, desired sustainability objectives, or a combination of these.
Environmental and Social Management Plan (ESMP)	Summarises the company's commitments to address and mitigate risks and impacts identified as part of the ESIA, through avoidance, minimization, and compensation/offset, and monitor these mitigation measures.
Environmental and social management system (ESMS)	Part of a Project's overall management system that includes the organizational structure, responsibilities, practices and resources necessary for implementing the Project-specific management program developed through the environmental and social assessment of the Project
Good International Industry Practice (GIIP)	Exercise of professional skill, diligence, prudence, and foresight that would reasonably be expected from skilled and experienced professionals engaged in the same type of undertaking under the same or similar circumstances globally or regionally. The outcome of such exercise should be that the Project employs the most appropriate technologies in the Project-specific circumstances
Greenhouse gases	The following six gases or class of gases: carbon dioxide (CO_2), nitrous oxide (N_2O), methane (CH_4), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulphur hexafluoride (SF_6)
Grievance mechanism	Procedure provided by a Project to receive and facilitate resolution of affected communities' concerns and grievances about the Project's environmental and social performance.

Term	Definitions
Habitat	Terrestrial, freshwater, or marine geographical unit or airway that supports assemblages of living organisms and their interactions with the non-living environment
Hazardous waste	By-products of society that can pose a substantial or potential hazard to human health or the environment when improperly managed. Substances classified as hazardous wastes possess at least one of four characteristics—ignitability, corrosivity, reactivity, or toxicity— or appear on special lists
Indigenous peoples	Defined by the World Bank E&S Framework as a distinct social and cultural group possessing the following characteristics in varying degrees: (a) Self-identification as members of a distinct indigenous social and cultural group and recognition of this identity by others; (b) Collective attachment to geographically distinct habitats, ancestral territories, or areas of seasonal use or occupation, as well as to the natural resources in these areas; (c) Customary cultural, economic, social, or political institutions that are distinct or separate from those of the mainstream society or culture; and (d) A distinct language or dialect, often different from the official language or languages of the country or region in which they reside
Indirect area of influence	Includes area which may experience Project related changes in combination with activities not under the direct control of the Project
Information disclosure	Disclosure means making information accessible to interested and affected parties (stakeholders). Communicating information in a manner that is understandable to stakeholders is an important first and ongoing step in the process of stakeholder engagement. Information should be disclosed in advance of all other engagement activities, from consultation and informed participation to negotiation and resolution of grievances. This will make engagement more constructive.
Intangible cultural heritage	According to the 2003 UNESCO convention for the safeguarding of intangible cultural heritage, manifestations of intangible cultural heritage include: Oral traditions and expressions, including language; Performing arts; Social practices, rituals and festive events; Knowledge and practices concerning nature and the universe
Invasive alien species	Non-native species of flora and fauna that are a significant threat to biodiversity due to their ability to spread rapidly and out-compete native species
KenGen	Kenya Electricity Generating Company Limited, the Project Proponent
Land acquisition	All methods of obtaining land for Project purposes, which may include outright purchase, expropriation of property and acquisition of access rights, such as easements or rights of way
Livelihood	Full range of means that individuals, families, and communities utilize to make a living, such as wage-based income, agriculture, fishing, foraging, other natural resource-based livelihoods, petty trade, and bartering
Magnitude	The assessment of magnitude is undertaken in two steps. Firstly, the magnitude of potential impacts associated with the Project are categorised as beneficial or adverse. Secondly, the beneficial or adverse impacts are categorised as major, moderate, minor or negligible based on consideration of several parameters
Modified habitat	Land and water areas where there has been apparent alteration of the natural habitat, often with the introduction of alien species of plants and animals, such as agricultural areas
Natural habitat	Land and water areas where the biological communities are formed largely by native plant and animal species, and where human activity has not essentially modified the area's primary ecological functions
Occupational health and safety	The range of endeavours aimed at protecting workers from injury or illness associated with exposure to hazards in the workplace or while working.
Pollution	Refers to both hazardous and non-hazardous pollutants in the solid, liquid, or gaseous forms, and is intended to include other forms such as nuisance odours, noise, vibration, radiation, electromagnetic energy, and the creation of potential visual impacts including light
Project affected people	Individuals, workers, groups or local communities which are or could be affected by the Project, directly or indirectly, including through cumulative impacts
Renewable energy	Energy sources derived from solar power, hydro, wind, certain types of geothermal, and biomass
Sensitivity	The sensitivity of a receptor is determined based on the review of the population (including proximity / numbers / vulnerability), presence of biological features of the site and the surrounding area, soil, agricultural suitability, geology and geomorphology, proximity of aquifers and watercourses, existing air quality, presence of any archaeological features etc.
Significance	Significance of impact considers the interaction between the magnitude and sensitivity criteria
Solid waste	Material with low liquid content, sometimes hazardous. Include municipal garbage, industrial and commercial waste, sewage sludge, wastes resulting from agricultural and animal

Term	Definitions
	husbandry operations and other connected activities, demolition wastes and mining residues
Stakeholders	Stakeholders are persons or groups who are directly or indirectly affected by a Project, as well as those who may have interests in a Project or the ability to influence its outcome, either positively or negatively.
World Bank Group EHS Guidelines	Technical reference documents for environmental protection and set out industry-specific examples of 'international good practice'. Projects are expected to comply with the levels and measures identified in the General EHS Guidelines where host country requirements are less stringent or do not exist

Acronyms

Acronym	Term
AC	Alternating current
AOI	Area of Influence
a-Si	Amorphous silicon
AWF	African Wildlife Foundation
CAPEX	Capital expenditures
BH	Bore hole
BPEO	Best Practical Environmental Option
BS	British standards
CBD	Convention on Biological Diversity
CdTe	Cadmium telluride
CHA	Critical Habitat Assessment
CHS	Community Health and Safety
CIGS	Copper indium gallium (di)selenide
CITES	Convention on International Trade in Endangered Species
CLO	Community Liaison Officer
CO	Carbon monoxide
CO_2	Carbon dioxide
CR	Critically endangered
CSR	Corporate social responsibility
DC	Direct current
EA	Environmental Assessment
ECIA	Ecological Impact Assessment
EcMP	Ecological Management Plan
EDGE	Evolutionarily Distinct and Globally Endangered
EHS	Environment, Health and Safety
EIA	Environmental Impact Assessment
EMCA	Environmental Management and Control Act
EN	Endangered
EPC	Engineering, procurement and construction
ERC	Energy Regulatory Commission
EPRP	Emergency Preparedness and Response Plan
ERP	Emergency Response Plan
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
ESMS	Environmental and Social Management System
FAA	Federal Aviation Administration
FGD	Focus group discussions
FIT	Feed-in Tariff
GDP	Gross domestic product
GHG	Greenhouse gases
GIIP	Good International Industry Practice
GIS	Geographical Information System
GN	Guidance note

Acronym	Term
GoK	Government of Kenya
HAZOP	Hazard and operability
HFO	Heavy Fuel Oil
HGVs	Heavy Goods Vehicles
HR	Human resources
HRRP	Habitat Removal and Restoration Plan
HSMS	Health and Safety Management System
IBA	International bird area
ICESCR	International Covenant on Economic, Social and Cultural rights
ICOMOS	International Council on Monuments and Sites
IFC	International Finance Corporation
ILO	International Labour Organisation
IP	Indigenous peoples
IPM	Integrated pest managment
IUCN	International Union for Conservation of Nature
K&M	K&M advisors (feasibility consultant)
KBA	Key biodiversity area
KCAA	Kenya Civil Aviation Authority
KeNHA	Kenya National Highways Authority
KeRRA	Kenya Rural Roads Authority
KFS	Kenya Forest Service
KNTS	Kenya National Transmission System
KPC	Kenya Power Company
KPLC	Kenya Power and Lighting Company
KURA	Kenya Urban Roads Authority
KWS	Kenya Wildlife Service
LRF	Livelihood Restoration Framework
LRP	Livelihood Restoration Plan
MMLLC	Mott MacDonald LLC
NBSAP	National Biodiversity Strategy and Action Plan
NEAP	National Environmental Action Plan
NEMA	National Environment Management Authority
NGO	Non-Governmental Organisation
NMHA	National Museums and Heritage Act
NMK	National Museums of Kenya
NO_x	Nitrogen oxides
NREL	National Renewable Energy Laboratory
NSWMS	National Solid Waste Management Strategy
NT	Near threatened
NTS	Non-Technical Summary
OHL	Overhead lines
OHS	Occupational Health and Safety
O&M	Operations and Maintenance
PCR	Physical Cultural Resource
PIT	Project Implementation Team
PMP	Pest Management Plan
PPA	Power Purchase Agreement

Acronym	Term
PPE	Personal protective equipment
PS	Performance Standards
PSC	Project Stakeholder Committee
PV	Photovoltaic
RAP	Resettlement Action Plan
RoW	Rights of Way
SEP	Stakeholder Engagement Plan
SIA	Social Impact Assessment
SIEA	South African Institute for Environmental Assessment
SO_x	Sulphur oxides
SWMP	Site Waste Management Plan
TARDA	Tana & Athi Rivers Development Authority
tCO_2 eq	Tonnes carbon dioxide equivalent
TMP	Traffic Management Plan
TOR	Terms of Reference
UN	United Nations
UNDRIP	United Nations Declaration on the Rights of Indigenous Peoples
USTDA	United States Trade and Development Agency
VU	Vulnerable
WHO	World Health Organisation
WHS	World Heritage Site
WMP	Waste Management Plan

1 Introduction

Kenya Electricity Generating Company Limited (KenGen or the Project Proponent) has identified a need to expand and diversify the generation portfolio of Kenya. Supported by consultants K&M Advisors, Mott MacDonald LLC USA and EcoPlan Management Limited (EcoPlan), KenGen plans to develop the "Seven Forks Solar Project" a solar photovoltaic (PV) power project with capacity of approximately 45MWAC[1] in Embu County, Kenya ("the Project"). It is intended that the electricity generated by the Project will be fed into the Kenya National Transmission System (KNTS). This document presents the environmental and social impact assessment (ESIA) for the development of the Project.

Mott MacDonald and EcoPlan have been commissioned to undertake an ESIA in accordance with the requirements of the Environmental Impact Assessment / Environmental Assessment (EIA/EA) regulations 2003, pursuant to the Environmental Management and Control Act (EMCA) 1999 and EMCA (amendment) 2015 Act and in accordance with international lending guidelines as defined by the International Finance Corporation (IFC) Performance Standards (PSs) 2012.

KenGen has secured funding from the U.S. Trade and Development Agency (USTDA) to undertake preliminary studies to assess the technical, economic, environmental, commercial, and financial feasibility of the Project and to prepare the EIA/ESIA. The Project itself will be funded through debt financing with 100% of equity funded by KenGen.

1.1 Project proponent

As of 1997, KenGen has managed all public power generation facilities in Kenya.[2] In 1996 KenGen, formerly Kenya Power Company (KPC), formally separated from Kenya Power, the government-run electricity transmission and distribution utility.[3] The Government of Kenya sold 30% of its stake in KenGen through an initial public offering (IPO) on the Nairobi Securities Exchange in 2006.

According to the KenGen annual report (year ending 30 June 2016), KenGen has approximately 70% market share in Kenya. As the largest power producer in Kenya and East Africa, KenGen had approximately 1,630 MW installed capacity as of 30 June 2016.[4]

[1] alternating current (AC)

[2] KenGen. 2016. Annual Report to Shareholders. Available at http://www.kengen.co.ke/sites/default/files/financial-reports/KenGen%20Annual%20Report%202016_0.pdf

[3] The Government of Kenya has a 50.1% stake with the remaining 49.9% owned by private investors through the Nairobi Securities Exchange; Kenya Power. About Kenya Power. Available at. http://www.kplc.co.ke/content/item/14/about-kenya-power

[4] Op. cit. KenGen.

Table 2 summarizes KenGen's installed capacity by generation technology. KenGen owns 32 generation plants throughout Kenya, including 14 hydroelectric plants, six geothermal plants, six thermal plants, and three wind plants, shown in Figure 1.

Table 2: KenGen installed capacity, MW (June 2016)

Energy Type	Installed capacity (MW)	Percent (%)
Hydro	819.9	51
Geothermal	518.8	32
Thermal	253	16
Wind	25.5	2
Total	**1,617.2**	**100%**

Source: Presentation by KenGen. 2017. The Seven Forks Cascade.

Figure 1: KenGen generation sites (as of April 2017)

Source: KenGen. 2017. The Seven Forks Cascade.

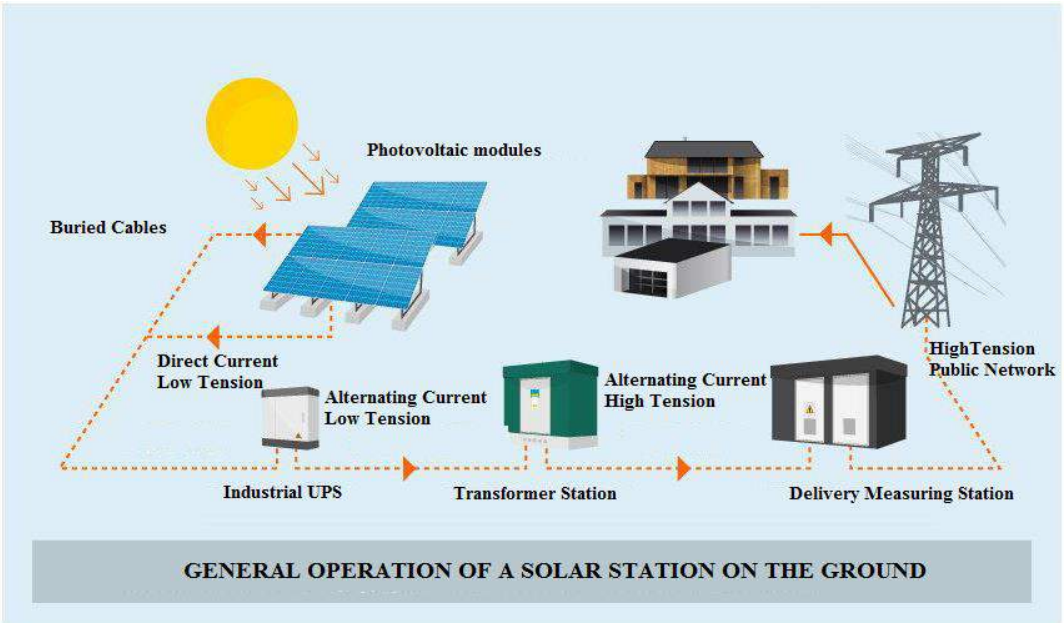
Note: Red dots are location of hydro generation facilities, black dots are key thermal generation.

1.2 Overview of photovoltaic solar power

Photovoltaic (PV) power uses solar panels to convert sunlight into electricity by converting the solar radiation into electricity. A power plant uses multiple panels, a direct current (DC) /

alternating current (AC) convertor, racking system that holds the solar panels, electrical and communications interconnections and supporting infrastructure such as water supply system, drainage systems, security infrastructure, stores and internal roads. Figure 2 illustrates the general principles of a solar PV power plant. A description of the Project is provided in Chapter 2.

Figure 2: General operation of a ground based solar power plant



Source: Mott MacDonald 2017

1.3 Project location

The Project will be located near the Seven Forks Hydroelectric Power Complex in Mbeere South Sub-County, Embu County, approximately 160km northeast of Nairobi at Latitude 47’48.826” S and Longitude 37 39’32.241” E. The Project site is adjacent to national Highway B7 (Kangonde - Embu Road), approximately 1.5km north of the Kamburu Dam as illustrated in green in Figure 3 and Figure 4.

Figure 3:Project Location

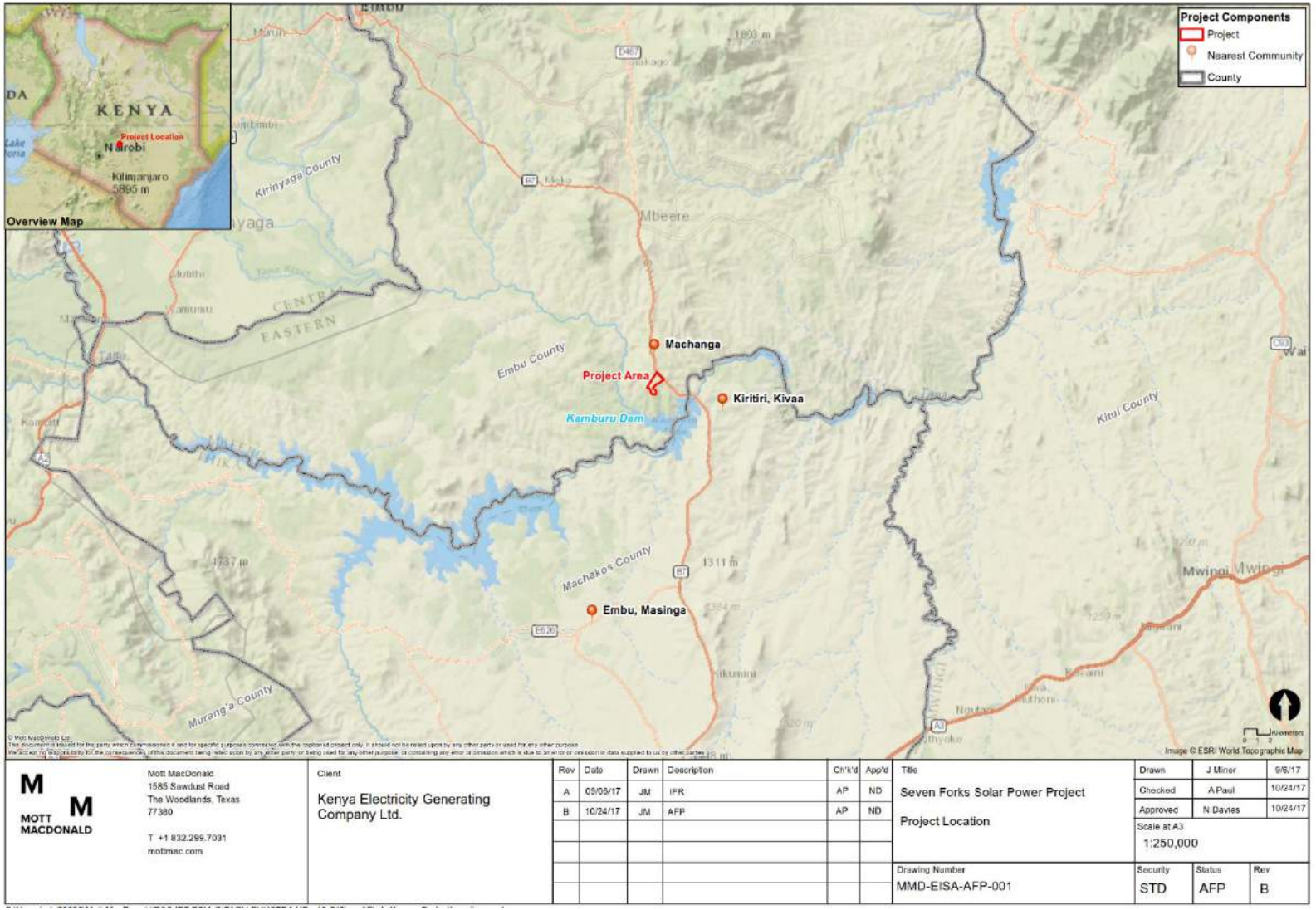
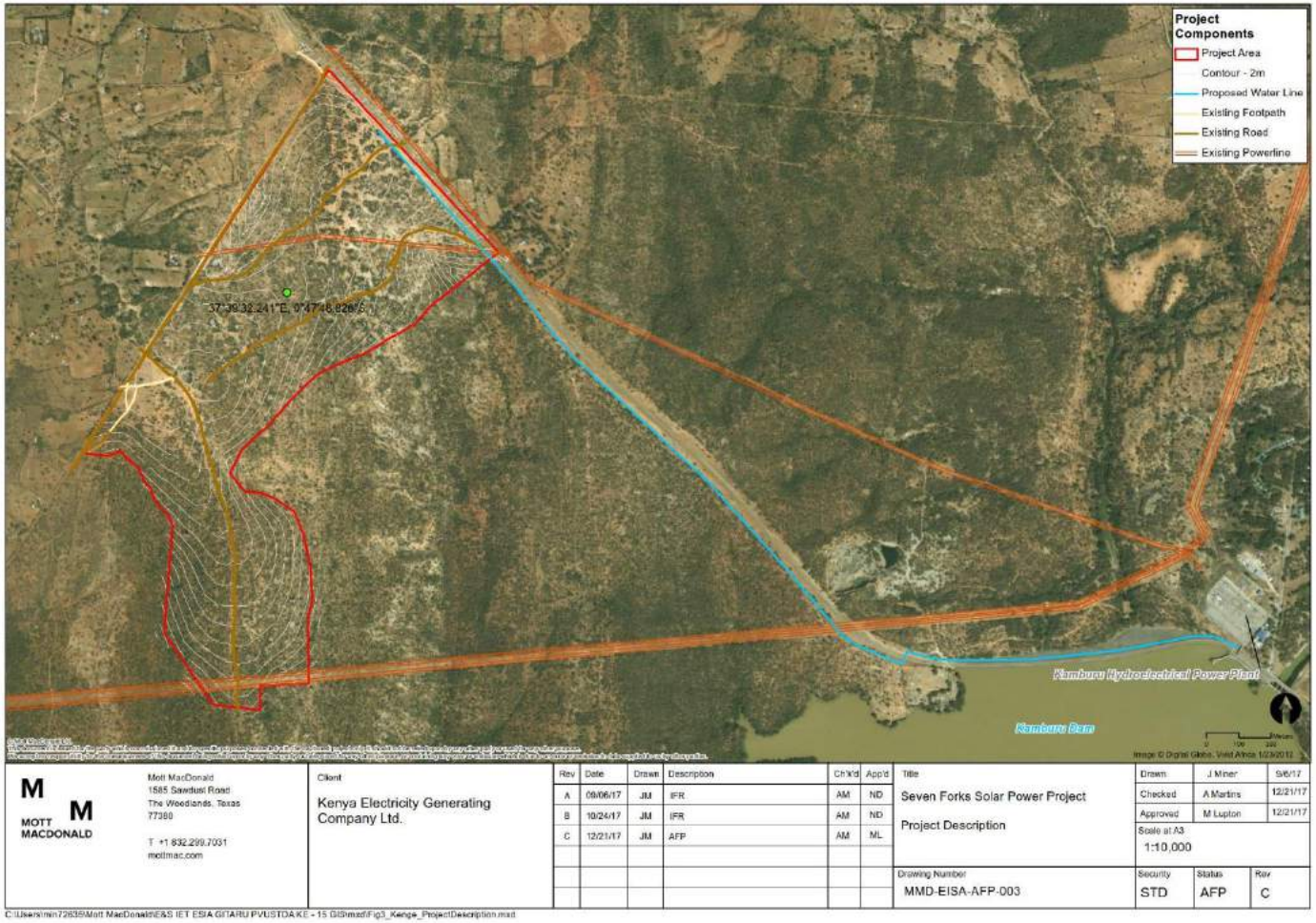


Figure 4: View of the Project area



1.4 Objectives and scope

The objectives of the ESIA are as follows:

- Identify and assess the potential environmental and social impacts that the Project may have on the environment and communities within its area of influence (AOI) (positive and negative)
- Collect baseline socio-economic and bio-physical data in the Project area and assess the impact significance
- To help avoid, or where avoidance is not practicable, minimise, mitigate or compensate for adverse impacts on the environment and communities
- To ensure that the affected communities[5] are appropriately engaged on issues that could potentially affect them
- To promote improved social and environmental performance through the development and effective use of management systems
- Align with national requirements for environmental and social impact assessment
- Demonstrate compliance with Equator Principles 2013 and IFC Performance Standards 2012 and relevant World Bank Group environmental, health and safety (EHS) guidelines.
- Establish mitigation measures, management and monitoring requirements in a formal environmental and social management plan (ESMP)
- Obtain environmental impact assessment license from National Environment Management Authority (NEMA)

1.5 Structure of the ESIA Report

The ESIA is organized as follows:

- **Volume I:** Executive (non-technical) summary (NTS)
- **Volume II**: Environmental and social impact assessment (ESIA) ***(this report)***
- **Volume III**: Technical appendices
- **Volume IV:** Environment and social management plan (ESMP)
- **Volume V:** Stakeholder engagement plan (SEP)

The ESIA report is set out as follows:

- Chapter 1: Introduction
- Chapter 2: Project description including needs case and analysis of alternatives
- Chapter 3: Policy, legal and institutional overview
- Chapter 4: ESIA framework and methodology
- Chapter 5: Information disclosure, consultation and participation
- Chapter 6: Baseline description
- Chapter 7: Impact assessment
- Chapter 8: Mitigation
- Chapter 9: Conclusion
- Chapter 10: References

[5] Reference to communities includes consideration of impacts on laborers

- Appendix A: Signature sheets
- Appendix B: Bill of quantity
- Appendix C: Approval of terms of reference (TOR)
- Appendix D: EcoPlan's NEMA certificate
- Appendix E: Team resumes
- Appendix F: Stakeholder meeting minutes and attendance lists – scoping
- Appendix G: Stakeholder meeting minutes and attendance lists – ESIA
- Appendix H: Questionnaires received from stakeholders
- Appendix I: Invitation letters for final stakeholder meeting – ESIA disclosure
- Appendix J: Minutes and attendance sheets for final stakeholder meeting – draft ESIA disclosure
- Appendix K: Land tile deed

2 Project description

This Chapter presents an overview of the Project including:

- Project setting
- Project components
- Project stages and activities
- Project budget
- Project development schedule
- Associated facilities

2.1 Project setting

The site is bounded to the north by an existing dirt road that runs east to west from highway B7 to the Thiba river. To the west is the Thiba River and to the south the Kamburu reservoir. There are small communities located within the wider AOI and several homesteads located along the track that marks the northern boundary of the site. The southern extent of the Project site is marked by an existing 132kV transmission line that runs north east across the site from the Thiba river to the existing Kamburu Substation, located approximately 3.28 km from the proposed site. The Mwea Nature Reserve is located across the Thiba River, approximately two km from the southern end of this site. This is illustrated in Figure 9 overleaf.

The Project infrastructure will extend over an area of approximately 80 to 100 hectares on land that is owned by KenGen. The Project site area is characterised by moderately flat terrain with sandy silty clay and rock slopes at the southern portion of the site close to the Kamburu reservoir. The vegetation is primarily dry and low to medium density, and periodically used by local communities for livestock grazing. The Project site is sometimes used by local communities as a shortcut between Route B7 and the reservoir from surrounding communities.

An example of the Project vegetation and site is presented in Figure 5 and Figure 6.

Figure 5: Example of site vegetation

Source: Mott MacDonald / EcoPlan site visit 2017

Figure 6: View across the site looking north

Source: Mott MacDonald / EcoPlan site visit 2017

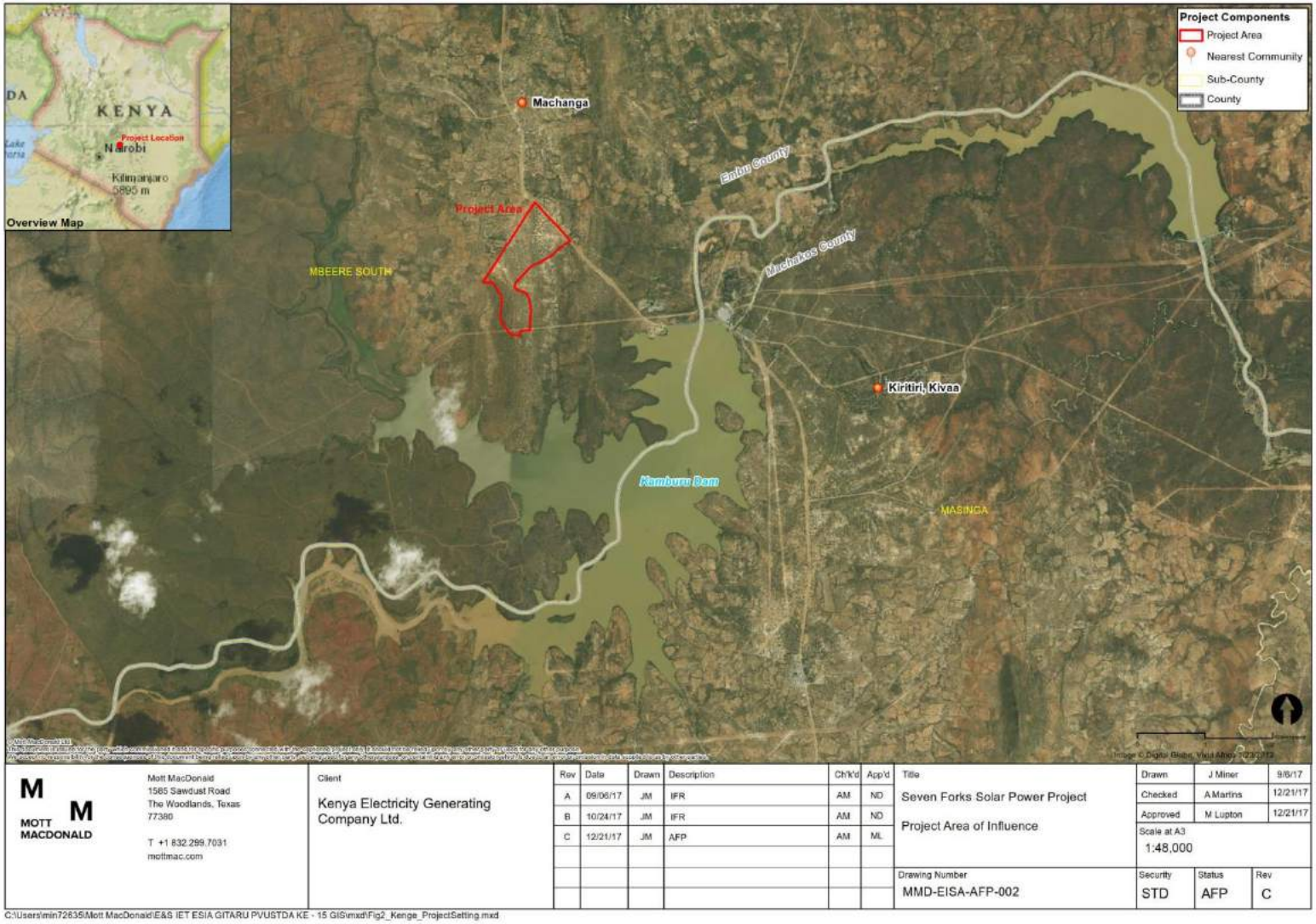
Figure 7: Grazing on land

Source: Mott MacDonald / EcoPlan site visit 2017

Figure 8: Bee hives at site

Source: Mott MacDonald / EcoPlan site visit 2017

Figure 9: Project setting

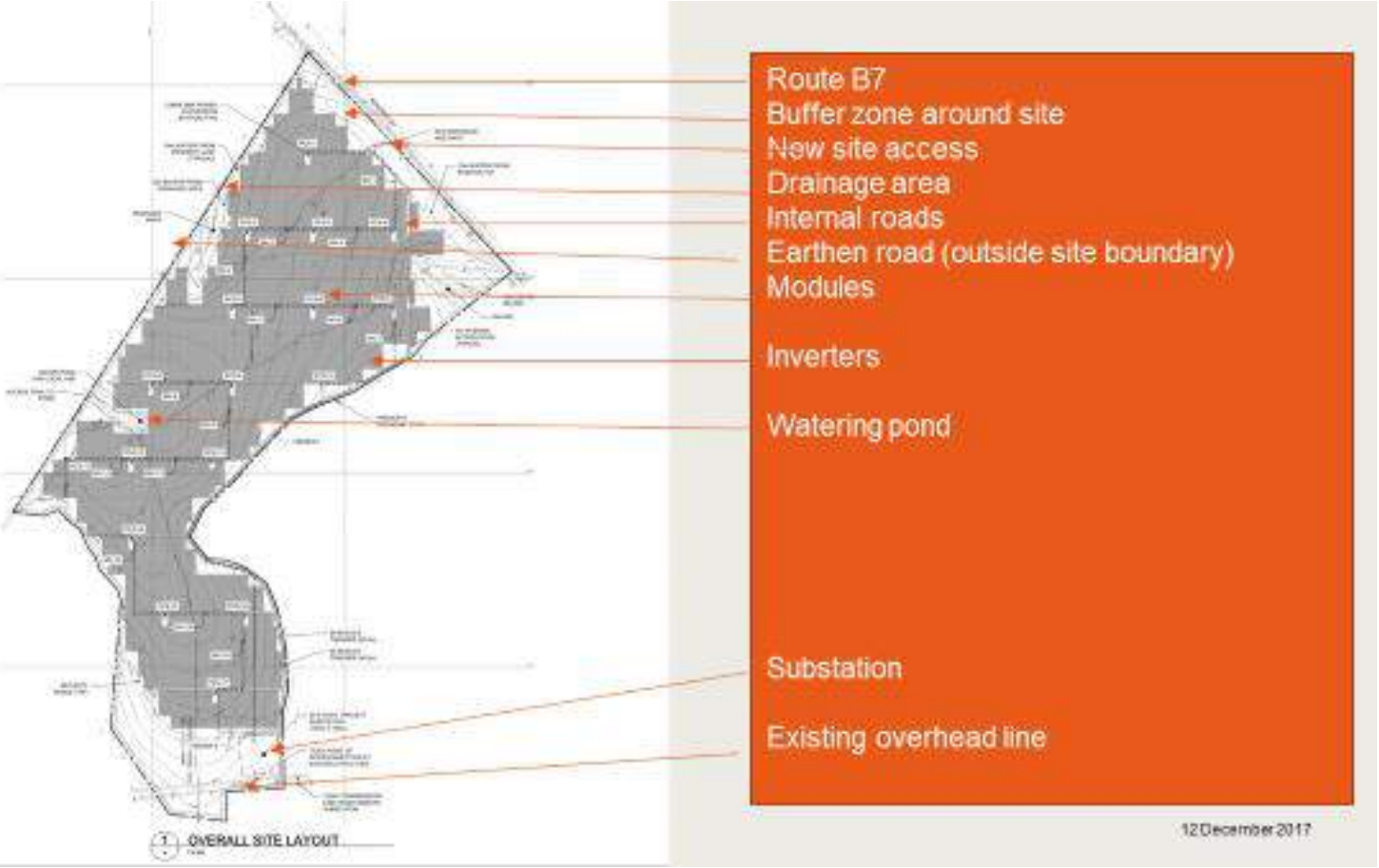


2.1.1 Site layout

A topographic map view including proposed infrastructure and the PV component layout is illustrated in Figure 10 below. The exact layout may change from the layout in Figure 10 below, but it will remain within the general Project boundary delineated in Figure 4 and 5 above.

A buffer area has been included along the boundary with the adjacent community of Machang'a and Route B7. The proposed Project site area contains a water pond that is used by the surrounding communities for watering livestock. The current Project layout proposes to maintain the water pond location and the means of access for local community members.

Figure 10: Site layout



Source: Modified from KenGen Feasibility report, September 2017

2.2 Area of Influence (AOI)

The Project Area of Influence (AOI) is the area over which the impacts of the Project are likely to be felt including all its related or associated facilities such as the transmission line corridor, water pipelines, access roads, borrow pits, and accommodation facilities as well as any reasonably foreseen unplanned developments induced by the Project or cumulative impacts.

The Project AOI is comprised of areas of direct impacts and indirect impacts as follows:

- Direct area of influence: considers the physical footprint of the Project such as the site layout, work staging area and area affected during construction and operation works (e.g. traffic patterns)
- Indirect area of influence: includes area which may experience Project related changes in combination with activities not under the direct control of the Project (e.g. inward migration, induced development, visitor influx, access to employment)

The Project direct AOI often varies depending on the specific environmental or social aspect considered based on the extent an impact may be affected and can be influenced on a spatial and temporal level.

To address this, a general AOI has been defined with sub-definitions for each E&S topic to inform the boundaries of the impact assessment work. Table 3 defines the AOI for specific E&S topics.

In addition to the Project footprint itself, stakeholder consultation during the baseline data collection process helped to inform the definition of the direct and indirect AOI and the structure for public consultation and stakeholder engagement and this is elaborated in Chapter 6.

The direct AOI for each topic is defined below. Unless stated, the indirect AOI is defined by the outer limits of the three affected municipal boundaries.

Table 3: Defining the AOI for each E&S aspect

Topics	Area of Influence (direct and indirect)	
	Direct	Indirect
Social / cultural heritage	Machang'a village	Embu County
Water Resources	Extraction point at the Kamburu Dam (Embu County)	Not relevant
Glint and glare	1km from the Project site (residential receptors and road users)	10km buffer (aviation)
Ecological	Direct site area	10km buffer around the site
Air quality	Site area and a buffer 200m around the site	Not relevant
Archaeology	Site area and 50m buffer around the site	10km buffer around the site
Noise	Site area and a buffer 200m around the site	Not relevant
Traffic and transportation	Route B7 south of the site within 1km Kenya Rural Roads Authority (KeRRA) earth road that runs the boundary of the site	Route B7 indirect outside local area (1km) and Route A3, national highways from Mombasa Port.

The temporal influence of the Project has been assessed by comparing the existing baseline conditions (socio-economic and biological) over the expected duration of the Project activities as listed below.

- Site establishment and civil work (three months)
- Panel installation (11 months)

- Site operation (30 years)
- Decommissioning (18 months)

2.3 Project infrastructure

A preliminary feasibility study has been completed, which concluded that monocrystalline, polycrystalline, and thin-film module technologies could be suitable for the Project. The feasibility study proposed the use of a horizontal single axis tracking system which rotates with the angle of the sun to maximize the power output of the PV modules. The Project will include the following key components:

- PV modules (mono or poly crystalline)
- Inverters, combiner boxes and transformers
- Underground cabling
- Project substation
- Grid connection directly to the existing 132 kilovolt (kV) Kamburu – Masinga overhead transmission line (OHL) at an interconnection point 3.28km northwest of the Kamburu 132 kV substation
- On-site buildings including an operational control centre, office, welfare facilities, security guard house, storage facilities and stores
- Access road from highway B7
- Internal access roads and upgrade to northern premier road
- Site drainage system
- Relocation of an existing low voltage electricity line crossing the site (to be performed by Kenya Power and Lighting Company (KPLC))

A final decision has not been made on many technology choices, the exact layout, design optimisation and number of panels. Final decisions will be required to exhibit an equal or better environmental impact. In most cases specific design changes are not expected to result in material changes to the ESIA findings.

2.3.1 Summary of plant characteristics

Conceptual plant characteristics are presented in Table 4.

Table 4: Summary of plant characteristics for conceptual design

Parameter	Value
DC capacity	47.53MW
AC capacity	42.5MW
DC/AC ratio	1.12
Yield	2044 kWh / kWp
Module	139,000 to 148,000
Inverter	17 – 25
Racking	Horizontal single axis tracker
Tilt / Azimuth	+/- 60^{o} / 180^{0}
Ground coverage ratio	0.450

Source: KenGen Feasibility report, September 2017

2.3.2 Panels and racking system

The Project is expected to include approximately 148,000[6] solar PV modules (panels) for a total nameplate capacity of approximately 45MW$_{AC}$. The modules will be provided by proven PV module and technology suppliers .

For this plant the type of solar panel to be used will be either:

- Crystalline silicon PV (mono-crystalline and poly-crystalline) or
- Thin-film PV (amorphous silicon (a-Si), copper indium gallium (di)selenide (CIGS) and cadmium telluride (CdTe)

Currently crystalline silicon is the preferred module type and has been considered in this ESIA. The modules will be set on either a fixed or tracked racking system facing south. The racking systems have minimal maintenance requirements and should require lubrication once a year (depending on manufactur recommendation).

The area between the panels will be grassed or covered with slow growing vegetation that will be planted to reduce the likelihood of soil erosion. Maintenance of this area will be manual and on an as needed basis.

2.3.3 Inverters

Inverters convert the DC electricity produced by PV arrays into AC electricity compatible with utility grids. In addition, PV inverters often provide system protection and data communications. Inverters typically fall into three main categories: (1) microinverters, (2) string inverters (10 to 120kW), and central inverters (>500kW). The Project's Feasibility Report outlines a conceptual plant design that will use central inverters to convert energy from DC to AC. The selection was based on the following criteria:

- Compatibility with DC input and counterpart PV array string voltage ranges
- Inverter efficiency
- Cost
- Reliability
- Grid compatibility

2.3.4 Underground cabling

A variety of underground trenching for cabling will be required throughout the site. It is expected that aluminium medium voltage (15kV) cables will be buried in a direct burial trench at least 1m depth surrounded by a minimum of 0.1m of screened native soil. Additional DC cable trenching may be required between array end posts and other Project components.

2.3.5 Access and security

The Project will require a junction with Route B7, a security fence enclosing the entire site (excluding the existing watering pond), and security guard house.

Security at the site will be 24 hours, seven days per week, manned by a security firm with the appropriate qualifications on a shift basis (3 x 8 hours shifts per day) resulting in four to five personnel total. The Project will maintain a tree buffer around the site starting 300m from the

[6] The precise number of modules will be determined based on the most suitable technology and supplier at the time of contractor selection.

nearest panel to prevent access to the site. Security lighting around the site and along the main road will be installed.

2.3.6 Supporting infrastructure works

Supporting infrastructure includes:

- Permanent internal access road
- On-site buildings (operational control centre, office, and welfare facilities)
- Guard house
- Laydown area (temporary)
- Re-alignment of the existing KPLC distribution line that crosses the site
- Solar street lighting around the vicinity of the site to improve security

All infrastructure will be designed to meet applicable construction standards and GIIP and reflect the weather and seismic requirements at the site.

2.3.7 Surface water drainage system

From the preliminary geotechnical investigation undertaken for the feasibility study, the groundwater table is well below the depth of impact. The area will be kept dry of surface water run-off by designing buildings to enable run off to be diverted away from structures and including drainage for both subsurface and surface water to protect foundations. Run off from the panels will not be channelled so as to retain filtration into the ground rather at than concentrated run-off points.

Drainage design for flow around and through the site will be sized to comply with applicable construction and building codes. The engineering, procurement and construction (EPC) contractor will be required to comply with applicable laws, regulations, and construction/building codes and take account of future climate change predictions when determining correct sizing. Where the slope is greater, terracing may be appropriate to aid run-off.

During construction subsoil compaction will be minimised during and after installation to allow the maximum amount of natural filtration to continue. If compaction occurs during construction, subsoil will be tilled and amended to return the soil to its pre-compaction condition.

2.3.8 Grid connection

The Project will connect directly to the existing 132kV Masinga – Kamburu overhead transmission line (OHL). This does not require any expansion of the existing right of way, but does require a new 132kV substation at the Project site. The connection will be at the southern end of the site adjacent to the OHL.

2.3.9 Water supply options

The Project will require water for construction, domestic water use (construction and operation) and for panel cleaning estimated to be one or two times per year. The Project does not require long-term significant water storage or a dedicated water borehole. Three options to meet the Project water supply requirements are under consideration and have been assessed:

- Option 1: install a 6 to 10in water pipeline from an existing water supply point at Kamburu Power Station (abstraction permit reference WMRA/40/KRG/4BG/23/S currently restricted to 1,200 m^3 / day for domestic abstraction and 20,234,000 m^3/day for hydropower generation). The new water pipeline will be located along Route B7 to the Project site

- Option 2: supply water to the Project site via tanker, particularly during panel cleaning exercises
- Option 3: combination: option 1 for domestic use and option 2 for panel cleaning

2.4 Project stages and activities

2.4.1 Construction

2.4.1.1 Site mobilisation and civil works

Typical site establishment and civil works at PV sites include the use of large equipment for excavation and soil movement, vegetation removal, excavating for foundation installations, and the use of potentially hazardous materials, among others. Further, transporting equipment, materials, and work crews to construction sites can strain existing infrastructure and degrade adjacent environmental quality. These activities can create environmental and social impacts both within the site itself and in adjacent areas. Impacts may be temporary or permanent in nature. Some of the major construction activities that may be required at the Project site are described below:

- Site mobilization: prior to installation of the PV panels, relevant areas of the site may be cleared of vegetation, re-graded, and/or excavated. Site preparation may also include creation or expansion of access roads, storage facilities, and the establishment of a secure site, including fencing and a guard post
- Foundations: typical foundation types for ground-mounted Projects include driven piles, helical piles, concrete encased piles, earth screw piles, and ballasted foundations. The geotechnical report recommends earth screw piles for the Project although prospective EPC contractors will be allowed to propose alternative foundation methods with soil treatments or other reinforcing measures such as removal, backfilling, or compaction

Typical equipment used during civil works will include graders, compactors, water tankers, excavators, piling machines, cranes and generators.

Announcement of Project viability and likely start of site preparation activities are anticipated for the first quarter of 2019.

2.4.1.2 Estimated job creation

The total number of labour hours for the Project using labour hours estimates published by the U.S. National Renewable Energy Laboratory (NREL)[7] is presented on the Project Feasibility Study. The results of the calculation are presented in Table 5. It should be noted that the numbers are estimates for the U.S. market and represent an average employment number during construction. A contingency component was included to reflect a potential productivity variance from U.S. rates. Actual employment during Project construction would fluctuate depending on the labour intensity of the tasks performed, the selected construction Contractor, technology and equipment supply.

Table 5: Calculation of total labour hours (construction)

Description	Low case	Base case	High case
Skilled labour content	0.633	0.844	1.055

[7] Residential, Commercial, and Utility-Scale Photovoltaic (PV) System Prices in the United States: Current Drivers and Cost-Reduction Opportunities, Goodrich et. al., National Renewable Energy Laboratory (NREL), Available at: https://www.nrel.gov/docs/fy12osti/53347.pdf, Accessed at: September 12, 2017

Description	Low case	Base case	High case
(hrs / kwdc)			
Total skilled labour (hours)	30,086	40,115	50,144
General labour content (hrs/kwdc)	0.139	0.185	0.231
Total general labour (hours)	6,607	8,793	10,979
Total labour hours	36,693	48,908	61,124
Contingency for lost labour hours (25%)	9,173	12,227	15,281
Total labour hours including contingency	45,866	61,135	76,404
Hours worked daily	8	8	8
Total construction days	200	200	200
Total full-time employment generated	29	38	48

Source: Feasibility Study for the Seven Forks Solar Power Project (K&M advisors, 2017)

In addition to the jobs set out in the table above, the following additional jobs are expected to be generated:

- Manual labour for panel cleaning (for duration of cleaning only – approximately 2 weeks): four to five personnel depending on speed
- Manual labour to maintain the landscaping (full-time): up to five personnel
- Supplementary labour at the KenGen nursery for additional seedling planting and reforestation efforts (duration of the compensation planning and monitoring - up to five years): up to five personnel
- General site maintenance workers (full-time): up to three personnel

Labour and working conditions will be regulated in compliance with Kenya`s labour laws, the core conventions of the International Labour Organisation (ILO) requirements and international safeguard policies e.g. IFC PS2. Compliance with occupational health and safety (OHS) standards will be the responsibility of all Project employers. Labour rights will be protected and transparent processes for the recruitment of staff will be identified. These requirements will be explicit in all Project contacts and apply to the lead contractor and all sub-contractors equally either by applying their own labour policies or signing up to the EPC contractor policy approved as aligned with IFC PS2.

Labour hiring will require the Contractor to implement a local hiring policy to be implemented which implements a policy of 2:2:1 (Embu County, Machackos County, other). This will be outlined in the EPC contract. The local hiring policy will be implemented with support of KenGen and in collaboration with the community.

2.4.1.3 Procurement and installation

The key activities required at the Project site during the procurement and installation phase are described below

- Procurement and transportation: equipment will be procured off site and delivered via trucks from the preferred port of the EPC Contractor, if not sourced in Kenya, to the temporary laydown area to be located within the site or other nearby land owned by KenGen
- Equipment installation: installing the PV modules will require trenching for cabling and the placement of the modules and associated components such as inverters, combiner boxes,

and transformers. Other equipment will include the switching station, meteorological stations, site surveillance system and communication works

- Waste generation and disposal: installation works will generate various classes of wastes, some of which may be hazardous and require special treatment and disposal

During procurement, the Project will specify a preference to re-use on-site or locally sourced raw construction materials where practicable e.g. sand, cement, national building stone blocks, gravel, timber (e.g. for the control room). When considering paints, solvents and other materials specifications that require reduced maintenance options will be explored. All materials will be handled and stored in accordance with national regulations.

2.4.1.4 Installation and commissioning

During commissioning, the Project will establish three main criteria (1) the plant is structurally and electrically safe, (2) the plant is sufficiently structurally and electrically robust for operation over the Project lifetime, and (3) the plant operates and performs as designed and anticipated.[8]

Commissioning tests typically include:

- Visual acceptance tests before any systems are energized
- Pre-completion acceptance tests to demonstrate plant capacity and operational capability.
- Post- completion tests to demonstrate plant energy performance over a specified period of time.[9]

2.4.2 Operation and maintenance (O&M)

Operational solar PV plants are often unmanned and generally require low impact maintenance work on a regular basis. It is envisaged that skilled maintenance work will be outsourced via contract. Typical maintenance is as follows:

- Tracking system: annual maintenance to maintain good lubrication. some regular checking and maintenance and the repair replacement of tracking system by the manufacturer
- Electrical: check electrical connections and enclosure for tracking motor/controller; check grounding braids for wear
- Controls: Inspect and calibrate anemometer, replace cup-wheel; inspect inclinometer; inspect limit switch; replace tracking-controller power-supply fan filter; inspect/test tracking controller
- Rack and Actuator: Check drive-shaft torque and visually inspect gearbox lubrication; inspect module table; grease screw jack; inspect screw jack; lubricate slew-gear; check slewgear torque and inspect wear; grease universal-joint (zerk fitting); inspect universal joint; lubricate tracker-mounting bearings/gimbals; repair/replace components as needed/required

PV modules require periodic cleaning, the frequency of which is determined based on site-specific conditions. Considering the geology (dust raising potential) and climatic conditions at the Project site, it is expected that the PV modules may be cleaned with water only (no detergents) once per year based upon frequency of dust storms, rainfall and pollution. Water requirements are estimated between 50,000 – 100,000 gallons / wash / approximately 180,000 to 360,000 litres of water per year.

[8] International Finance Corporation (IFC). 2012. Utility Scale Solar Power Plants: A Guide for Developers and Investors. Available at http://www.ifc.org/wps/wcm/connect/04b38b804a178f13b377ffdd29332b51/SOLAR%2BGUIDE%2BBOOK.pdf?MOD=AJPERES

[9] Ibid.

Once the PV module technology selection has been finalized and O&M plans have been established, any cleaning agents which would potentially be used for wet-cleaning of the modules will need to be investigated in case it is necessary to collect the water run off during the cleaning process.

When selecting the preferred PV module cleaning method, multiple factors will need to be considered including:

- Spacing of modules and subsequent access restraints
- Economic efficiency
- Water usage restrictions
- O&M staffing plans and sufficiency
- Availability of automation or mechanical machinery
- Required frequency of cleaning

Automated and mechanical cleaning methods are typically less water-intensive, require less manpower and are both fast and effective. However, for this Project the panel cleaning will be performed by local unskilled labour (four to five people) hired on an as needs basis who have been trained to work at heights and in the requirements of the role, with appropriate personal protective equipment (PPE) provided. Panels are cleaned by using a washer / mop type instrument that feeds water to the brush. It is anticipated the pure water (potable water) will be used for this purpose. No cleaning agents are envisaged. Water will be sourced from trucks placed strategically at the point of cleaning.

The area between the panels will be grassed to keep soil erosion and dust to a minimum during the operation phase. Landscaping works will be performed by unskilled local labour on an as needs basis. Weed control and vegetation management is particularly important for ground-mounted solar systems. The Project will limit the use of fertilizers to that necessary to maintain vegetation and use mowing for vegetation control instead of herbicides.

2.4.3 Decommissioning

Plant decommissioning generates similar impacts to those associated with construction activities. However, decommissioning of a PV facility also requires the appropriate disposal of the PV cells and associated equipment, which will require transport to specialized waste management facilities.

2.5 Associated facilities

Associated facilities are defined as facilities that are not funded as part of the Project, but would not have been constructed or expanded if the Project did not exist and without which the Project would not be viable[10]. No associated facilities as defined by IFC PS1 are considered relevant.

2.6 Project budget

The total capital expenditures (CAPEX) budget for the Project considering the aforementioned Project components has been roughly estimated to be in the range of US$57 million and will depend highly on the offers to be received by the EPC Contractors.

[10] IFC PS1 paragraph 8, page 3.

2.7 Implementation schedule

The Project implementation schedule (accounting for contingency) is envisaged to be 14 months. Site establishment and civil works is expected to take three months, followed by eight months for installation a further three months for commissioning. Announcement of Project viability and likely start of site preparation activities is anticipated for the first quarter of 2019.

2.8 Need for Project and analysis of alternatives

The assessment of alternative sites and technologies has taken account of various criteria including the Project requirements, existing infrastructure, land use planning and the potential environmental and social impact. This Chapter provides a summary of the design decisions made to date with reference to the above stated criteria.

The Project need has been reviewed in the context of Kenyan energy policy in addition to economic and market factors in order to evaluate whether there are sufficient drivers to justify development of the Project.

Those significant alternatives considered for the Project are broadly categorised as follows, and discussed in more detail below:

- 'No Project' alternatives
- Options for alternative sites
- Options for alternative generation technologies

2.9 Needs case

Kenya's territory covers approximately 580,370 km^2, and includes a multi ethnic population with an estimated 48.5 million inhabitants. Kenya is considered the largest economy in East Africa with a per capita gross domestic product (GDP) of US$70.5 billion in 2016[11], demonstrating growth of approximately 5.8% in 2016[12].

The most prevalent development challenges for Kenya currently include poverty, inequality, climate change and economic vulnerability to internal and external influences. [13] Kenya has seen an increase in overall poverty, with approximately 11.9 million people (33.6%) living on less than international poverty line in 2005 compared to approximately 6.2 million (21%) in 1997[14]. Reducing energy poverty is seen as one of the highest priorities for the Kenyan government.

Electricity consumption in Kenya is currently forecasted to grow by an annual average of approximately 7.3% per year over the long term, while annual peak load is forecasted to grow by an annual average of approximately 7.5%[15]. To alleviate poverty, the country needs to stabilize electricity prices while continuing their current rapid expansion of energy across the County to meet current and future energy demand. This can be achieved by diversifying Kenya's energy source portfolio through the development and implementation of geothermal, wind, solar, and natural gas Projects. As Kenya's grid is now largely dependent on hydropower,

[11] GDP in 2016 (constant 2016 US$). Data Bank (World Development Indicators), World Bank Group, Washington DC, [accessed 25 August 2017]

[12] Data Bank (World Development Indicators), World Bank Group, Washington DC, [accessed 25 August 2017]

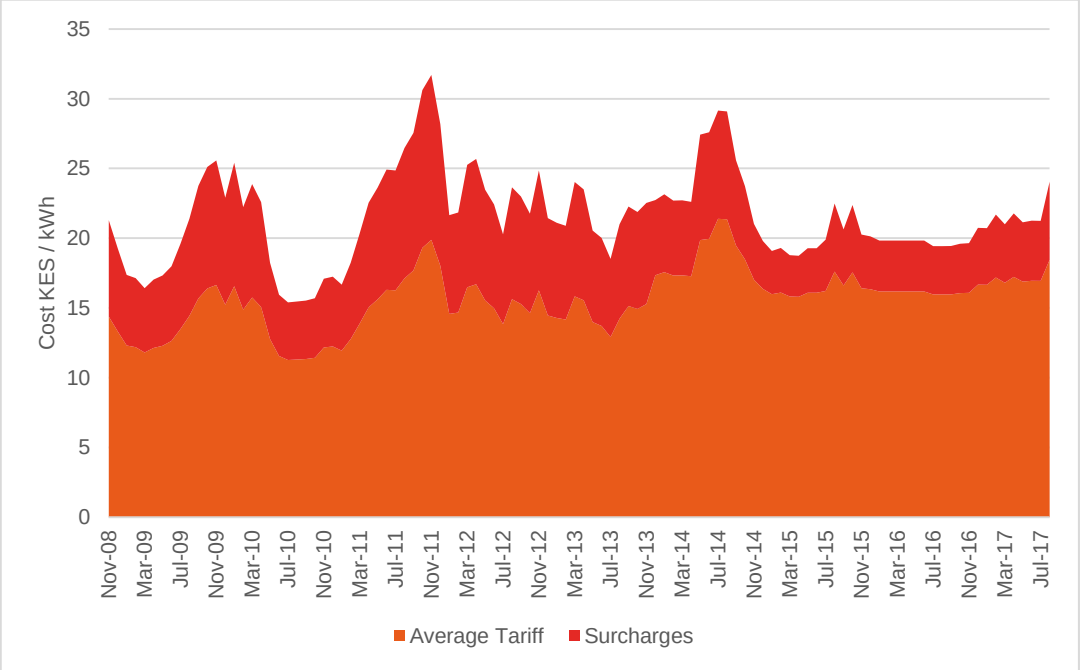
[13] Kenya Overview, Data Bank, World Bank Group, Washington DC, [accessed 1 September 2017]

[14] Data collection in Kenya has been infrequent and ad hoc. Only four surveys were conducted since 1990, the most recent survey was conducted in 2005-06, according to The World Bank. Poverty & Equity Data Portal. Available at: http://povertydata.worldbank.org/poverty/country/KEN.

[15] Power Generation and Transmission Master Plan, Kenya, Long Term Plan 2015 – 2035 Vol. I

electricity tariffs and surcharges become increasingly volatile during periods of drought, as is demonstrated in the Figure 11 below.

Figure 11: Average electricity prices in Kenya 2008 to 2017, KES / KWh



Source: Regulus with data from Kenya Power

Some of the highest electricity tariffs and surcharges during the last 10-year period were seen during the late summer months of 2011 and 2014, during which time much of Kenya was experiencing significant drought conditions. When the necessary flexible hydropower resources are lacking during periods of peak load, the generation deficit is compensated for with diesel power plants, which are more expensive. Currently the average annual hourly load and generation profile for Kenya shows that geothermal generation acts as the country's primary baseload power resource with hydroelectric resources providing intermediate power. The system starts peaking after 6pm and reaches maximum demand around 8pm[16].

Lahmeyer International was appointed by the Kenyan Ministry of Energy and Petroleum to produce the Development of a Power Generation and Transmission Master Plan Report (the "Long Term Plant Report") by carrying out a qualitative and quantitative economic analysis to determine the top power generation expansion candidate sources to be employed as a part of Kenya's goal for rapid national electrification. According to the Long-Term Plan Report, which includes 2015 through 2035, the following sources have been identified as the best expansion candidates for base load, intermediate load and peak load periods, and renewables:

- Base load – geothermal power plants
- Intermediate load – coal or combined cycle gas turbine power plants
- Peak load – hydropower
- Renewables – wind energy followed by solar PV.

[16] Seven Forks Development Impact Assessment, September 2017

Solar power has a lower marginal cost than heavy fuel oil (HFO) / diesel, so it would actually be less costly to dispatch the solar before the HFO/diesel plants or alternatively to reduce the hydroelectric generation (to save water) while the solar plant is generating (estimated between 6am and 6pm). Stored water could be released during peak hours to generate more hydropower, thereby replacing HFO / diesel generation. The net effect of both approaches will be the same as HFO diesel generation will be displaced by the amount of solar generation. Further information on avoided greenhouse gas (GHG) emissions is provided in 7.11 below.

Kenya's Long-Term Plan ultimately calls for more than 85% of the country's power to be generated by renewable energy sources, including geothermal, hydropower, wind, biomass cogeneration and solar PV. Kenya's prioritization of renewables is driven by the goal to "ensure sustainable, adequate, affordable, competitive, secure and reliable supply of energy to meet national and County needs at least cost, while protecting and conserving the environment."[17] To assist in achieving this goal, the first Feed in Tariff (FIT) Policy for renewable energy was enacted in Kenya in 2008, and was revised to include solar PV Projects in 2010.

Kenya's solar power potential is much larger than the electricity demand in Kenya due to significant solar irradiation. According to Kenya's Power Generation and Transmission Master Plan for Renewable Energy from 2015 to 2035, the moderate renewable energy expansion scenario assumes for expansion of solar PV Projects beginning in 2020, with overall expansion to 2035 implemented through Kenya's solar PV feed-in tariff competition as of May 2016.

Solar PV expansion is more ambitious under the accelerated renewable energy scenario, and conversely far less ambitious in the slowed renewable energy scenario which includes plans for 100MW of installed solar power up to 2035. Solar projects are also considered in parallel with wind power projects, of which there is currently a considerable pipeline of projects in final planning stages or that have reached financial close. The Project would contribute to meeting Kenya's goals under the three aforementioned renewable energy scenarios as one of the first utility-scale solar PV projects in the country.

The following points summarize the need for and benefits of this Project:

- Contributes to national energy goals for sustainable development
- Contributes to diversification of Kenya's energy sources
- Provides continuous, reliable, energy that is not adversely impacted by recurrent drought
- Meets local demand, interconnect to the national grid to lower electricity costs and make it more affordable to reduce poverty and stimulate economic growth
- Provides employment opportunities to the community residing in and around the region
- Contributes to the local economy, and local social and technical infrastructure
- Helps to meet Kenya's ambitious national target to increase the country's electricity generation from renewable sources to 85%

2.10 Analysis of alternatives

2.10.1 "No Project"

The 'no Project' alternative could exacerbate the deficit in electricity production and would hinder the diversification of energy sources in Kenya. In addition, PV solar plants will allow

[17] Draft National Energy and Petroleum Policy, Kenya Ministry of Energy and Petroleum

KenGen to save water during sun-hours and displace more fossil-fuel (particularly) diesel generation during peak hours in the evening.

Foregoing the development and installation of Kenya's solar resource will result in greater reliance on wind and hydropower Projects. Hydropower Projects are however vulnerable to the recurrent droughts seen in Kenya in recent years, an issue which is expected to be exacerbated given prevailing climate change perspectives. Conversely, the 'no Project' alternative could lead to a longer-term reliance on fossil fuel generation (domestic or imported) which would contribute to GHG emissions. The 'no Project' alternative would result in:

- Slower transition to 85% electricity generation from renewable energy target
- Reduced or delayed diversification of Kenya's generation portfolio
- Potential increase of imports of fuel for fossil fuel power plants with lower capacity factors and higher energy costs

The environmental impact of the no Project alternative would mean no impact to the existing habitats, assuming no alternative development takes place. However, as mentioned above, the 'no Project' alternative creates the need for an alternative energy source to meet the country's demand for reliable electricity supply. Depending on the alternative source selected, there is potential for this additional source to produce harmful pollutants and in the case of wind, have increased habitat take per megawatt during the Project lifecycle.

From a social perspective, there is some opportunity for local employment mainly during construction of the Project, including training opportunities for local people. The land proposed would not require physical displacement and subject to adequate compensation for land use at the Project site, the impact on communities is expected to be comparatively low to alternative options.

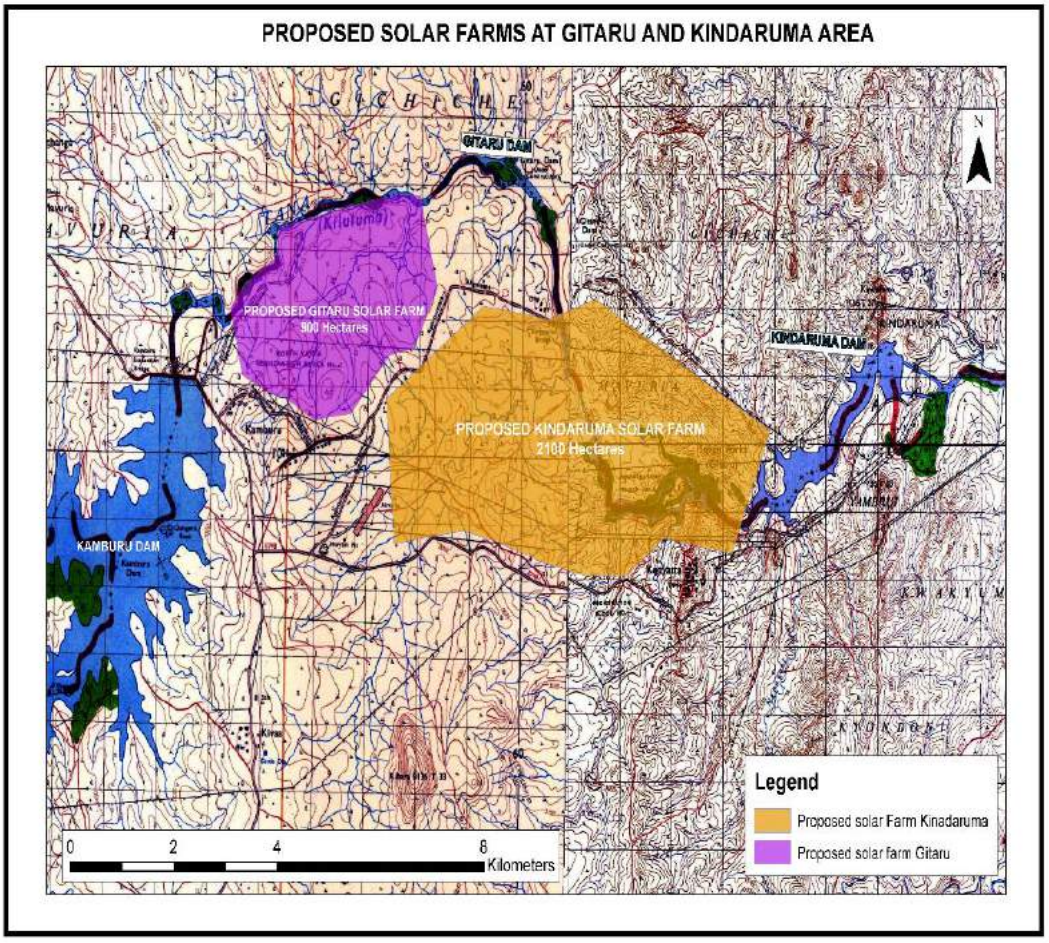
Selecting the 'no Project' alternative would delay the diversification of Kenya's energy sources and ultimately would detract from the goal of the Kenyan energy sector to "ensure sustainable, adequate, affordable, competitive, secure and reliable supply of energy to meet national and County needs at least cost, while protecting and conserving the environment". Furthermore, the 'no Project' alternative would contribute to a continued electricity price volatility nationally.

2.10.2 Site selection

KenGen considered options to develop a solar PV Project within the existing boundaries of land owned[18] by KenGen near the Kamburu substation, outlined in Figure 12

[18] As described in land title, refer to Appendix K.

Figure 12: Initial proposed site locations



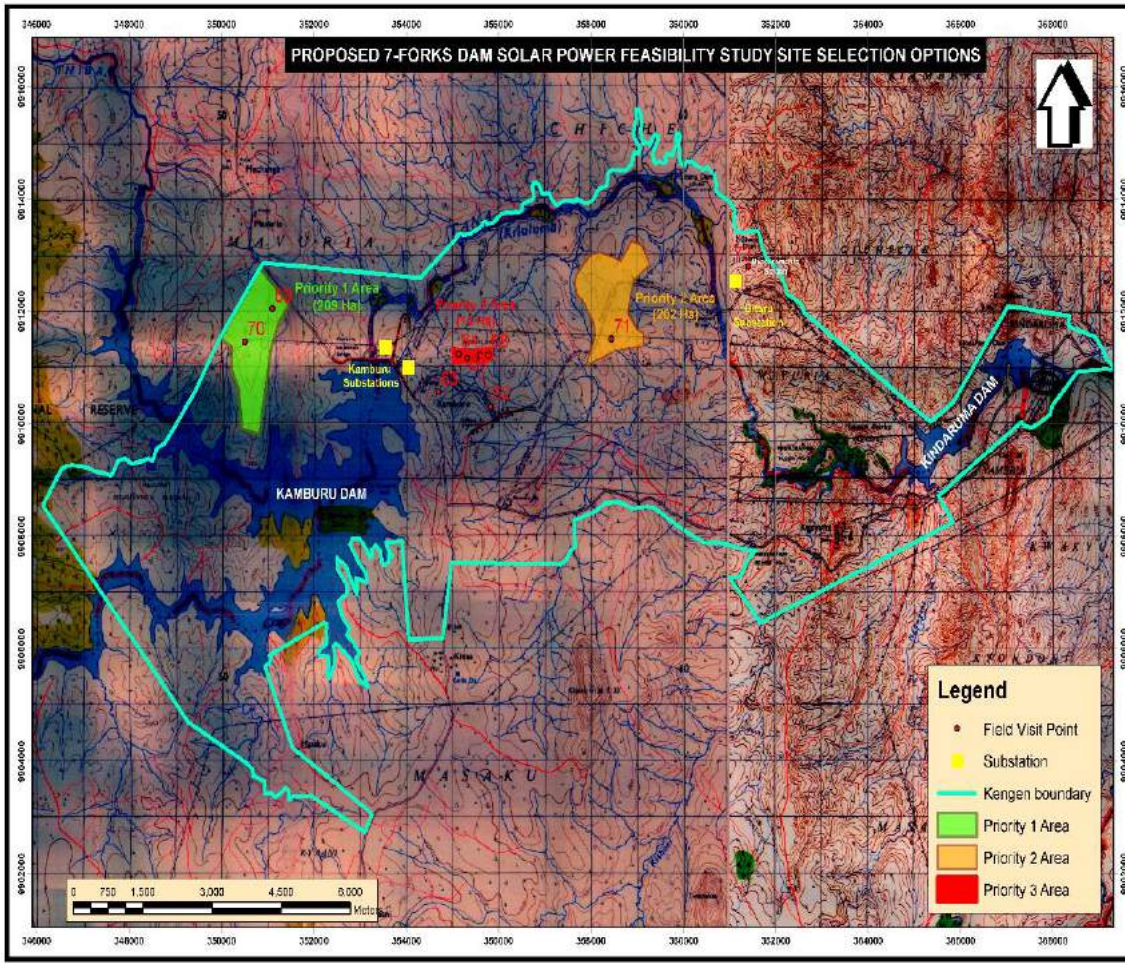
Source: KenGen Feasiblity report, September 2017

After initial review, three sites were identified as areas of interest as described below and illustrated in Figure 13:

- Priority Area 1: Site is approximately 3km from the Kamburu substation. Soils appear to be a soft combination of silt and clay with a moderate amount of vegetation. A preliminary determination was made that up to 100ha of the site might be suitable for a solar PV Project
- Priority Area 2: Site is approximately 1km east of the Kamburu substation. The site soils appear to be a soft combination of silt and clay. Approximately 15ha of the site could be suitable for a solar PV Project
- Priority Area 3: Site is located approximately 2km west of the Gitaru substation. Soils appear be a mix of silt and clay that retains more moisture than the soils at the other two sites. Vegetation at this site is also comparatively dense. Approximately 202ha of the site could be suitable for a solar PV Project

After visiting the three sites described above, Priority Area 1 was deemed the best option with Priority Area 3 as an alternative option. Priority Area 1 was selected based on the large area of suitable land, vegetation density, proximity to existing road network and proximity to high voltage interconnection options.

Figure 13: KenGen land near Kamburu substations



Source: KenGen Feasiblity report, September 2017

2.10.3 Technology alternatives

This section provides a brief overview of alternative technologies, namely alternative energy sources to solar PV. As Kenya is currently prioritizing diversification of their energy sources, there are multiple generation sources which could be considered as technology alternatives, including:

- Wind energy
- Geothermal
- Hydropower
- Biomass / biogas

A comparison of the advantages and disadvantages of solar thermal or PV and each of the aforementioned technologies is included in Table 6 below. The analysis indicates that solar PV is a viable option for electricity generation in Kenya.

Table 6: Comparison of alternative generation technologies

Technology	Advantages	Disadvantages
Solar (photovoltaic solar panels)	• Renewable technology- free fuel- with CO_2 emissions only considered with lifecycle assessment of equipment manufacture- no CO_2 emissions from general operations • Typically, low maintenance • Contribute to Kenya's goal of 85% renewable energy • Poverty reducing benefits • Recent technological advancements result in greater efficiency and lower costs, potential to become a major source of Kenya's energy matrix • Potential to combine with storage as batteries or other storage technologies become commercially competitive	• Power only possible during sunlight hours • Relative inefficiency / square meter • Generally, not seen as suitable for base load power given intermittent energy source • Fewer employment opportunities compared to hydroelectric and thermal power plants • Panel efficiencies reduce over time (though typically manufacturers offer maximum degradation guarantees)
Geothermal power	• Typically, only needs a small area of land • Renewable technology • Small quantities of raw materials used • Contribute to Kenya's goal of 85% renewable energy • Stable power generation compared to wind, solar and pumped storage • Poverty reducing benefits	• Significant challenge to mobilize private investment due to high upfront risk • Ecological impacts will depend on siting of the geothermal plant • Emissions of potential significance are hydrogen sulphide and small amounts of CO_2
Wind	• Renewable technology- free fuel- with CO_2 emissions only considered with lifecycle assessment of equipment manufacture- no CO_2 emissions from general operations • Contribute to Kenya's goal of 85% renewable energy • Poverty reducing benefits • Wind energy is an emerging market in Kenya and there is a pipeline of Projects currently under development	• Only suitable for areas with high wind intensity/regularity • Dependent on wind, allowing little scope for increasing power generation if needed: generally, not seen as suitable for base load power given inconsistencies in generation • Typically needs large areas of land • Wind turbines sometimes considered as visually detrimental to the surrounding landscape • Environmental impacts associated with migratory birds relevant in Kenya
Hydropower	• Renewable technology- free fuel- with CO_2 emissions only considered with lifecycle assessment of equipment manufacture- no CO_2 emissions from general operations • Energy storage possible with dam use • Established energy source in Kenya • Run of river schemes typically minimise impacts to river users • Contribute to Kenya's goal of 85% renewable energy • Potential poverty reducing benefits	• Can often significantly impact on communities upstream and downstream • Dam construction for large scale Projects can be costly • Can be significant impacts on the hydrological profile / river ecologies • Hydropower is vulnerable to drought which is becoming an increasingly common occurrence in Kenya • Energy tariffs in Kenya become volatile during periods when hydropower resources are lacking
Biomass / biogas	• Contribute to Kenya's goal of 85% renewable energy • Poverty reducing benefits • Potential for biomass / biogas in Kenya is tied to agricultural industry, which is strong in Kenya	• Issues with feedstock availability • Agricultural industries, and subsequently resources for biomass / biogas, are vulnerable to drought conditions • Displace agricultural and livestock land activities

3 Policy, legislative and institutional framework

This Chapter presents both the national and international legal framework for planning and environmental and social protection in Kenya applicable to solar power Projects. In addition, reference has been made to relevant international lender standards namely the IFC PSs 2012. The Project will be required to defer to the most stringent requirement except in cases where national law or regulations have been explicitly identified as taking precedence over more stringent international standards.

3.1 National legislation

3.1.1 Policy framework

Kenya has approximately 77 statutes that guide environmental and social management and conservation. Most of these statutes are sector specific, covering issues such as public health, soil conservation, protected areas conservation and management, endangered species, public participation, water rights, water quality, air quality, excessive noise control, vibration control, land use among other issues.

The National Environmental Management Agency (NEMA), in conjunction with the various lead agencies require ESIA studies to be undertaken for proposed Projects and that all their aspects adhere to institutional and regulatory Frameworks requirements.

Table 7 provides a summary of the key legislative and policy instruments relevant to the energy sector and solar Projects in Kenya.

Table 7: Summary of key sectoral legislative instruments

Legislative or policy instrument	Main relevant details
The Constitution of Kenya 2010	• Article 42 states that every citizen has the right to a clean and healthy environment. Articles 10 and 69 recognize public participation as a principle of the Kenyan government and assigns the State responsibility in encouraging public participation in the management, protection and conservation of the environment and to establish systems for EIA, environmental auditing and monitoring of the environment. • Article 232 further outlines transparency and timely provision to the public of accurate information as one of the values and principles of public service, going further to bind all state agencies at both national and County government levels and state corporations to these values and principles. • Article 66 regulates use of any land or any interest or right over any land, in the interest of public health or public planning and Article 185 provides for the protection of the environment and natural resources with a view to establishing a durable and sustainable system of development. • Article 11. (1) recognizes culture as the foundation of the nation and as the cumulative civilization of the Kenyan people and nation. • Article 44. (1) Every person has the right to use the language, and to participate in the cultural life, of the person's choice. • Article 59. (1) Establishes the Kenya National Human Rights and Equality Commission. • Article 63. (1) Community land shall vest in and be held by communities identified

Legislative or policy instrument	Main relevant details
	on the basis of ethnicity, culture or similar community of interest. • Article 69(1)(c) and (e) mandates the state to protect and enhance intellectual property and traditional knowledge.
The Energy Act, 2006	**Section 27 (1)** requires a license to generate electricity. **Section 38 (1)** requires a license from the Energy Regulatory Committee for any electrical installation work. **Section 103 (1)** provides that the Minister shall promote the development and use of renewable energy technologies, including but not limited to biomass, biodiesel, bioethanol, charcoal, fuelwood, solar, wind, tidal waves, hydropower, biogas and municipal waste.
Environmental Management and Coordination Act (EMCA), 1999 and EMCA (Amendment) 2015 Act	The EMCA, 1999 and its 2015 amendment, is the framework law on environmental management and conservation. EMCA establishes among others the following institutions; National Environment Management Authority, Public Complaints Committee, National Environment Tribunal, National Environment Action Plan Committees, and County Environment Committees. The National Environment Management Authority (NEMA) was established as the principal instrument of government charged with the implementation of all policies relating to the environment, and to exercise general supervision and coordination over all matters relating to the environment. In consultation with the lead agencies, NEMA is empowered to develop regulations, prescribe measures and standards and, issue guidelines for the management and conservation of natural resources and the environment. The Act provides for environmental protection through: • Environmental impact assessment • Environmental audit and monitoring • Environmental restoration orders, conservation orders, and easements NEMA is also the Designated National Authority for certain Multilateral Environmental Agreements.
The Local Government Act (Cap 265) Revised Edition 2010	Under **Section 163 (e)**, municipal councils have the power to control or prohibit all businesses, factories and workshops which, by reason of smoke, fumes, chemicals, gases, dust, smell, noise, vibration or other cause, may be or become a source of danger, discomfort or annoyance to the neighbourhood.
Land Act No. 6, 2012	The Act provides guidelines on land acquisition.
The National Land Commission Act (2012)	An Act of Parliament to make further provision as to the functions and powers of the National Land Commission, qualifications and procedures for appointments to the Commission; to give effect to the objects and principles of devolved government in land management and administration, and for connected purposes
Public Health Act (Cap 242), Revised 2012	**Section 115 (9)** states that no person or institution shall cause nuisance or condition liable to be injurious or dangerous to human health. Any noxious matter or waste water flowing or discharged into a watercourse is deemed as a nuisance. **Section 116** requires that local Authorities take all lawful necessary and reasonable practicable measures to maintain their jurisdiction clean and sanitary to prevent occurrence of nuisance or condition liable to injuries or dangerous to human health. **Section 136 (12)** 136 states that all collections of water, sewage, rubbish, refuse and other fluids which permit or facilitate the breeding or multiplication of pests shall be deemed a nuisance.
Public Health (Drainage and Latrine) Rules, 1981	**Rule 85** provides that every owner or occupier of every premises where persons are employed shall provide proper and sufficient latrines for use by employees. **Rule 87** requires every contractor, builder or other person employing workmen to provide in an approved position, sufficient and convenient temporary latrines for use by such workmen. **Rule 91** provides that no person shall construct a latrine in connection with a building other than a water closet or a urinal, where any part of the site of such building is within 200 feet of a sewer belonging to the local authority which is at a suitable level, and where there is sufficient water supply.
Public Roads and Roads of Access Act (Cap 399)	**Sections 8 and 9** of the Act provides for the dedication, conservation or alignment of public travel lines including construction of access roads adjacent to lands from the nearest part of a public road. **Sections 10 and 11** allows for notices to be served on the adjacent land owners seeking permission to construct the respective roads.
The Kenya Roads Act, 2007	The Act provides for the establishment of three independent Road Authorities, namely: Kenya National Highways Authority (Kantha), Kenya Rural Roads Authority (KeRRA), and Kenya Urban Roads Authority (KURA).
Occupational Health and Safety Act, 2007	This Act applies to all workplaces and workers associated with it; whether temporary or permanent. The main aim of the Act is to safeguard the health, safety and welfare of

Legislative or policy instrument	Main relevant details
	workers and non-workers.
Occupiers Liability Act (Cap 34), Revised 2012	**Section 1 (4)** provides guidance on determining whether the occupier of a premises has discharged with the common duty of care to a visitor.
Wildlife Conservation and Management Act (Cap 376), Revised 2009	This Act provides for the protection, conservation and management of wildlife in Kenya. The Act deals with areas declared as National Parks, under the Act. The Act controls activities within the park, which may lead to the disturbance of animals.
Water Act, 2002	The Act provides guidelines on use and management of the of the water resources in the country. This Act prohibits the pollution of water. **Part 2 (3)** of this act states that "every water resource is hereby vested in the state, subject to any rights of user granted by or under the Act or any other law". The Act requires any organization/person intending to abstract water for supply to over twenty (20) users to obtain a permit from the Water Resource Management Authority and should form a Water Users Association (WUA). The act further notes that, the issuance of the permit is subject to public consultation as well as an EIA.
Forest Act (Cap 385) , Revised 1982	The Act guides the establishment, development and sustainable management, including conservation and rational utilization of forest resources for the socioeconomic development of the country.
The Standards Act (Cap 496), Revised 2013	This Act is implemented by the Kenya Bureau of Standards which provides standards on the requirements of equipment, Project materials and the security and safety of the public.
Children Act No. 8 of 2001	States that every child shall be protected from economic exploitation and any work that is likely to be hazardous or to interfere with the child's education, or to be harmful to the child's health or physical, mental, spiritual, moral or social development'.

Source: summarized by EcoPlan 2017

See Table 8 for the key legislative and policy instruments relevant to the energy sector and solar Projects in Kenya.

Table 8: Summary of key sectoral legislative and policy instruments

Policy instrument	Main relevant details
Vision 2030 (GoK, 2008)	Aims to ensure a clean, secure and sustainable environment by promoting and safeguarding the state of environment for economic growth with the following specific goals (1) increasing forest cover from less than 3% to 4%; (2) protecting five water catchment areas; (3) fully protecting all wildlife ecosystems; (4) reducing by 50% environmental health related diseases; (5) substantially reducing losses due to floods and droughts; (6) enforcing all environmental regulations and standards.
The Kenya National Biodiversity Strategy and Action Plan, 2000 (NBSAP)	The overall objective of the NBSAP is to address the national and international undertakings elaborated in Article 6 of the Convention on Biological Diversity' (CBD). It is a national framework of action for the implementation of the Convention to ensure that the present rate of biodiversity loss is reversed, and that present levels of biological resources are maintained at sustainable levels for posterity.
National Policy for Disaster Management, 2009 (GoK, 2009)	Promoting the mainstreaming of disaster management and climate change into development planning and management for sustainability.
National Climate Change Response Strategy, 2009 (GoK, 2010)	Ensuring that all new infrastructure is climate-proof over its lifespan.
Embu Integrated Development Plan, 2013-2017 (KCG, 2013)	To promote, conserve and protect the environment for sustainable national development.
National Environmental Action Plan (NEAP)	Prepared in the mid-1990s, with a key objective of integrating environmental considerations into the country's economic and social development through a multi-sectoral approach to develop a comprehensive framework to ensure that environmental management and the conservation of natural resources forms an integral part of societal decision-making. The application of this plan is widening as the government through NEMA does not approve a development Project unless the impacts of the proposed Project are

Policy instrument	Main relevant details
	evaluated and mitigation measures proposed for incorporation in the Project's development plan which is in line with the requirements of the NEAP.

Source: EcoPlan

3.1.2 Environmental framework

3.1.2.1 Environmental Management and Coordination (EMCA) 1999 & EMCA (Amendment) 2015, Act

NEMA is mandated under section 9(2) (a) of the Environmental Management and Coordination Act, No. 8 of 1999 to coordinate the various environmental management activities being undertaken by the lead agencies to promote the integration of environmental considerations into development policies. Under section 9(2) (c) & (d), of the EMCA Act, 1999 NEMA, in consultation with lead agencies, is tasked with the function of establishing and reviewing land use guidelines and examining land use patterns to determine their impact on the quality and quantity of natural resources.

Section 58 of the Environmental Management and Co-ordination Act of 1999 sets out the need for EIA for all Projects listed on the second schedule of the Act. Section 58 states the time period within which oral or written comments from members of the public should be submitted to the Authority.

Part V section 42, subsection 1 directs that no person shall deposit any substance in a water body if the substance will have an adverse environmental effect on the water. According to section 45 of the Act, hilly or mountainous areas are at risk when they are prone to erosion, high rate of vegetation removal or land use activities likely to lead to environmental degradation. Section 47 defines these measures, which include control of soil erosion.

Part VIII section 72 of the Act prohibits discharging or applying pollutant materials into aquatic environment. Section 73 requires that all operators of Projects which discharge effluent or other pollutants to the environment submit to NEMA accurate information on the quality and quantity of the waste thereof.

KenGen will be in compliance with the Act by commissioning this ESIA study which identifies the mitigation measures aimed at guiding KenGen and any Project contractors to abate anticipated negative impacts while enhancing positive impacts.

3.1.2.2 Key governmental bodies

Table 9 provides a brief description of the key governmental bodies in Kenya involved in the environmental and social impacts of a solar energy Project.

Table 9: Key Governmental Bodies

Governmental Body	Description
Ministry of Environment & Natural Resources	To facilitate good governance in the protection, restoration, conservation, development and management of the environment and natural resources for equitable and sustainable development
NEMA	NEMA was established to exercise general supervision and coordinate over all matters relating to the environment and to be the principal instrument of the government in the implementation of all policies relating to the environment. The Director General of NEMA is appointed by the President of Kenya. NEMA's responsibilities include coordinating environmental management activities, examining land use patterns, identifying Projects and programs or types of Projects and programs, establishing plans and policies for which environmental audit or monitoring must be conducted under EMCA, monitoring and assessing

Governmental Body	Description
	activities to ensure the environment is not being degraded, and rendering advice and technical support where practicable to entities engaged in natural resources management, among other functions. NEMA's mandate is designated to the committees described below.
County Environmental Committees	According to the Environmental Management and Co-ordination (Amendment) Act, 2015, the Governor shall by notice in the gazette constitute County Environment Committees of the County. Each committee is responsible for the proper management of the environment within the County for which it is appointed. The decisions of these committees are legal and it is an offence not to implement them.
National Environmental Complaints Committee	The National Environmental Complaints Committee (1) investigates any allegations or complaints against any person or against the authority in relation to the condition of the environment in Kenya; (2) prepares and submits periodic reports of its activities which shall form part of the annual report on the state of the environment; and (3) undertakes public interest litigation on behalf of citizens in environmental matters.
National Environment Action Plan Committee	The National Environmental Action Plan Committee is responsible for the development of a 6-year National Environment Action Plan (NEAP).
National Environment Tribunal (NET)	This tribunal guides the handling of cases related to environmental offences in the Republic of Kenya. If disputes related to environmental matters arise during the implementation of the Project, such matters should be presented to the tribunal for hearing and legal direction.

Source: EcoPlan 2017

3.1.3 Project categorization

The second schedule of EMCA 1999, defines the Projects which require a full EIA to be undertaken and approved prior to their development. Although solar power energy generation facilities are not explicitly described within Schedule 2, there are a number of categories which could be deemed to be applicable to the Project and supporting infrastructure. These comprise the following:

- Electricity generation station
- Electrical OHLs
- Electrical sub-stations
- General - any activity out of character with its surrounding; any structure of a scale not in keeping with its surrounding; major changes in land use

3.1.4 EIA regulations

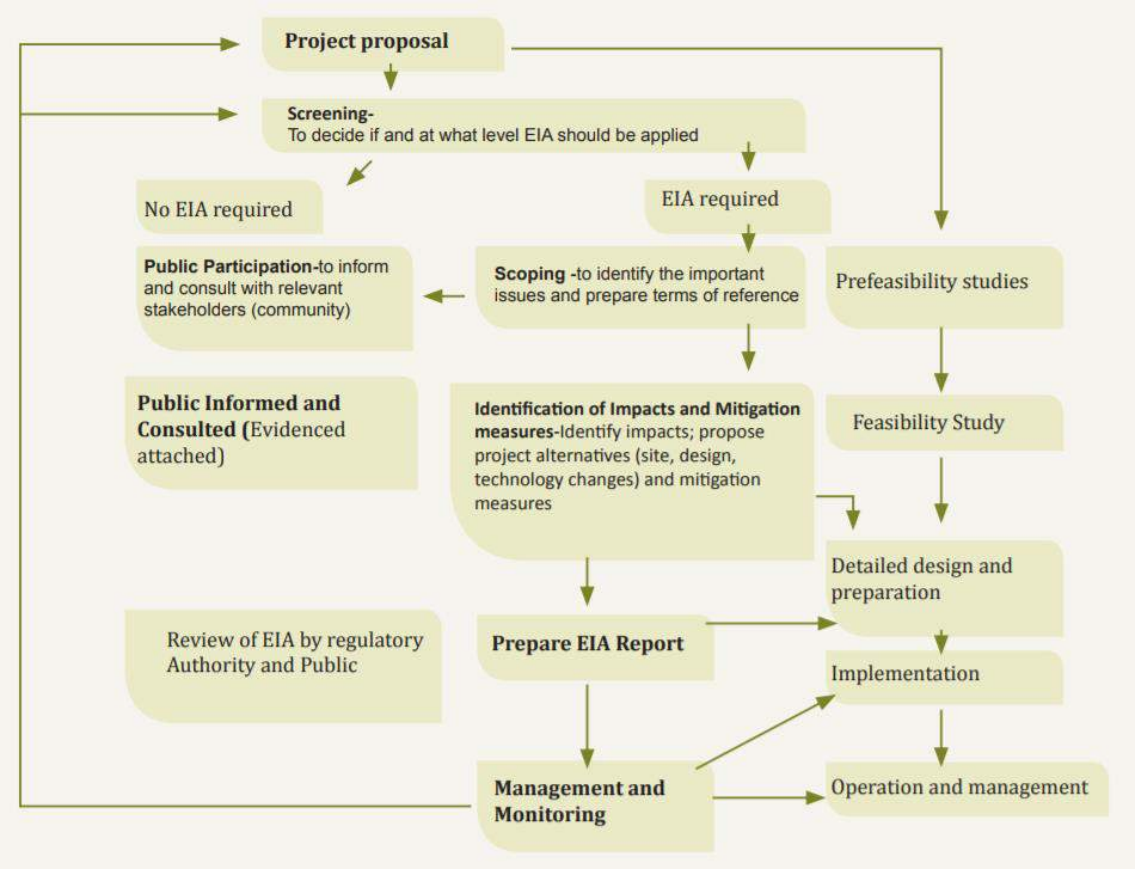
Development and submission of a Project Report is required for Projects or activities which are not likely to have significant environmental impacts or those for which no EIA study is required. However, if the Authority considers that an EIA study is required, then the ensuing EIA process is as follows:

- Screening and Project categorization
- Scoping and creation of terms of reference (TOR) for the study, to be approved by NEMA
- Gathering of baseline information
- Submission of EIA study report to NEMA
- Review of EIA by NEMA and relevant lead agencies
- Decision on EIA (approval, approval with conditions, or rejection)
- Appeals (where necessary)
- Project implementation
- Project monitoring

- Project auditing

The key stages of the EIA process are illustrated in Figure 14.

Figure 14: EIA process flow diagram



Source: Environmental Impact Assessment: Review Guide, NEMA 2014

3.1.5 National environmental regulations

The main legislative instruments relating to environmental management relevant to the ESIA are listed below.

- Environmental (Impact Assessment and Audit) Regulations, 2003 legal Notice 101
- EMCA (Waste Management) Regulations, 2006
- EMCA (Water Quality) Regulations, 2006
- EMCA (Controlled Substances) Regulations, 2007
- EMCA (Noise and Excessive Vibration Pollution Control) Regulations, 2000
- EMCA (Wetlands, River Banks, Lake Shores and Sea Shore Management) Regulations, 2009
- EMCA (Conservation of Biological Diversity and Resources, Access to Genetic Resources and Benefit Sharing Regulations, 2006)
- EMCA (Fossil Fuel Emission Control) Regulations, 2006
- Environmental Management and Coordination (Air Quality) Regulations, 2014

- The protection of Traditional Knowledge and Cultural Expressions Act,2016
- Fire Risk Reduction Rules, 2007
- Hazardous Substances Rules, 2007
- The Wildlife (conservation and management) Act, 2007

3.1.6 Labour regulations

The main legislative instruments that help protect employees and employers and specify rights and obligations in relation to working terms and conditions are:

- Labour Code, Law 185
- Labour Institution Act 2007
- Employment Act, 2007
- Minimum Wages Act, No. 625 (2007)
- The Occupation Safety and Health Act, 2007
- Medical Examination Rules, 2005

3.1.7 Land regulations

Kenyan Laws recognise the rights of owners to compensation should there be a requirement for land acquisition. Articles 3 and 4 under Section 40 of the Constitution of Kenya (2010) state that:

(3) The State shall not deprive a person of property of any description, or of any interest in, or right over, property of any description, unless the deprivation—results from an acquisition of land or an interest in land or a conversion of an interest in land, or title to land, in accordance with Chapter Five; or is for a public purpose or in the public interest and is carried out in accordance with this Constitution and any Act of Parliament that—requires prompt payment in full, of just compensation to the person; and allows any person who has an interest in, or right over, that property a right of access to a court of law.

*(4) Provision may be made for compensation to be paid to occupants in good faith of land acquired under clause (3) who may **not** hold title to the land.*

Chapter Five, Land and Environment, - Part 1, Land, of the Constitution of Kenya, 2010 recognises three categories of land ownership: i) Public (formerly Government Land), ii) Community (formerly Trust Land), and iii) Private Land.

The Land Acquisition Act (295) is an Act of Parliament to make provision for the compulsory acquisition of land for the public benefit. It describes the procedure for compulsory land acquisition required by this Act. Article 8 of this law states the compensation requirements, where land is compulsorily acquired, for all persons interested in the land. Article 9 of the Act highlights the process and the applicability of monetary compensation for persons interested in the land.

Table 10 summarises the main legislative instruments relating to land management.

Table 10 Key legislative instruments for land management

Legal or policy instrument	Relevant details
Government Lands Act	Enables for further and better provision for regulating the leasing and other disposal of Government lands, and for other purposes.
Registration of Title	Provides for the transfer of land by registration of titles.

Legal or policy instrument	Relevant details
Land Titles Act	Makes provision for the removal of doubts that have arisen regarding titles to land and to establish a Land Registration Court.
Land Consolidation Act	Provides for the ascertainment of rights and interests in: land in the special areas; registration of title; transactions and devolutions affecting such land and other land in the special areas
Trusts of Land Act	An Act of Parliament relating to trusts of land.
Equitable Mortgages Act	An Act of Parliament relating to equitable mortgages.
Land Act 2012	The Land Act No. 6 of 2012 has repealed the Wayleave Act, Cap 292 and the Land Acquisition Act 295 and thus covers all issues regarding land ownership in the country. The Act provides guidelines on land acquisition.
Trespass Act	An Act of Parliament to make provision regarding trespassing on land.
Land Acquisition Act	An Act of Parliament to make provision for the compulsory acquisition of land for public benefit.
Rent Restriction Act	An Act of Parliament to make provision for restricting the increase of rent, the right to possession and the exaction of premiums, and to fix standard rents, in relation to dwelling-houses, and for other purposes incidental to or connected with the relationship of landlord and tenant of a dwelling-house.
Wayleaves Act	In this Act, "private land" does not include any land sold or leased under any Act dealing with Government lands.
Survey Act	An Act of Parliament to make provision in relation to surveys and geographical names and the licensing of land surveyors, and for connected purposes.
The Registered Land Act	An Act of Parliament to make further and better provision for the registration of title to land, and for the regulation of dealings in land so registered, and for purposes connected therewith.
The Land Control Act	An Act of parliament to provide for controlling transactions in agricultural land.
Land (Group Representatives) Act	An Act of Parliament to provide for the incorporation of representatives of groups who have been recorded as owners of land under the Land Adjudication Act.
Land Adjudication Act	Provides for the ascertainment and recording of rights and interests in Trust land.

Source: EcoPlan

3.1.8 Glint and glare

There is no specific guidance on glint and glare in Kenya. International guidance that has been applied to this review include:

- UK Planning Practice Guidance, 2015. Renewable and low carbon energy
- The Highway Code, 2016. Department of Transport, UK Government.
- United States Federal Aviation Administration (FAA) and updated in 2013
- 'Interim Policy, FAA Review of Solar Energy System Projects on Federally Obligated Airports Aviation Administration (FAA) and updated in 2013

3.2 Cultural heritage

Africa is a land of cultural diversity. Key policy protections include:

- Africa Cultural Charter of 1976
- Nairobi Declaration of 2005
- The Algiers Declaration 2008
- Africa Agenda 2063

Cultural heritage matters are mainly covered by this National Museums and Heritage Act (NMHA) of 2006. This Act consolidates the law relating to national museums and heritage; to provide for the establishment control, management and development of national museums and the identification, protection, conservation and transmission of the cultural and natural heritage of Kenya; to repeal the Antiquities and Monuments Act and the National Museums Act; and for connected purposes. It mandates the National Museums of Kenya (NMK) to conduct an impact assessment on areas of cultural heritage interest prior to development taking place.

3.3 County and local laws and regulations

A number of County laws govern the development of this Project and key requirements to be addressed in this ESIA are summarised in Table 11.

Table 11: County and Local laws

Legal or policy instrument	Relevant details
The Embu County Environment Management Act, 2015	This is an Act of the County Assembly of Embu to provide for the management of the environment including; control of air pollution, noise pollution, waste management, and general nuisances in order to promote a clean and healthy environment and to provide for matters incidental thereto. Section 9(2) states that every person within the jurisdiction of the County is entitled to right of access and enjoyment of the various public elements and segments of the environment for recreational, educational, health, spiritual and cultural purposes. Section 10(1) of the Act state that if a person alleges that the entitlement conferred under section 9 has been, is being or is likely to be contravened, that person may apply to a High Court for redress and the High court may take such orders, or give such directions as it may deem appropriate as shown in the following sub-sections- Section 10(1d) compel persons responsible for the environmental degradation to restore the degraded environment as far as practicable to its immediate condition prior to the damage; and Section 10(1e) Provide compensation for any victim of pollution and the cost of beneficial uses lost as a result of pollution and other losses that are connected with or incidental therewith.
The Embu County Cultural Heritage Act, 2016	This is an Act of the County Assembly of Embu to promote and protect culture and cultural heritage in the County and for connected purpose. Section 3 gives the object of the Act which is noted as to regulate, protect and promote some of the following activities and services doe the interest and enjoyment of the community and persons visiting the County- (a) cultural sites (b) cultural activities (c) ensure respect for and safeguard the culture and cultural heritage of the communities, groups and individuals in the County (i) provide a framework under which communities and groups within the County will receive compensation, royalties or other benefits from the activities, goods, services and use of their culture and cultural heritage.

3.3.1 International conventions

Kenya has signed and ratified several international conventions and treaties for the protection and conservation of the environment as highlighted in Table 12.

Table 12: International Agreements and Conventions ratified by Kenya

International Environmental Agreement	Date of signature	Approval date by GoK
United Nations (UN) charter	1963	1963
Convention on biological diversity (CBD) (Rio de Janeiro)	1992	1994
United Nations framework convention on climate change (UNFCC) (Rio de Janeiro)	1992	1994

International Environmental Agreement	Date of signature	Approval date by GoK
Kyoto protocol to the framework convention on climate change	-	2005 (a)
Basel convention on the control of transboundary movements of hazardous wastes and their disposal	1989	2000 (a)
Rotterdam convention on procedures for hazardous chemicals and agricultural pesticides in international trade	1998	2005
Stockholm convention on persistent organic pollutants	2001	2004
Montreal international convention on substances that deplete the ozone layer	1987	1988
Cartagena protocol on biosafety	2000	2002
Ramsar international convention on wetlands of international importance, especially as waterfowl habitats	-	1990
Convention on international trade in endangered species of wold fauna and flora CITIES (Washington)	-	1978
Convention for the protection of cultural property in the event of armed conflict (Hague)	-	1999 (A)
Convention concerning the protection of world cultural and natural heritage	-	1991 (A)
Convention for the safeguarding of intangible cultural heritage	2003	2007
Covenant on economic, social and cultural rights (ICESCR) (New York)	-	1972
Forced labour convention / ILO 29	1930	1964
Abolition of forced labour convention / ILO 105	1957	1964
Workmen's compensation (accidents) convention / ILO 17	1925	1964
International Council on Monuments and Sites (ICOMOS) convention in Stockholm in 1998		

Note: (a) indicates assession to indicated convention or treaty. (A) indicates acceptance to indicated convention or treaty. Assession and acceptance carry the same legal weight as ratification. Assession is often used for parties joining a treaty or convention after it has been negotiated or entered into force. Acceptance is often used in nations where constitutional law does not require ratification by the head of state. [19]

3.3.2 International Labour Organisation (ILO)

IFC PS2 requires compliance with specific International Labour Organization (ILO) and United Nations (UN) conventions. Kenya has ratified seven of the eight core (fundamental) ILO conventions, namely:

- ILO Conventions 29 and 105 on elimination of forced and compulsory labour
- ILO Convention 98 on collective bargaining
- ILO Conventions 100 and 111 on elimination of discrimination in respect of employment and occupation
- ILO Conventions 138 and 182 on abolition of child labour

Kenya has not ratified ILO Convention 87 on Freedom of Association and Protection of the Right to Organize, compliance with which IFC PS2 requires. Kenya has ratified three of the four governance conventions (priority) and 40 of 177 technical conventions of the ILO[20]. Kenya has ratified the United Nations (UN) Convention on the Rights of the Child and the UN Convention

[19] United Nations. United Nations Glossary of Terms. Available at https://treaties.un.org/pages/Overview.aspx?path=overview/glossary/page1_en.xml#accession

[20] International Labour Organization. Ratifications of ILO Conventions: Ratifications for Kenya. Available at http://www.ilo.org/dyn/normlex/en/f?p=NORMLEXPUB:11200:0::NO::P11200_COUNTRY_ID:103315

on the Rights of Persons with Disabilities. Kenya has not ratified the UN Convention on the Protection of the Rights of All Migrant Workers' and Members of their Families.

3.4 International framework

The IFC PSs set the framework of requirements to be addressed in an international ESIA and the means to address them to international standards. The standards and the Project understanding as to whether they are triggered or not is presented in Table 13:

Table 13: IFC PSs triggered by the Project

Triggered by the Project	Yes	No
IFC PS1 – Assessment and Management of Environmental and Social Risks and Impacts	X	
IFC PS2 – Labour and Working Conditions	X	
IFC PS3 – Resource Efficiency and Pollution Prevention	X	
IFC PS4 – Community Health, Safety and Security	X	
IFC PS5 – Land Acquisition and Involuntary Resettlement	X	
IFC PS6 – Biodiversity Conservation and Sustainable Management of Living Natural Resources		X
IFC PS7 – Indigenous Peoples		X
IFC PS8 – Cultural Heritage	X	

IFC PS1 establishes the importance of: (i) integrated assessment to identify the social and environmental impacts, risks, and opportunities of Projects; (ii) effective community engagement through disclosure of Project-related information and consultation with local communities on matters that directly affect them; and (iii) management of social and environmental performance throughout the life of the Project.

IFC PS2 through IFC PS8 establish requirements to avoid, reduce, mitigate or compensate for impacts on people and the environment, and to improve conditions where appropriate. While all relevant social and environmental risks and potential impacts should be considered as part of the assessment, IFC PS2 through IFC PS8 describe potential social and environmental impacts that require particular attention in emerging economies and in sensitive and critical natural and human environments. Where social or environmental impacts are anticipated, they are to be managed through an environmental and social management system (ESMS) consistent with requirements of IFC PS1.

IFC PS3 refers to the World Bank Group EHS Guidelines. These guidelines are the technical reference documents for environmental protection and set out specific examples of good international industry practice (GIIP). The General EHS Guidelines contain information on crosscutting issues applicable to Projects in all industry sectors including geothermal. They provide guidance on performance levels and measurements considered to be achievable at reasonable cost by new or existing Projects with the use of existing technologies and practices. Projects are expected to comply with the levels and measures identified in the General EHS Guidelines where host country requirements are less stringent or do not exist.

World Bank Group EHS Guidelines applicable to the ESIA are:

- EHS General Guidelines (April 2007)
- EHS Guidelines for Electric Power Transmission and Distribution (April 2007)

The General EHS Guidelines cover four areas of GIIP:

- Environmental
- Occupational health & safety (OHS)

- Community health & safety (CHS)
- Construction and decommissioning

Also of relevance to this Project are the World Bank Group EHS Guidelines with respect to emergency preparedness and response which state that Projects should have an emergency preparedness and response plan (EPRP) that is commensurate with specific risks. This includes the requirement to assess the risk posed to the Project by geological, landslide and seismic hazards and formulate appropriate strategies that effectively reduce any potential impact associated with these hazards on the Project.

Of specific note for this Project, given its location near the Mwea Nature Reserve is determining the relevance of IFC PS6 and the PS6 Guidance Note. IFC PS6 objectives are:

- To protect and conserve biodiversity
- To maintain the benefits from ecosystem services
- To promote the sustainable management of living natural resources through the adoption of practices that integrate conservation needs and development priorities

IFC PS6 requires that conservation importance is allocated to the ecological features (protected areas, habitats and species) which are likely to be directly or indirectly impacted in the Project AOI. The requirements of IFC PS6 must be considered for Projects in all habitats, whether those habitats have been previously disturbed and whether they are legally protected. Specifically, a Project is required to:

- Assess significance of Project impacts on all levels of biodiversity as an integral part of the social and environmental assessment process
- Consider differing values attached to biodiversity by specific stakeholders
- Assess major threats to biodiversity, especially habitat destruction and invasive alien species

In accordance with IFC PS6, habitats are divided into modified, natural and critical habitats. Critical habitats can be either modified or natural habitats supporting high biodiversity value, including:

- Habitat of significant importance to Critically Endangered and/or Endangered species (International Union for Conservation of Nature and Natural Resources (IUCN) Red List)
- Habitat of significant importance to endemic and/or restricted-range species
- Habitat supporting globally significant concentrations of migratory species and/or congregatory species
- Highly threatened and/or unique ecosystems
- Areas associated with key evolutionary processes

3.5 KenGen Corporate Environmental Policy Statement

KenGen has a corporate environmental management system (EMS) certified to ISO14001:2004. All aspects of its operations must conform to the requirements of this EMS. In addition, it is certified to ISO9001 for quality and has an occupational health and safety (OHS) system that is aligned with OHSAS 18001. Labour and worker obligations are set out in its corporate human resources (HR) policy and are aligned as a minimum with requirements of the Ministry of Labour. Together these policies and management systems make up the KenGen environmental and social management system (ESMS). KenGen has three key policies that are relevant to the environmental and social management of this Project, these are further discussed in the ESMP, Volume IV:

- Environmental policy statement
- Occupational safety and health policy statement
- Fire safety and emergency policy statement

3.6 Project implementation team

KenGen will establish a Project implementation team (PIT) to oversee the Project development and construction phase. The PIT includes representatives from all relevant disciplines including environment, health and safety and community liaison as well as technical and financial representatives. The PIT will have overall responsibility for overseeing the development of the Project and contractor performance.

In addition, KenGen will establish a Project Stakeholder Committee (PSC) consisting of KenGen representatives from the PIT, KenGen consultant, community nominated representatives and when relevant the Main Contractor. The PSC will be formed early in the development process to coordinate pre-construction, construction and operational links with the community. This Project specific committee will be retained for the duration of the Project (pre-construction, construction and operation). Further elaboration on this is provided in the ESMP, Volume IV and the SEP Volume V.

4 ESIA Framework and Methodology

4.1 Scope of the ESIA

The ESIA scope includes:

- Environmental, social, labour, gender, health, safety, risks and impacts
- The Project and related and associated facilities (where relevant)
- Risks and impacts that may arise for each activity in the Project cycle, including site establishment, panel installation and testing, and site closure / decommissioning
- Role and capacity of the relevant parties including government, contractors and suppliers
- Potential third-party impacts including supply chain considerations
- This ESIA has identified potential beneficial and adverse, direct and indirect, and cumulative impacts of the Project related to the bio-physical and socio-economic environment.

The definition of the Project includes all infrastructure and facilities that are directly part of the proposed development.

4.2 Methodology

The following activities were performed in support of the ESIA study:

- 17 April 2017 to 21 April 2017: Kick off meeting and site selection visit (narrowed down to 3 preferred sites and subsequent selection of the current site as the preferred site)
- 10 September 2017 to 16 September 2017: Scoping site visit (objective: preliminary consultation in the community and counties and scoping of issues, site reconnaissance visit)
- September / October 2017: Prepare draft Scoping report and Terms of Reference (TOR)
- 25 September 2017: Submit TOR for ESIA to NEMA
- 27 September 2017: NEMA approve ESIA TOR (Appendix C)
- 02 to 06 October 2017: ESIA site visit (objective: consultation, focus groups, baseline data collection)

For the scoping report the following information was reviewed to help defined the ESIA TOR:

- Maps of the Project area
- Review of relevant legislation (as set out in Chapter 3)
- Consultation (as set out in Chapter 6)
- Review of baseline information (as set out in Chapter 7)

The potential environmental and social aspects associated with the Project are presented in section 4.3 and formed the basis for the ESIA TOR and this ESIA report.

4.3 Consultation

Consultation has been undertaken including key stakeholder meetings, focus groups and questionnaires. These are described in full in Chapter 6.

4.4 Summary of potential environmental and social impacts

The detailed TOR for the EIA / ESIA is based on the preliminary scoping assessment as performed by Mott MacDonald and EcoPlan. The TOR was issued on 25 September 2017 and approved by NEMA on 27 September 2017 (reference number NEMA/TOR/5/2/Kenya Electricity Generating Company).

4.4.1 Potential positive impacts

The ESIA TOR identified the following potential positive impacts for further assessment as set out in this ESIA report:

Construction

- Temporary job creation
- Indirect creation / expansion of business opportunities (food delivery, driving, accommodation, locally available materials (cement, hardware))

Operation

- Improved earthen road that allows community access to the Kamburu reservoir (surrounding the site, if practicable)
- More stable and diversified electricity network
- Clean energy generation / reduction in national GHG emissions
- Improved visibility and security from Project lighting in the immediate site location
- Job creation

Decommissioning

- Rehabilitation of site to previous land use
- Temporary job creation

4.4.2 Potential negative impacts

The ESIA TOR identified the following potential temporary and permanent negative impacts for further assessment as set out in this ESIA report:

Construction

- Community health and safety risks during construction including need to consider emergency and abnormal working situations
- Project induced in-migration from outside the local area with potential to impact community health and safety (communicable diseases) and worker conflicts due to competition for jobs
- Abuse against labour rights for local workers
- Impacts during emergency situations
- Occupational health and safety impacts on local workforce
- Livelihood restoration to addressing loss of informal access rights to land for grazing, bees keeping and access to the reservoir for fishing
- Nuisance effects on local community resulting in:
  - Increase in local traffic movements and wear and tear
  - Increase in ambient environmental noise levels (noise pollution)
  - Increase in ambient dust levels and vehicle emissions around the site
- Biodiversity impacts including:
  - Accidental introduction and dispersal of invasive species

  - Disturbance to terrestrial animal species (e.g. noise, artificial light, vibration)
  - Injury or death of terrestrial animals
  - Permanent habitat loss and habitat fragmentation
  - Hunting and poaching of wildlife due to improved access road
- Temporary or permanent changes to surface water flow and drainage patterns
- Increased water abstraction for construction water requirements resulting in potential conflict with existing local users)
- Contaminated surface water runoff from construction site into nearby surface water bodies (permanent and ephemeral)
- Foul water discharges
- Cultural heritage including loss of ecosystem services (medicinal vegetation)
- Increased soil erosion due to loss of land cover leading to increased sediment run off
- Depletion of natural resources (production of modules, and other bulk materials)
- Increased solid waste (non-hazardous) e.g. soil, wood, timber, packaging
- Land use change and economic displacement (no structures of temporary or permanent buildings are noted on the site)
- Loss of tangible or intangible cultural heritage

Operation

- OHS impacts on local workforce
- Increased water abstraction for operational domestic water use and panel cleaning resulting in potential conflict with existing local users)
- Contaminated surface water runoff (during panel cleaning, abnormal events)
- Foul water discharges
- Hazardous waste disposal (including end of life disposal for panels and batteries)
- Release of hazardous material (abnormal operations e.g. module fire, oil spills)
- Potential glint and glare impacts to road users and nearby residential receptors (impact on airfields has been scoped out due to distance to nearest airfield)
- Permanent change in landscape character and visual intrusion (deforestation and introduction of panels)

Decommissioning

- As construction phase but most notably: nuisance (traffic, noise, dust)
- Generation of solid waste (general and hazardous) including infrastructure, materials used during construction, and panels

4.5 Evaluation impact and determining significance

The following sections describe how this ESIA has determined significance.

4.5.1 Sensitivity

Sensitivity is site specific and relevant criteria have been developed from the baseline information gathered. The sensitivity of a receptor is determined based on the review of the population (including proximity / numbers / vulnerability), presence of biological features at the site and the surrounding area, soil, agricultural suitability, geology and geomorphology, proximity of aquifers and watercourses, existing air quality, presence of any archaeological features, etc. Generic criteria for determining sensitivity of receptors are outlined in Table 14.

Table 14: Criteria for determining sensitivity

Sensitivity (positive or negative)	Definition (considers duration of the impact, spatial extent, reversibility and ability of comply with legislation)
High	Vulnerable receptor (human, ecological etc.…) with little or no capacity to absorb proposed changes or minimal opportunities for mitigation.
Medium	Vulnerable receptor (human, ecological etc.…) with limited capacity to absorb proposed changes or limited opportunities for mitigation.
Low	Vulnerable receptor (human, ecological etc.…) with some capacity to absorb proposed changes or moderate opportunities for mitigation.
Negligible	Vulnerable receptor (human, ecological etc.…) with good capacity to absorb proposed changes or and good opportunities for mitigation.

Source: Mott MacDonald

4.5.2 Magnitude

The assessment of magnitude will be undertaken in two steps. Firstly, the magnitude of potential impacts associated with the Project will be categorised as beneficial or adverse. Secondly, the beneficial or adverse impacts will be categorised as major, moderate, minor or negligible based on consideration of the parameters such as:

- Duration of the impact – ranging from beyond decommissioning to temporary with no detectable impact
- Spatial extent of the impact – for instance, within the site, boundary to regional, national, and international
- Reversibility – ranging from permanent requiring significant intervention to return to baseline to no change
- Likelihood – ranging from occurring regularly under typical conditions to unlikely to occur
- Compliance with legal standards and established professional criteria – ranging from substantially exceeds national standards and limits / international guidance to meets or exceeds minimum standards or international guidance

Generic criteria for determining the magnitude of impact are outlined in Table 15. Each detailed assessment will define magnitude in relation to their topic if required.

Table 15: Criteria for determining magnitude

Magnitude (Beneficial or Adverse)	Description
Major	Fundamental change to the specific conditions assessed resulting in long term or permanent change, typically widespread in nature, and requiring significant intervention to return to baseline; exceeds national standards and limits.
Moderate	Detectable change to the specific conditions assessed resulting in non-fundamental temporary or permanent change.
Minor	Detectable but minor change to the specific condition assessed.
Negligible	No perceptible change to the specific condition assessed.

Source: Mott MacDonald

4.5.3 Impact evaluation and determination of significance

Significance will be attributed taking into account the interaction between magnitude criteria and sensitivity criteria as presented in the significance matrix in Table 16.

Table 16: Impact significance matrix (adverse or beneficial)

Magnitude of Impact	Sensitivity of Receptors			
	Negligible	Low	Medium	High
Negligible	Insignificant	Insignificant	Insignificant	Insignificant
Minor	Insignificant	Minor	Minor	Moderate
Moderate	Insignificant	Minor	Moderate	Major
Major	Insignificant	Moderate	Major	Critical

Source: Mott MacDonald

For each aspect, the significance of impacts has been discussed before and after mitigation (i.e. residual impact).

Impacts identified as having moderate to major significance based on the above approach are classified as significant impacts.

4.6 Data limitations and uncertainty

Any uncertainties associated with impact prediction or the sensitivity of receptors due to the absence of data or other limitation has been considered, and summarized in Table 17. Where applicable, the ESIA will make commitments concerning measures that should be put in place with monitoring and /or environmental or social management plans to deal with the uncertainty. This is summarized in Volume IV ESMP.

Table 17: Data limitations and uncertainties

Topics	Limitations / uncertainties / key data gaps	How were addressed
Air quality	• Lack of detailed construction work program • Concrete batching plants would be located off site at existing batching locations • No external power sources are required to support construction works	• Assumed 3 months for key dust generation activities as a worst case scenario • Electricity will be diverted to site to support construction works or EPC Contractor will use generators
Noise	• Limited information about exact construction vehicles required • Lack of detailed construction work program	• Applied a 200m buffer zone around the site (conservative) • Assumed that best practicable means (BPM) will be applied to manage noise as standard through the construction contracts • Local residents would be informed where they may be potentially affected by noise ahead of major works • Assumed 3 months for key dust generation activities as a worst case scenario
Traffic and transportation	• Lack of real time local traffic flow data • Lack of detailed construction work program	• Yearly country-wide network traffic flow averages associated with each road type have been utilised • Site observations to assess capacity to absorb additional flow
Water resources	• Limited available information on community water needs and current abstraction but current water use considered to be very low based on availability	• Assumed that the Project can work within the existing abstraction permit (subject to variation)
Materials and	• Exact quantities of construction	• The ESIA has identified likely waste streams and

Topics	Limitations / uncertainties / key data gaps	How were addressed
waste management	waste to be generated • Exact disposal requirements not clear	will set parameters / minimum standards for disposal that the construction contractor will be required to work within and to require a detailed Site Waste Management Plan • This EISA has identified where the constraints are likely to arise and has presented options for consideration as the Project progresses
Cultural heritage	• No intrusive survey works undertaken due to low risk and shallow foundation work and geology of the site • Limited formally recorded information for the Project area	• Required survey work prior to the start of construction • Requirements for watching brief • Employed local herbalist / elder to provide oral information on this topic • Require the preparation of a chance find procedure
Biodiversity	• Limited primary data for the Project area • Surveys undertaken during the dry season	• Employed local herbalist / elder to provide oral information on this topic • Required wet season survey and tree inventory before works commence
Greenhouse gases (GHG)	• Detailed Project information is currently unknown (material type)	• Use of published data to make assumptions about GHG generation

4.7 Qualifications of the personnel

The work has been performed by Mott MacDonald LLC USA and EcoPlan Management. A copy of EcoPlan's NEMA certificate is provided in Appendix D. A summary of the team members qualifications is provided in Table 18; resumes are provided in Appendix E, including NEMA licenses for the Kenya experts.

Table 18: Key team members

Name, Organisation, Responsability	Qualifications	Headline experience
• Irene Keino • EcoPlan • ESIA co-ordinator; National framework; ESIA framework and methodology; Information, disclosure, consultation and participation; Baseline	• Executive Masters in Business Administration, majored in strategic management, United States International University, Nairobi Branch campus • MA (Hons) Urban Planning, University of Nairobi • BA (Hons) Geography & Sociologist, University of Nairobi • SEA Short course at African Wildlife Foundation (AWF), Karen Funded by Ewaso Ng'iro Lions and Laikipia Wildlife Foundation under Ewas Ng'iro Basin Stakeholder Forum and in Collaboration with South African Institute for Environmental Assessment (SIEA) by Executive Director Mr. Peter Tarr. • Conservation of heritage-University of Lund (shirt course)	• Project team leader at EcoPlan • Local sociology expert • NEMA licensed • EIK licensed • Worked on a number of ESIA/SEA/RAP
• Richard Ogoti Mongare • EcoPlan • National framework; ESIA framework and methodology; Information,	• Bsc. Soil, Water and Environment Engineering, Jomo Kenyatta University of Agriculture and Technology • Diploma in Agricultural Engineering, Jomo Kenyatta University of Agriculture and	• Associate Expert at EcoPlan • Local environmental

Name, Organisation, Responsability	Qualifications	Headline experience
disclosure, consultation and participation; Baseline	Technology • International General Certificate in Occupational Safety and Health-NEBOSH SMTS Ltd UK- Nairobi • International-Certificate in OSH. Institution of Occupational Health and Safety- (IOSH) Mekelle Ethiopia. • Certificate in Information Technology Wantech Computer College	expert • NEMA licensed • EIK licensed • Worked on a number of ESIAs and resettlement action plans (RAP)
• Mwihaki Mathu • EcoPlan • Information, disclosure, consultation and participation	• BA (Hons) Environmental Science	• Staffer at EcoPlan • Local environmental expert • NEMA licensed • EIK licensed • Worked on a number of EA/RAP/ESIA
• Romanus Opiyo • Consultant expert for EcoPlan • Socio-economic baseline (Cultural heritage and land use)	• PhD in Urban and Regional Planning, University of Nairobi • Post Graduate Certificate in Environmental Impact Assessment and Environmental Audit (EIA/A), Jomo Kenyatta University of Agriculture and Technology • MA (Hons) Urban Planning, University of Nairobi • BA Social Sciences, Catholic University of Eastern Africa	• Urban Planner Researcher • Local environmental expert • NEMA licensed
• Sunday Abuje • Consultant expert for EcoPlan • Biodiversity baseline (Ecology)	• PhD in Urban Planning (Climate Change Adaptation), Jomo Kenyatta University of Agriculture and Technology • Masters in Environmental Planning and Management (M.EPM), Kenyatta University • Bachelors Degree in Landscape Architecture (B.LA), Jomo Kenyatta University of Agriculture and Technology	• Local environmental expert
• Nicola Davies • Mott MacDonald • ESIA co-ordinator; Project description; Policy, legislative and institutional framework; ESIA framework and methodology; Information, disclosure, consultation and participation; Baseline; impact assessment; Mitigation	• MSc Environmental Management and Auditing • BSc Environmental Science, Chemistry	• EIA Project Manager • 15 years' experience providing ESIAs and advisory services to the power sector
• Aline Martins • Mott MacDonald • Information, disclosure, consultation and participation; Socioeconomic baseline; social impact assessment; social mitigation	• MSc Community Psyco-sociology and Social Ecology • BSc Geography	• Social lead • 12 years experience providing ESIA services to the energy sector
• Justin Miner	• MEM Environmental Management	• EIA GIS Specialist

Name, Organisation, Responsability	Qualifications	Headline experience
• Mott MacDonald • Mapping, Bio-physical baseline	• BLA Landscape Architecture and Environmental Planning • Professional Wetland Scientist	• 16 years' experience providing ESIA and advisory services to the power sector
• Hallie Harris • Mott MacDonald • Bio-physical baseline	• BS Biology • Certified Wetland Botanist • Professional Wetland Scientist	• Biodiversity Lead • 17 Years experience providing ESIA services to the energy sector

5 Information Disclosure, Consultation, and Participation

5.1 Overview

This Chapter explains the stakeholder engagement (consultation, participation and disclosure) process followed during the ESIA. A stakeholder engagement plan has been developed as part of the ESIA process to serve as a management tool to guide stakeholder engagement for the Project lifecycle. The Seven Forks Solar Power Project Stakeholder Engagement Plan (hereafter referred to as 'the SEP') is provided in Volume V of this ESIA.

The SEP has aimed to promote communication between KenGen and stakeholders including the public, governmental entities, NGOs and Project affected persons and communities.

After a summary of the SEP objectives, this Chapter describes the ESIA phase engagement activities and results.

5.2 SEP objectives

The purpose of the SEP is to provide a consultation and participation strategy for the Project which:

- Identifies stakeholder groups that could be affected or may have an interest in the Project
- Ensures that such stakeholders are appropriately engaged through a process of information disclosure and meaningful consultation on environmental and social issues that could potentially affect them
- Maintains a constructive relationship with stakeholders on an on-going basis through meaningful engagement during Project implementation
- Provides a grievance mechanism to allow communities and other stakeholders to register complaints, queries or comments that are addressed in a timely manner by the Project

All stakeholder engagement activities have been and will be undertaken in compliance with Kenya's environmental law and related requirements as well as IFC PS1 as summarised in Chapter 3.

5.3 Summary of stakeholder engagement

Consultation activities performed in support of this ESIA include:

- Consultation round 1: Stakeholder consultation began during the first site visit where key stakeholders involved in the regulatory approval process were visited. These meetings were held in April 2017 and consisted of presentations regarding the Project and receipt of feedback from the stakeholders consulted.
- Consultation round 2: A second period of consultation was performed during the scoping site visit in September 2017 consisting of public consultations with affected communities and interviews with key informants such as representatives from local authorities and from the local community. This included meetings, interviews and issue of questionnaires. The meetings had an important role related to regulatory approvals. Each stakeholder expressed interest in and support for the Project. However, concerns about compensation, positive

impacts and benefit sharing were raised, mainly by community members. Meeting minutes are presented on Appendix F.

- Consultation Round 3: Consultation was held during the ESIA baseline data collection period in October 2017, including meetings with government officials, regulatory authorities in Embu County, and meeting with ward chiefs and opinion leaders. Meeting minutes are presented in Appendix G. In addition, four focus group discussions (FDG) were held in the village of Machang'a covering the social groups listed below.
  - Women's representatives
  - The Youth and Business Group
  - Livelihood restoration and small business owners
  - Land users including agriculture, bee keeping, herbalists (medicine men/women) and livestock groups
- Consultation Round 4: Two final stakeholder meetings were held to disclose the findings of the ESIA to the local community and department heads at the National, Regional, County and Sub-County level in December 2017. These were:
  - Meeting with National, Regional, County and Sub-County stakeholders and political leader in Embu (07 December 2017)
  - Public consultation (Baraza) with community leaders and members from Machang'a, NGOs, business and commerce representatives and education institutions in Machang'a (06 December 2017)

During Consultation Rounds 2 and 3, questionnaires were handed out to stakeholders to support data collection. Questionnaires received from stakeholders are provided in Appendix H.

Invitation letters for the final stakeholder meetings (Consultation Round 4) are provided in Appendix I. Minutes of these final meetings and attendance sheets are provided in Appendix J.

A summary of all the meetings are provided in Table 19 below. Table 20 contains a summary of the issues raised by stakeholders during those meetings and how they were addressed in the ESIA. Feedback from stakeholders were considered in the ESIA and in the ESMP.

Note that stakeholders related to Machakos County were engaged until Consultation Round 3 as a directly affected community as one potential connection option would have impacted on Machakos County, but they were excluded from the final consultations as this potential connection was decided against. Inputs from the consultation events have informed mitigation and decision making related to mitigation of indirect impacts, but Machakos consultees are no longer considered directly affected based on the final Project specification.

Table 19: Summary of consultation meetings performed in support of this ESIA

Stakeholder	Summary
Consultation Round 1: April 2017	
KETRACO – Kenya Electricity Transmission Co. Ltda.	The Project will need to interface with KETRACO on issues related to interconnection and grid connection studies. KETRACO demonstrated interest in the Project, mainly due to its potential to add necessary capacity to Kenya's electricity grid, provide emissions-free generation, and diversify the country's energy matrix.
ERC – Energy Regulatory Commission	ERC will be responsible for approving the Project PPA and issuing its generation license. The ERC demonstrated significant interest in the Project, primarily due to the its potential to improve hydropower reservoir management and reduce system risk during dry periods. The ERC views this type of Project as a strategic priority for Kenya's electric sector.
NEMA – National Environmental	NEMA is responsible for reviewing and approving environmental license applications. It will review, comment, and approve the ESIA's initial "TOR" and

Stakeholder	Summary
Management Authority	then evaluate the final ESIA study prior to a decision to award an Environmental License. NEMA expressed interest in the Project's potential to diversify Kenya's gene  ration portfolio and provide climate change mitigation benefits.
Stanbic Bank	Stanbic is a candidate for Project debt financing. Stanbic demonstrated significant interest in the Project, due to its positive view of KenGen's financial stability and strong track record of developing and managing power Projects.
Standard Chartered Bank	Standard Chartered Bank is a candidate to provide debt financing for the Project. Standard Chartered Bank demonstrated significant interest in the Project, due primarily to its strong relationship with KenGen and keen interest in financing strategic KenGen Projects with similar characteristics.
Consultation Round 2: September 2017	
Mavuria Ward Chief	The County chief is the administrative leader for Mavuria ward. The chief assisted the consultant to mobilise the community and assist in identification of community groups and availing his office to conduct the meeting with the representatives of the community groups. His office has the latest survey map for Mavuria ward bought from survey of Kenya.
Kiritiri Sub County Commissioner	The sub commissioners are the elected officials of a County's legislative branch. The County Board of Commissioners, serving in a similar role as a city council member or a state representative or senator. This office will be important to the Project in that it will assist in mobilising sub County staff to attend meetings called and consultations on the Project.
Game warden KWS (Kenya Wildlife Service) at Mean National Reserve	Under the Constitution 2010, many national and municipality roles have been devolved to the counties. Mwea National Reserve falls under Embu County administratively and KWS manages the Reserve on behalf of Embu County Government. The in-charge of the reserve is the game warden who was consulted on expected conflicts of animals and Project implementation. A concern was raised in regard to elephants that cross the river and may reach the Project site. Other than that, no impacts are expected.
Embu County Cultural Office	The Department of Culture is involved in the promotion of cultural cooperation locally, regionally and internationally. The Department aims at promoting rich cultural values in the local and international fraternity. This approach would help to promote progressive cultural trends while discarding dysfunctional practices. The Embu Cultural office was consulted on the indigenous people in the region and other communities, whether they were migrants or not and which languages they spoke.
NEMA Embu County Director	This office was consulted regarding public consultations, the number of legal meetings to be conducted, the submission or TORs. We were advised to conduct detailed public consultations so that as much as possible all issues are captured at an early stage of the ESIA process and can be addressed. The Director commended the consultant on engaging the community and

Stakeholder	Summary
	interested groups at the scoping stage.
Embu County Commissioner	The Commissioner noted that she will provide all the support that the Project will require including security during implementation or conducting consultations at public meetings. She also noted that in case the consultant required information and consultations with County government offices, she would inform the staff to address the requests immediately.
Public meeting with the various groups representatives (fisherman, business owner, bee keeping, boda boda (motorbike) riders, miraa growers, business, teacher, herbalists (medicine man/women) from Machang'a	The consultant held a meeting at the Sub County's office with the representatives of various groups in the community at the Project area. The consultant handed out brochures and five questionnaires to the members present to fill them. The chief introduced the team of consultant and requested the representative of community groups to present their concerns. The consultant handed out a signed attendance sheet and took recordings and photos of the session.
Kiritiri Sub County department heads (Forestry, water, agriculture, public works, metrological, KWS, NEMA)	The consultant met with the sub County department heads at the Sub County's Commissioners board room. A few questionnaires were shared out and the heads of department were requested to fill them in. The consultant therefore captured a number of concerns raised by the officers.
Round 3: October 2017	
Meetings with Deputy Governor Embu County	Key concerns included 1) need for electrification 2) need for water 3) youth unemployment 4) enabling commercial Projects (including industrial park and bamboo planting scheme) 5) crocodiles in the Project site.
Meeting with Machakos sub-County commissioner and department heads from Machakos County (water and agriculture)	Indicated support for the Project and highlighted need to addressed employment (young men), electrification and water as key needs in this County.
Meeting with Kenya Forest Service (KFS) Embu County	Indicated that they support the Project. They will identify someone local that can be our liaison for the Project during site clearance. Would like to be kept informed of the Project. Noted that permits are only required for big trees (not shrubs).
Meeting with the Department of Culture and Gender (Embu County)	Informed that the department does not have studies or documented information, but will sit with the staff and prepare a briefing note and send via e-mail.
Focus Groups – Embu County	Held four focus groups in Machang'a community to understand the specific concerns of these groups in relation to the Project. Main highlights from the focus group meeting were: • Need to take account opportunity for employment • Need to consider livelihoods (existing and future opportunities) • Need for electrification and water services, which are expected to be supported by the Project
Meeting with NEMA County Environment Officer – Embu (Kennedy Odhiambo)	Described the Project, and confirmed the approval process and timing.
Meeting with KPLC	Purpose of this meeting was to discuss the distribution line that runs across the site and to get preliminary indication that this line can be re-routed and the level of effort required to maintain electrical connection for the proprietor. Also considered power options for the construction phase works.
Round 4: December 2017	
Government departments Stakeholder meeting	The purpose of this meeting was to provide Project information and the results of the ESIA and consult government departments. A questions and answers session was moderated by KenGen. The main questions raised were about, but not restricted to: community benefits, stakeholder engagement, infrastructure improvement, waste management and impacts on biodiversity. The meeting last two hours. 39 persons were present.
Community meeting	The purpose of this meeting was to provide Project information and the results of the ESIA and consult the community. A questions and answers session was moderated by the Machang'a Area Chief. The main questions raised were about, but not restricted to: community benefits, stakeholder engagement, positive discrimination to disabled people, Land take and land use change, Community health and safety and impacts on biodiversity. The meeting last five hours. 302 persons were present.

Source: Mott MacDonald (consultation round 1, 2, 3, and 4)

Table 20: Summary of issues raised by stakeholders during Rounds 1 to 4

Issues raised	Main comments	How they have been addressed in the ESIA
Community enhancement	Machanag'a has been overlooked for a long time and not benefitted from the hydro schemes. Therefore, the Solar Project should consider community enhancements such as: • To provide accessibility to dams and river for animals and to fetch water • To extend the water supply from the Project to the community • To provide at least 5% of the electricity to the community • To implement a youth centre to empower the youth • To empower talented children and provide scholarships to students (KenGen currently supports 2, this is not enough) • To improve all weather roads • To upgrade local dispensaries to a health centre (maternity beds, better clinic facilities) • Document the development with photos for future posterity and perhaps develop an exhibit The above to be included in a Project specific enhancement programme, rather than be included in KenGen CSR alongside the rest of Kenya. A community agreement should be prepared to define community's benefits.	A social enhancement plan is presented in section 5.7 of the Volume IV ESMP. KenGen through the Project Implementation team and the Project Stakeholder Committee (PSC) will agree the exact detail of the enhancement programs committed to the ESIA and have it documented. The social enhancement plan focuses on the directly affected community. KenGen does not distribute energy, so it cannot be done under this Project. At the Project level, KenGen will develop a training risk assessment and structured trainings in response to the needs of the Project. Scholarships to students are founded by KenGen Foundation (KenGen National CSR) and are not included in the Solar Project social enhancement plan. The existing road in the vicinity of the site will be improved and a new road will be built to allow access to from the community to the dawn. The Volume IV ESMP includes a technical empowerment program to support institutions to enhance technical education for local community and empower children and the youth. KenGen will seek to partner with government organisations to support improvements in health facilities as a mitigation to labour and community health and safety impacts. However, KenGen cannot improve the health system as a whole.
Stakeholder Engagement	To establish a committee including community members to meet regularly for the Project To have a clear community dialogue and invite the community as a whole to maintain a good relationship with KenGen. To consider a magazine giving updates on Project milestones.	A PSC will be established. This is described in Volume IV ESMP and Volume V SEP. It includes other ways to engage with the community through the cycle of the Project, including public meetings, a "push" short message service (SMS), magazines and social media communication and will be the forum for agreeing the enhancement Projects and coordinating things like employment. .
Project budget	To clarify Project budget so the community can negotiate the CSR percentage.	The total capital expenditures (CAPEX) budget for the Project is approximately US$50 million. The Project budget is presented in Chapter 2 Project Description of the Volume II ESIA.
Positive discrimination to disabled people	To consider how the Project can incorporate benefits to disabled people and compensate the negative impacts KenGen caused over the years.	A social enhancement plan is presented in section 5.7 of the Volume IV ESMP, which considers that vulnerable people will not be differentially or disproportionately affected by the Project and will receive benefits equally, including employment opportunities. The Volume V SEP considers that vulnerable people will receive information and participation opportunities in unique ways. It is also suggested that the community nominate representatives from disadvantaged groups (disabled people, women, youth, small businesses) on the PSC. This is noted in the SEP.
Land take and land use change	To clarify how change of land use was addressed when KenGen acquired the land and how it can fit a Project if it was the Hydropower Plant`s buffer zone.	The land was set apart for energy generation. Based on consultation with planning authorities, we do not consider that a subsequent change in land use is required. Land take impact will be mitigated by the livelihood restoration plan that will be prepared (as outlined in Chapter 8 of the ESIA). The loss of vegetation as a result of site clearance will be compensated at a 10:1 replanting ratio. The replanting is to be focussed on the remaining buffer zone area. Refer to section 5.10.1 of the ESIA and

Issues raised	Main comments	How they have been addressed in the ESIA
		Volume IV ESMP for more detail on the reforestation planning program.
Community health and safety	To ensure the community will be protected from strangers. To address social impacts from HIV transmitted by strangers.	A community health and safety plan is presented in section 5 of the Volume IV ESMP. In addition, the Contractor is required to develop a code of conduct that all employees have to sign up to. Contravention of the code of conduct is a disciplinary offence. All employees will be made aware of their responsibilities during the site induction.
Planting trees	To consider planting more trees and replant with indigenous trees.	Reforestation plan, section 5.10.1 of the Volume IV ESMP. The proposed reforestation ratio is 1:10 and it states that indigenous species will be used and replanting will focus on the hydropower buffer zone. .
Medicinal plants	Not all trees were identified in the report. To conserve trees of medicinal value. Consider that there is one plant that has a presidential decree (finos Africana) that might be at the site.	Updated the ESIA report to include more baseline information from the biodiversity survey report which includes a comprehensive list of medicinal trees. Refer to section 6.3.8.12 of the ESIA. In addition, the ESMP requires a follow up survey will be required to do tree counts for the purpose of the reforestation plan development. Medicinal plants will be relocated.
Electrification	To connect electricity to homes. Streetlights are not a priority. Transformers need to be considered.	Social enhancement plan, section 5 of the Volume IV ESMP. Street lighting was recommended by the small business owners so they can sell their goods. Therefore, this enhancement remains in the ESMP. KenGen will partner with Kenya Power to increase electricity supply in the local area.
Biodiversity	To undertake a proper consultation regarding biodiversity To consider if the Project area is suitable habitat for bats as there is one threatened bat in the region. To consider impacts in mammals and birds. There is a rare owl found in the Project area. To consider measures if a rare mwiria plant is found in the Project site. To record biodiversity findings using photos.	During the site survey work, consultation was performed with a local elder / herbal man, who over two days supported the ecological specialist to identify important trees that may be present in the area. In addition, the ESIA team undertook consultation with representatives from the Mwea Nature Reserve and KFS and KWS to understand any specific concerns that may be present. The Project habitat was not considered suitable for bats based on the survey work performed. Impact on mammals and birds has been considered. Please refer to section 6.3.8.2 of the ESIA Also refer to Volume III Technical Appendix, where the full biodiversity baseline report is contained, including photos from the field work.
Soil erosion	To consider soil erosion and adequate mitigation.	The ESIA includes specific mitigation for addressing soil erosion in particular connected with surface water run off in section 7.4.5.1. This includes a) good practice measures to remove top soil during works, requirement to restore undergrowth from cleared area a s soon as possible. To replant under the panes during operation and to terrace the site to reduce the impact of soil erosion.
Wastes	To ensure that waste will not contaminate the dam and will be disposed properly. To ensure the community will not be impacted by titanium To emphasise that waste management must follow NEMA and international requirements and that transport of waste must be licensed by NEMA	During construction and operation good industry practice will be required to manage water including storage on site, segregation, handling, transfer and disposal. At all times compliance with NEMA regulations will be required. All waste will be disposed off site via a designated disposal means authorised by NEMA. No waste is expected to reach the reservoir. Refer also to section 7.9 of the ESIA and section 5 of the ESMP.
Project Schedule	To clarify when the Project will start.	Announcement of Project viability and likely start of site preparation activities at anticipated for the first quarter of 2019.
Climate change	To consider climate (microclimate) change.	Potential microclimate effects are discussed in section 7.11.3.2 of the ESIA and section 5.10.1 of the ESMP. There is likely to be a change in ground level microclimate as a result of the PV array and change in land use. The ESIA has made some recommendations for reducing these variations including measures to maintain vegetation under the panels, retain moisture levels (surface water run-off). The impact outside the direct area of influence is considered to be low and the land uses adjacent to the site of negligible significance.
Potential impact from weather	To consider potential impact from weather as cyclones cross the site in February, March, September and August.	Solar panels will be installed with the highest technical standards to withstand the adverse of weather. Potential for wind is addressed in baseline section (6.3.1) of the Volume II ESIA. Chapter 2 Project description

Issues raised	Main comments	How they have been addressed in the ESIA
		on Volume II ESIA outlines the construction specification for the Project and the need to account for weather extremes including wind and rain.
Glare	To consider glare related electromagnetic interference. To consider glare to road users driving south along B7. To clarify if glare from the panels can cause damage to the eyes.	The impacts on these aspects are discussed in section 7.6 of the ESIA and measures to address impacts summarised in the ESMP, section 5.11.1.
Infrastructure improvements	To consider how the Project can support infrastructure improvements that might support future secondary development in the area (e.g. an industrial park). The road from Machang'a to Kivaa to be upgraded.	Support to infrastructure improvements addressed on social enhancement plan, section 5.7 of the Volume IV ESMP. Improvements to the road from Machang'a to Kivaa are not anticipated. If it is damaged by any Project activity, it will be restored to pre-works condition under the contractor scope. The earthen road adjacent to the site will be graded improving access to the reservoir. Solar streetlighting around the site and along the main road will support business development in the local area.
Protecting livelihoods	The neighbouring homestead dwellers had no objection to the Project but were keen if KenGen could allow them to continue grazing on the land and access water and firewood. If not, what alternative land will be made available. To consider that beehives are not easy to relocate.	Grazing on the directly affected land will not be possible. Continued access to land around the site will be permitted by KenGen as is currently the case. A livelihood restoration plan will be prepared (as outlined in Chapter 8 of the ESIA) to address beehives relocation, alternative means and grazing needs.
Crocodiles	Risk to local community from need to access water directly from the reservoir	One community water storage project (as proposed by the community) will be supported by the Project to enhance benefits and compensate for reduced access to the reservoir across the site. This should reduce the need for community members to use the reservoir and in turn risk of death from crocodiles.
Employment	To consider local sub-counties around Machang'a and Kivaa for employment opportunities and do so equally in both sub-counties as is currently required under KenGen hiring policy. The community has skilled and unskilled labour that the Project should try to recruit. Recently, KenGen hired drivers that were not local. Workers need to be well paid.	Section 8.2 Socio-economic of the Volume II ESIA and in the ESMP. Mechanisms and protocols already exist for equitable benefit sharing through the Project enhancement program, the general KenGen existing CSR program and for equitable job creation through KenGen`s local hiring policy. Those protocols will be applicable to this Project and set out in the ESMP and EPC contract. Recruitment will be managed through the stakeholder forum[21] to ensure anyone interested in working for the Project can share their resumé with the contractor. In regard to hiring outsiders, KenGen`s Hiring policy establishes a 2:2:1 ratio (Machakos / Embu /Other). Therefore, eventually someone from outside this County will be hired. KenGen`s Human Resources Policy will be followed and will be disclosed for all workers. Contractors will be required to adhere to ILO conventions as stated in IFC PS2 for payment of workers. This will be monitored by KenGen.
Detailed environmental and social plans	The mitigation, compensation and enhancement plans need to be more specific and the strategies need to be defined.	The plans will be detailed by the EPC contractor and KenGen prior to construction commencement. Volume IV ESMP contains a reasonably detailed framework for the Contractor and KenGen to implement detailed plans.

Source: Mott MacDonald (consultation round 1, 2, 3, and 4)

[21] The stakeholder forum is detailed on Volume V SEP.

6 Baseline Description

6.1 Overview

This Chapter provides an overview of the baseline socio-economic and bio-physical characteristics of the Project AOI as defined in Chapter 5.

This Chapter covers:

- Climate including climate vulnerability
- Land character
- Geology (including natural hazard potential), soils (including erosion potential) and hydrogeology
- Socio-economic including land use, indigenous peoples, cultural heritage
- Ecosystem services
- Biodiversity including presence of critical habitat or sensitive habitat
- Water resources and water quality
- Air quality
- Noise
- Existing regional infrastructure (ports, roads, railways, waste management facilities)

Where supporting baseline reports have been prepared they are referred to in each section and provided in Volume III -Technical Appendix.

6.2 Approach

Baseline data collection to inform the impact assessment has been generated through a combination of approaches for all specialist areas and include primary and secondary source information.

- Preliminary Project site visit observations including interviews, site visits, preliminary field surveys, meetings, focus groups, and visual observation
- Secondary source information: includes a desk based review of laws, policies, reports from the relevant governmental and non-governmental institutions and existing national and international publicly available information data from websites and national EIAs

The baseline data collection approach is underpinned by stakeholder consultation as set out in Chapter 5. This Chapter provides baseline information on the following topics:

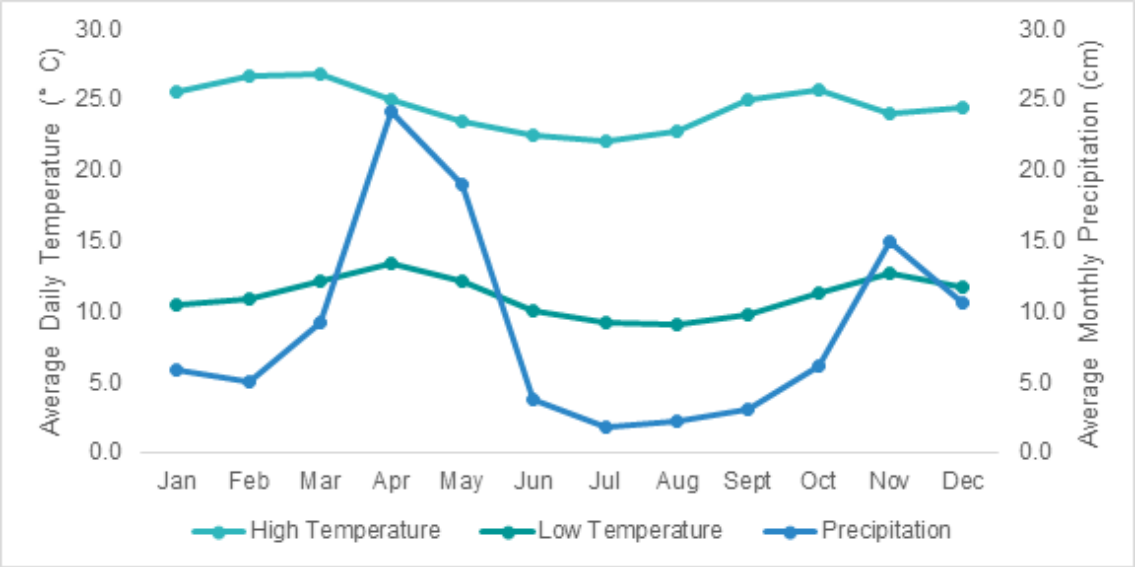
- Bio-physical: Climate including precipitation, temperature, humidity, wind, infiltration, topography; land cover, land use; topography, geology, seismicity, soils, and groundwater; water resources, water quality and flood risk; soils; biodiversity and ecosystem services, air quality, noise and regional infrastructure including traffic and transportation and waste infrastructure;
- Socio-economic including: cultural heritage

6.3 Bio-Physical

6.3.1 Climate

The Mbeere South District has a semi-arid climate with average annual rainfall of 50-76cm. High temperatures in the Mbeere District lead to high rates of evapotranspiration throughout the year, contributing to low humidity in the region except near large waterbodies. Monthly average daily high temperatures in Kamburu, within the Mbeere District, range from a peak of 26.8°C in March to a low of 22°C in July. Average daily low temperatures follow a similar pattern, peaking at 13.4°C in April and reaching their coldest in August, at 9.1°C. Kamburu has two rainy periods, from March to May and from October to December. From July to September, Kamburu experiences very little rainfall, with average monthly precipitation under 5cm. Figure 15 presents monthly averages for precipitation and daily high and low temperatures in Kamburu.

Figure 15: Kamburu Average Temperature and Precipitation, °C and cm



Source: The Weather Channel. 2017. Kamburu Monthly Weather. Available at https://weather.com/weather/monthly/l/KEXX1808:1:KE

The Project site itself is understood to be susceptible to high winds during the hot / dry season between February to March up to the onset of the wet season and is also highly susceptible to forest fires during this period.

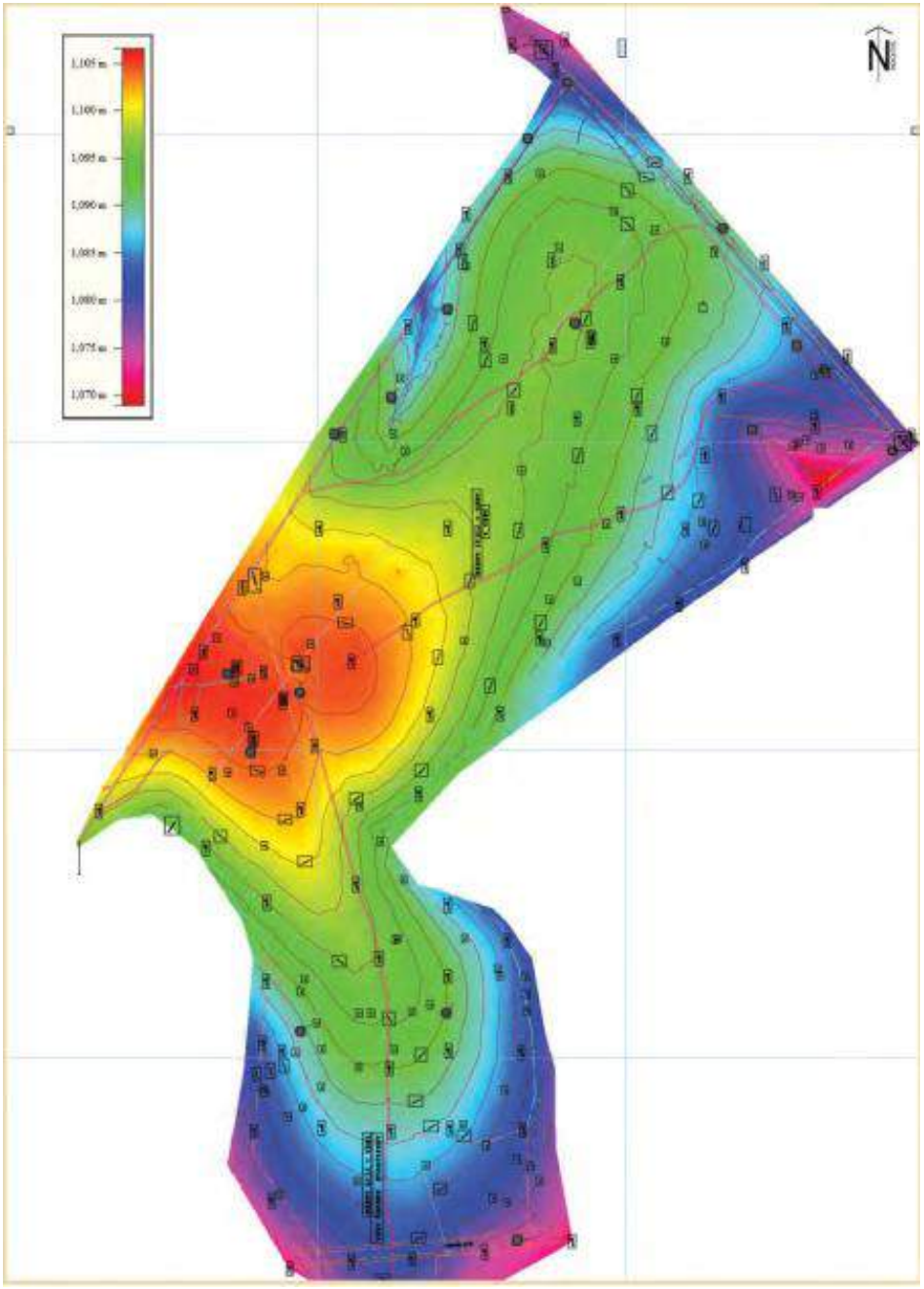
6.3.2 Landscape and topography

The Project site has variable vegetation cover ranging from mostly clear to moderate cover. Over half of the Project site area is relatively flat, shown as red/orange/yellow/green in Figure 17. As shown in Figure 16, the northeast corner of the Project site has a large ravine generated by surface water run-off from the site located on the northwest corner of the Project site. The ravine is outside the direct AOI.

Figure 16: Project site landscape and ravine

Source: Draft inception report 20170425-3

Figure 17: Site topography



Source: KenGen Feasibility Report, September 2017

The Mbeere South District, where the Project site is located, is characterized by a savannah landscape with small hills, open grassland, and some large trees and thick undergrowth along main rivers. The region supports agricultural activities including grazing of cattle, sheep, and goats, and cultivation of crops such as maize, cowpeas, green grams, sorghum, millet, melons, mangoes and citrus, although only some grazing and honey production has been observed on the Project site. The district houses the Mwea National Reserve (4,200ha) (2km from the Project site) and two forest reserves in its Gachoka Division, Kinajiru (1,004ha) and Kiambere (643ha).

The Mbeere South District slopes down from the Embu side (1,400m) south to the Kamburu dam side (1,000m) of the district.

6.3.3 Geology and soils

The Mbeere South District is predominantly a dissected peneplain (low relief plain subject to protracted erosion) with a basement system of granite and igneous rock. Soils in the area are well drained, shallow, dark red to yellow red, and stony loamy to clay. The most common types of soils in the area are eutic astosols, andisols/nitisols, chromic cambrisols and ferralic arenosols[22]. Flat areas in the region contain vertisols, or black cotton soils. Soils in the Mbeere Southern District are subject to extensive erosion, particularly as they are dusty during the dry seasons and become muddy during the wet seasons. Changes in vegetation, overgrazing, and road construction also contribute to erosion in the region.

The Project site comprises two main geologic layers: a top layer of silty sand mixed with clay and a biotite gneiss rock layer below. Data collected from five boreholes (BHs) on the Project site demonstrate that the silt/sand/clay mixture ranges in depth from 2.0m to 3.5m. The distinct geologic layers from each BH are presented in Table 21.

Table 21: Project site geologic layers

Borehole	Depth (m)	Material
BH 1	0.0 to 2.5	Sandy silty clay
BH 1	2.5 to 35.0	Biotite gneiss
BH 2	0.0 to 3.5	Silty sand
BH 2	3.5 to 35.0	Biotite gneiss
BH 3	0.0 to 2.0	Clayey silty sand
BH 3	2.0 to 35.0	Biotite gneiss
BH 4	0.0 to 3.5	Silty sand
BH 4	3.5 to 6.5	Granitic boulders
BH 4	6.5 to 35.0	Biotite gneiss
BH 5	0.0 to 2.0	Silty sand
BH 5	2.0 to 35.0	Biotite gneiss

Source: KenGen Feasibility Report, September 2017

No major seismic faulting was noted during the preliminary geotechnical investigations.

There is no record or evidence of historical activity at the site that may have resulted in previous land contamination.

6.3.4 Air quality

Ambient air is influenced spatially and temporally based on meteorological and topographical features. Scoping indicated that significant permanent air quality sources affecting the Project study area are unlikely and no significant points sources were identified during scoping site visits. As a result, no site surveys or monitoring surveys for baseline air quality were deemed necessary. The airshed is not considered degraded as defined by IFC EHS guidelines – general guidelines (2007)

6.3.5 Noise

The noise baseline has been informed by the results of a high-level desk study of the Project site and noise baseline data collection at key receptors and locations around the site boundary within the AOI (refer to Table 3 for definition of the AOI for each E&S aspect). A methodology for the calculation of noise impacts was performed in line with British Standard (BS) 5228 Code of Practice for Noise and Vibration Control on Construction and Open Sites

[22] Gachimbi, LN. 2002. Technical Report of Soil Survey and Sampling Results: Embu-Mbeere Districts, Kenya. LUCID Working Paper Series Number: 9. Available at http://www.lucideastafrica.org/publications/Gachimbi_Embu_LUCID_WP9.pdf; LOG Associates. 2012. Final Project Report – Environmental and Social Impact Assessment (ESIA) Study for Securing of KenGen Boundaries Buffer Zones at Gitaru, Kamburu and Kindaruma Hydropower Plants. Provided by KenGen.

(2009) hereafter referred to as BS 5228 – 1:2009. The sound level meter was used to obtain noise levels in contiguous 10-minute intervals.

The general character of the site is rural and quiet with no significant anthropogenic noise sources other than intermittent traffic noise from vehicles travelling along Route B7. On October 03, 2017 daytime baseline noise measurements were performed at points along the road and nearest residential receptors adjacent to the site to confirm the baseline noise environment.

No noise is expected during the night-time (7pm to 7am) during construction and the site will not result in operational noise, as such no night-time noise monitoring was deemed necessary.

The findings of the noise survey are summarized in Table 22 below.

Table 22: Baseline noise results (03 October 2017)

Location / Description	Time	L_{Aeq},10min dB_A (average)	Weather conditions	Other noise sources
Machang'a village	05:45	64.5	Dry, sunny, 25°C, low wind.	Road / insects
Machang'a village	05:55	57.7	Dry, sunny, 25°C, low wind.	Road / insects
In between the shrubs frontage road	06:05	45.0	Dry, sunny, 25°C, low wind.	Road / insects
In between the shrubs frontage road	06:14	45.3	Dry, sunny, 25°C, low wind.	Road / insects
Route B7 near existing earthen road (near proposed new access point)	17:15	55.6	Dry, sunny, 25°C, low	Road / insects (increased to 75bBA) when car passed)
Route B7 near security road block	17:30	56.2	Dry, sunny, 25°C, low	Road / insects (increased to 75bBA) when car passed)
Nearest residential receptors (north of the Project site)	17:00	53.8	Dry, sunny, 25°C, low	Road / insects (increased to 75bBA) when car passed)

Source: Mott MacDonald / EcoPlan 2017

6.3.6 Surface water and groundwater

During the site scoping visit, one pond was observed on the Project site, which was completely dry. The topographic analysis undertaken as part of the Feasibility Report also identified two ravine areas through which water passes during periods of heavy rain only: one on the north-western edge of the Project site and one on the north-eastern corner (both outside the planned operational boundary of the site). The Project definition includes for keeping the watering pond for local use with an access trail the western side of the Project site as well as a drainage area in the north-western portion of the Project site.[23] Further, site visits during site selection identified the potential need for drainage infrastructure to alleviate flooding, particularly during the rainy season. The Seven Forks Feasibility Report noted that groundwater was not encountered in any of the five 35m BHs created as part of the Project site geologic analysis.

The Project site is near the Kamburu Reservoir, fed by the Tana river. The convergence of the Tana and Thiba rivers and the reservoirs at the Kamburu and Masinga hydroelectric dams are major landscape features of the Mbeere South District. The Tana River, fed by Kangiri tributary, is the main drainage basin of the Mbeere South District. Seasonal rivers, such as the Ngurungu, Munyoriri, and Njagori, drain into the Tana River and associated dams. The area also contains a number of earth dams including Gitaraka Kianthaga, Miranguri, Kiamwathi, Gicege, and Ciarukunyi, Kathamba.

The Tana River drainage basin has an annual mean discharge of five billion cubic meters and a 126,000km^2 catchment area draining the eastern slopes of Mount Kenya and the Aberdare Ranges. The Tana River and associated tributaries stretch over 1,000km. High demand for water for irrigation in the upper basin and extensive use for hydroelectric power generation contribute to water scarcity in the lower Tana River basin.[24] Much of the surface water in the Mwea area, within the Mbeere South District, is polluted with agro-chemicals and untreated human waste.[25]

Although there are five perennial rivers draining into the Tana River in the Mbeere District (Nyamindi, Rupingazi, Thiba, Rwamuthambi, and Ragati), groundwater resources are limited and relatively undescribed. In 2009, the limited number of existing groundwater BHs produced saline water.[26]

Water quality information from the Kamburu dam tail race tunnel which is indicative of the water quality in the Kamburu reservoir is presented in Table 23. This provides baseline data on the e current water quality of the reservoir. The current water quality with reference to national and international standards for water quality are shown. This shows that the water quality is generally acceptable except for levels of chloride.

[23] Seven Forks Solar Project FR

[24] Institute of Economic Affairs (IEA). 2009. Mapping and Characterizing Water Points in Mbeti South Location, Mbeere District. Available at https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&ved=0ahUKEwi4qpPjtafWAhXH0iYKHfAnAvYQFggmMAA&url=https%3A%2F%2Fwww.africaportal.org%2Fdocuments%2F11951%2FMapping-water-points-in-mbeere-district-IEA1.pdf&usg=AFQjCNH451ktYQaMb0RzmhHfY0Zy1Dnk_Q

[25] Athi Water Services Board. 2014. Environmental Impact Assessment Project Report for Mwea-Makima Water Supply System in Tana Water Services Board Area. Available at http://documents.worldbank.org/curated/en/523211478552425153/pdf/SFG1171-V1-REVISED-EA-P096367-ESIA-Mwea-Makima-Box393239B-PUBLIC-Disclosed-11-4-2015.pdf

[26] Op. cit. IEA 2009

Table 23: Kamburu reservoir water quality versus current standards

Parameter	Measurement Kamburu Dam tail race tunnel	IFC EHS guidelines (general), table 1,3,1 values for treated sanitary sewage discharges	IFC EHS guidelines (general) Table 5 effluent guidelines (applicable for site drainage and oil separated water)
pH	8.7	6-9	6-9
Electrical conductivity (micro mhos/cm)	127.1	-	-
Total dissolved solids (mg/l)	88.7	-	-
Chloride (mg/l)	20.0	-	0.2
Free and saline ammonia (N) mg/l	6.5	-	-
Albuminoid ammonia (N) mg/l	-	-	-
Nitrate (N) mg/l	3.6	10	-
Nitrite (mg/l)	0.037	-	-
Phosphorous			0.5
Suspended solids (mg/l)	26.0	50	50
Permanganate value (4 hours at 27^{O}C) mg/l	0.3	-	-
Biochemical oxygen demand (5 days at 20^{O}C) mg/l	-	30	-
Chemical oxygen demand (C.O.D) mg/l	-	125	-
Oil and grease		10	10
Free available chlorine or total residual chlorine			0.2

Source: Ministry of Health, certificate of Analysis (WE40/16-17, 20 September 2017, KenGen

6.3.7 Supporting infrastructure

6.3.7.1 Waste management infrastructure

Only an estimated 25% of solid waste in Nairobi is collected and the waste that is collected is taken to unprotected and unlined dump sites.[27] Although counties are charged with providing waste disposal services and designating locations, desktop research during scoping did not reveal any designated facilities within Embu County. However, the Draft County Integrated Development Plan 2013 to 2017 for Embu County included the purchase of 120ha for a waste disposal site as a potential new Project proposal. No waste disposal sites are currently present in the County. The final destination of waste mostly consists of simple open-air rubbish dumps. In these places, waste is burnt, buried and compacted, which has certain potential health and environmental implications because:

- The rubbish dumps are located in the centre of residential areas, and the waste is transported along public roads

[27] Andole, OH. 2016. The State of Solid Waste Management in Kenya. Available at http://www.envr.tsukuba.ac.jp/~sustep/dl/160412_02.pdf

- There are few studies on the types of soil under these rubbish dumps, which may sometimes be susceptible to leaching and contamination
- Air pollution may occur, caused by the fumes, bad smells, and potentially toxic particles, since the waste is not subject to prior sorting, and is burnt periodically
- The dumps may not easily accessible which means that the waste may be deposited at the entrance and beside the roads

There is no special treatment of hazardous wastes. Rural communities such as Machang'a tend to adopt an "informal" waste management system (recycling, burying and burning rubbish).

Figure 18 and Figure 19 provide illustration of some current waste management activities in the area.

Figure 18: Current waste management provision in Project area

Source: Mott MacDonald

Figure 19: typical waste management provision in Project area

Source: Mott MacDonald

The nearest waste management facilities for general and hazardous waste in accordance with GIIP and NEMA regulations are located in Nairobi.

Waste management facilities for sanitation in Mbeere South and Mbeere North areas of Embu County are limited. As of a 2009 census, 329 persons used main sewer lines, 400 used septic tanks, 57 used cesspools, 3,173 used VIP latrines, 45,504 used pit latrines, and 2,082 used other methods such as buckets and bush in these areas.[28]

6.3.7.2 Road infrastructure

As of 2013, Embu County contained 914.3km of earthen roads, 548km of gravel roads, and 120km of paved roads, including the Meru-Embu highway and the Embu-Kiritiri road.[29] Hilly terrain, expensive maintenance during the rainy season, and poor drainage have hindered the development of the road network in Embu County. Embu County Governor Wambora laid out an ambitious plan to pave 100km of road in Embu County by the end of 2017, starting with the

[28] Op. cit. Embu County Government 2013.

[29] Embu County Government. 2013. County Integrated Development Plan. Available at http://www.embu.go.ke/wp-content/uploads/2016/09/EMBU-COUNTY-DRAFT-CIDP.pdf

12.2km Embu-Kibugu road. The County purchased two additional graders in 2015 to contribute to enhancing and rehabilitating rural roads.[30]

Throughout Kenya, approximately 6.95% of roads were paved as of 2013. Further, the Projected financing gap for Kenya's roads from 2012 to 2020 was estimated at US$9 billion.[31] Roads in Kenya are classified under the following scheme:

- A: International trunk roads that link centres of international importance, cross international boundaries, or terminate at international airports
- B: National trunk roads that link nationally important centres
- C: Primary roads that link locally important centres and higher-class roads
- D: Secondary roads that link locally important centres to higher class roads
- E: Minor roads that link minor centres
- F: Special purpose roads including park roads, agriculture roads, and strategic roads
- U: Unclassifed

Table 24: Kenya's road infrastructure by class and managing agency (in km)

Managing agency	Road Class	Paved	Unpaved	Total
Kenya National Highway Authority (KeNHA)	A	2,772	816	3,588
	B	1,482	1,156	2,638
	C	2,529	4,932	7,461
	Total	6,783	6,904	13,687
Kenya Rural Roads Authority (KeRRA)	D	1,069	9,092	10,161
	E	461	24,448	24,909
	F	46	9,817	9,863
	U	692	84,442	85,134
	Total	2,268	127,799	130,067
Kenya Urban Roads Authority (KURA)	B	7	0	7
	C	164	2	166
	D	169	367	536
	E	116	919	1,035
	F	64	552	616
	U	1,620	8,569	10,189
	Total	2,140	10,409	12,549
Kenya Wildlife Service (KWS)	C	0	230	230
	D	0	24	24
	E	0	704	704
	F	0	7	7
	U	6	3,612	3,618
	Total	6	4,577	4,583
	Whole Network	**11,197**	**149,689**	**160,886**

Source: Ong'uti, MA. 2015. Road Infrastructure Gap: Kenya's Experience, 2000-2010. International Journal of Applied Research. Available at http://www.allresearchjournal.com/archives/2015/vol1issue12/PartK/1-12-57.pdf

[30] Embu County Government. Infrastructure, Energy, and Housing. Available at https://www.embu.go.ke/?page_id=25

[31] Oguso, A. 2015. Enhancing Road Infrastructure Development through Public Private Partnership in Kenya: A Comparative Analysis. Kenya Institute for Public Policy Research and Analysis (KIPPRA). Available at http://kippra.or.ke/kippra-publications-2/#3-discussion-papers

The main road near the Project site is the Route B7 (KeNHA secondary road) that runs alongside the site passing through nearby villages such as Machang'a. Immediately adjacent to the site and connect directly from Route B7 is an earthen road (managed by KeRRA) that runs along the northern boundary of the site. A new access for the Project directly from Route B7 is planned. The existing earthen road adjacent to the site will be repaired and graded, no plans for expanding the width of the road are envisaged. This road is primarily used by local community to access the dam for fishing.

Route B7 is paved and maintains good standards in terms of safety and road infrastructure. The road is used by trucks carrying various types of crops and agricultural products of the region as well as personal vehicles and bikes and is suitable for heavy goods vehicles.

Heavy equipment will be transported to the Project from Port of Mombasa along Route A109 or Route A3 to Route B7 from the south to avoid travel through Embu Town. The final route will be determined by the Contractor.

In the local area, the common means of transport of goods and people in the area are bicycles, horses, motorcycles, and trucks. The B7 road does pass through a number of villages en-route from Route A3. There are six or seven villages along the route, the largest of which is Kivaa and each can be characterized by anywhere between five and twenty homesteads and market stands set back at least 10m from the road side.

Figure 20 to Figure 23 illustrate road type and condition around the Project site.

Figure 20: A3 at junction with B7

Source: EcoPlan 2017

Figure 21: Example B road at point of new access to the site

Source: EcoPlan 2017

Figure 22: Route B7 and junction with A3

Source: EcoPlan 2017

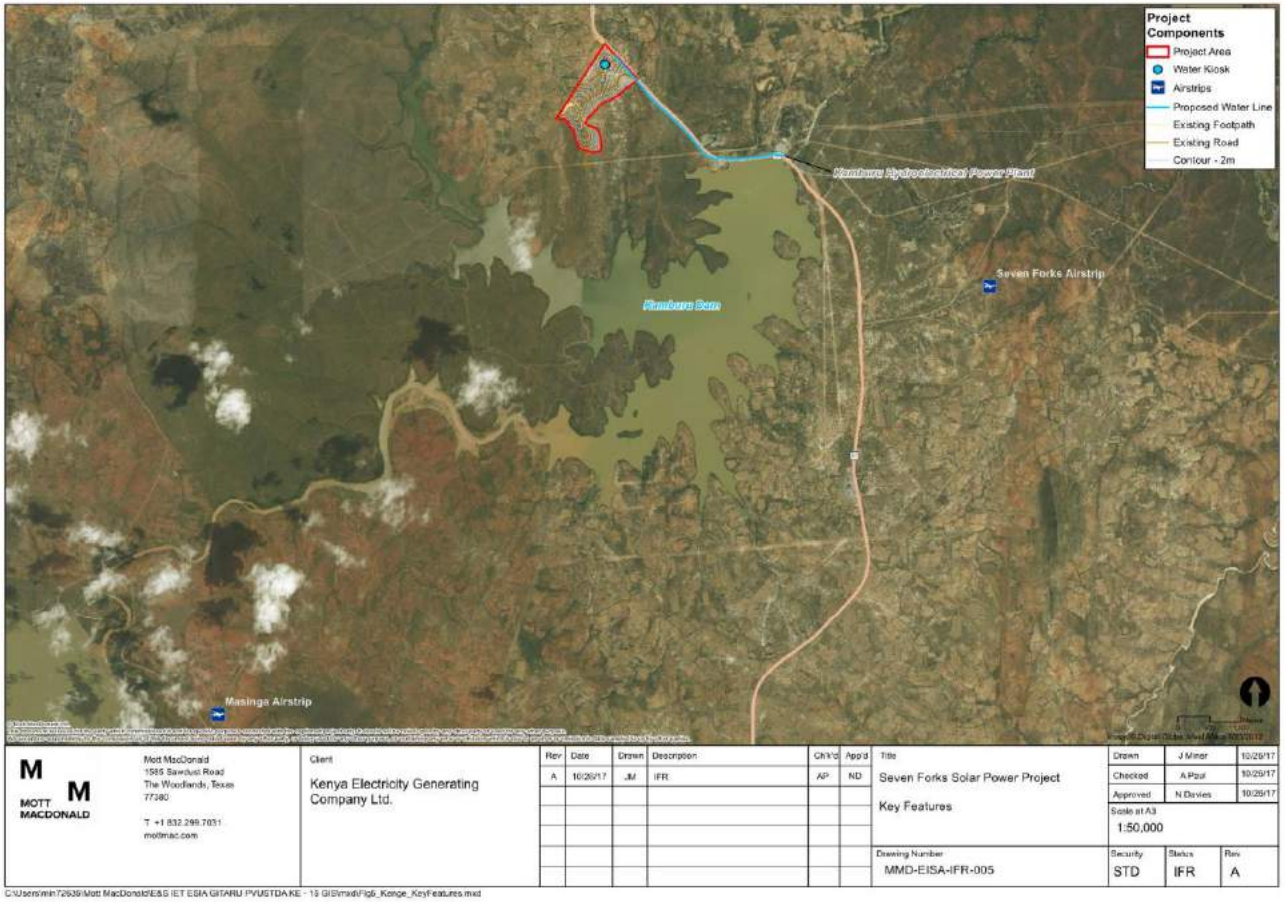
Figure 23: Earthen road adjacent to Project site

Source: EcoPlan 2017

6.3.7.3 Nearby airfields

The scoping site visit identified two airstrips near the Project site, shown in Figure 24.

Figure 24: Airfields near the Project site



Source: 5.77 17-05-09 Proposed Kenge Solar Farm.kmz

The two confirmed nearby airstrips are the Seven Forks airstrip, shown in Figure 25, and the Masinga airstrip, shown in Figure 26. The Seven Forks and the Masinga airstrips are approximately 6.6km southeast and 9.8km southwest of the Project site respectively. Neither airstrip appears to have additional associated infrastructure such as hangers or office buildings. The Embu County Government describes the Seven Forks airstrip as "mainly used by KenGen."[32] Embu County is also home to another airstrip at Don Bosco in Embu Town, which is primarily used for security purposes.

Figure 25: Seven Forks airstrip

Source: Google Earth

Figure 26: Masinga airstrip

Source: Google Earth

[32] Op. cit. Embu County Government. 2013. Pg 13

6.3.7.4 Communication network

Embu County has two major post offices, one in Embu Town and one in Runyenjes Town, and 13 sub-post offices throughout the County. Four mobile network providers (Safaricom, Airtel, Yu, and Orange) provide coverage in the County, whereas Jambonet and Kenya Data works provide data services. Vsat offers satellite services in Embu County. Telkom Kenya provides fixed line connectivity in the County. A fibre optic cable passes through Embu and Runyenjes towards Meru and through Kiritiri to Masinga as part of the fixed national digital network, though the network is not connected to buildings or other places in the County.[33]

6.3.8 Biodiversity

The primary threats to biological diversity in Kenya include growing population; poverty; land use practices; inadequate laws, policies, and intuitional framework; and lack of education. The ecology of the Project area has been impacted by livestock and human alteration. Biodiversity of the Project location is influenced by the savannah ecosystem comprised of grasses, shrubs, and scattered trees. Plants typically occurring within the savannah ecosystem include river bushwillow, okra, Bermuda grass, thorny tree species in the acacia family, and non-thorny trees including baobab, manketti, cadelbra and jackalberry. Due to livestock grazing, the vegetative community within the Project site has been degraded resulting in large areas of bare ground with a sparse cover of grasses and shrubs. Although tree densities vary across the site, overall, trees are moderately spaced consisting of young saplings and mid-aged acacia and non-thorny tree species.

Aquatic habitats are limited to an intermittent pond located at the south-western edge of the Project site and an ephemeral drainage located on the north-western edge of the property. The pond is used primarily as a water source for livestock, and because of the seasonal nature of the pond, aquatic ecosystems have not developed. However, local farmers rely on the water source for livestock as may wildlife species.

6.3.8.1 Desk based review

A desk-based review of available information from national and international sources was undertaken. This included:

- Convention on Biological Diversity website (http://www.cbd.int/)
- UNESCO database on World Heritage Sites (http://whc.unesco.org/en/interactive-map/)
- IUCN Red List of Threatened Species (http://www.iucnredlist.org)
- Integrated Biodiversity Assessment Tool (IBAT, 2017)
- BirdLife International Data Zone (http://www.birdlife.org/datazone/home).
- Protected Planet (https://www.protectedplanet.net/)
- The Reptile Database (http://reptile-database.reptarium.cz/)
- The Amphibia Web http://amphibiaweb.org/
- Catalogue of Life (http://www.catalogueoflife.org/)
- National Museums of Kenya Centre for Biodiversity (http://www.museums.or.ke/centre-for-biodiversity/)
- Kenya Wildlife Service Priority Ecosystems and Species (http://www.kws.go.ke/content/priority-ecosystems-and-species)

[33] Op. cit. Embu County Government. 2013.

- Aerial photography
- Topographic maps

The Project AOI was determined to include the Project boundary (85ha), an additional area abutting the southern end of the Project boundary (11ha). A 10km buffer was also applied. A search of existing data was conducted to determine protected species, habitat types, human influences, conservation areas, native and alien species, migration routes, potential ecosystem services, and protected areas (existing or proposed) within the AOI.

Information gathered during desktop review was used to inform stakeholder consultations (see Chapter 5) and baseline biodiversity surveys (Volume III).

Information on the following nature conservation areas and other protected areas (existing or proposed) within the AOI and up to 10km of buffer has also been collected and reviewed:

- Ramsar sites
- Key Biodiversity Areas (KBA)
- Important Bird Areas (IBA)
- World Heritage Sites (WHS)
- Biosphere Reserves
- National Protected Areas of Kenya:
  - National Park
  - Nature Reserve
  - Private Wildlife Reserve
  - Forest Reserve
  - Game Sanctuary
  - Cloud Forest Site

In addition, biodiversity information was collected and consultation with local NGOs was undertaken during the scoping and ESIA site visit, refer to Chapter 5.

6.3.8.2 Biodiversity surveys

Baseline biodiversity surveys were undertaken between 4 and 7 October 2017 to inform this assessment. The following biodiversity surveys were undertaken in support of the Project:

- Habitats and flora
- Mammals
- Birds
- Herpetofauna (reptiles and amphibians)
- Insects
- Interviews with local residents and experts

Four days of surveys were carried out by EcoPlan Management (EcoPlan) by a qualified Biologist. The survey area assessed the potentially affected landscape which included the Project boundary (85ha) plus an additional area abutting the southern end of the Project boundary (11ha). Local community members, Project site users and specialized informants were identified for the purpose of interviews and FGDs. The specialized informants were a local community man and a herbalist with indepth knowledge of the local fauna. Targeted information on the interviews and FGDs were on the medicinal and other values of flora, and the historical and current perspective of biodiversity composition (habitats typologies and fauna).

The baseline biodiversity reports and data from October 2017 are included in Volume III. This document includes: the locations of the 2017 survey sites shown on the maps and detailed methods used for survey. The next sections include a summary of the methods used during these surveys.

The biodiversity baseline report is provided in Volume III – Technical Appendix a summary of the key findings is also presented below.

Habitat and fauna survey

A habitat map was prepared using aerial imagery and topographic survey data which was ground-truthed by EcoPlan. Vegetation transects were established in each habitat type within the Project survey area. A total of 11 transects were surveyed (30 meters each). A list of plant species was recorded along each transect. The uses and functions of the flora were also recorded for each species through interviews with a local medicine man and the EcoPlan Biologist.

Insect diversity study

To evaluate the diversity of insect species within the Project survey area, five pit-fall insect trapping stations were established. Each trap consisted of a small jar set into the ground, with the finish level with the ground, so insect could pit-fall into the jar. A stone was laid on the trap to avoid depredation by small carnivores.

Bird diversity survey

Two methods were used to assess bird diversity within the Project area: Fixed radius and transects. Fixed radius surveys involved establishing six bird count points within the Project survey area. Bird counts were conducted in the morning from 6:00 am to 10:00 am and during the afternoon from 3:00 pm to 5:00 pm, following the methodology described in *Bird Monitoring Methods: A Manual of Techniques for Key UK Species* by Gilbert et al. (1998). In each bird fixed radius location, all bird species either observed or heard for a period of 10 minutes were identified. Transect surveys involved establishing transects along existing roads and rights-of-way. The observer recorded all birds seen or heard while traversing each section/transect of a trail. Using this method, the observer covered a given amount of trail in a fixed amount of time.

Reptile and amphibian diversity surveys

The purpose of this study was to determine the overall diversity of reptile and amphibian species within the survey area, identify habitats within the survey area that show higher diversity than other habitats and create an inventory of common species present within the Project area. To evaluate the status of reptiles and amphibian populations within the survey area, visual encounter surveys were conducted in accordance with procedures described in *Field Techniques for Herpetofaunal Community Analysis* (Campbell and Christman, 1982) and Measuring *and Monitoring Biological Diversity: Standard Methods for Amphibians* (Heyer, et al, 1994). Surveys were conducted utilizing a randomized-walk design. The observer chose at random a sequential series of compass directions; they selected a random number of meters to walk in each selected direction. All reptile and amphibian observed within 1m on either side of the path were recorded. Leaf litter, logs, rocks, and other likely microhabitats were turned over and investigated.

Mammal diversity survey

The intent of the mammal diversity study was to determine mammal species that migrate through or are residence of the survey area. To evaluate presence of large mammal species, field teams conducted surveys in areas of suitable habitat for tracks, scat, and direct observations of mammals. Field teams made observations during other field survey efforts and conducted field walks along known trails up to a 1km distance and variable width. Field walks were conducted at various times during the day with the objective of detecting footprints, remains, faeces, burrows, sounds and odours. To determine the presence of rodents on site, five Sherman traps were randomly established across the Project site at a distance of at least 10m from each other. A bait appropriate to the area was used to lure rodents to the traps. All traps were activated from 5:00 pm to 6:00 am of the next day. Captured rodents were identified to species and data recorded including weight, length of the body, sex, reproductive status, developmental stage (i.e. adult, juvenile). In addition, a review of the presence or absence of suitable bat habitat was conducted. Field teams made observations while travelling within the Project site and conducting other surveys. Where suitable habitat was determined to be present, field teams mapped the boundaries of the habitat using GPS. The habitat was not considered suitable for bats and no specific bat surveys were performed.

Interviews with local people

In addition to the field surveys, local people were interviewed regarding the threatened, endemic/restricted-range, migratory or protected species. Information was collected regarding the presence, abundance, local distribution, migration seasonality, breeding, threats of these species. The interviews conducted with the local people. This followed three main models:

- Identification and interviews with a village elder and medicine man
- Interviews with random people using the site
- Biodiversity oriented questions during the FGD questions

The interview with the village elder focused on identification of the flora and fauna, gaining a historical perspective and the species taxonomy in the local dialect for purposes of further plant and animal species identification.

The interviews with randomly sampled people on the site as well as the FGD was to gain insight on to how the people use and relate with the flora and fauna on site, observed animals on site, locations where viewed and how often.

6.3.8.3 Threatened species

The IUCN Red List of Threatened Species database searched[34] to determine potential at-risk species within a 10km radius of the Project site. The search overlapped the range of 12 species listed as critically endangered (CR); however, all of these species are extinct or presumed extinct. Extant species within the search radius include two species listed as endangered (EN), one species listed as vulnerable (VU), and two species listed as near threatened (NT). These species are listed in Table 25 along with their status and habitat requirements.

[34] IUCN Red List of Threatened Species. http://www.iucnredlist.org . Downloaded on September 22, 2017

Table 25: IUCN Red List of Threatened Species potentially occurring near the Project

Scientific Name	Common Name	Red List Category	Habitat
Hyaena hyaena	Striped hyena	NT	This mammal inhabits forest, savanna, shrublands, grasslands, and wetlands. This species is known to scavenge in garbage.
Neotis denhami	Denham's Bustard	NT	This large avian species inhabits grasslands, grassy dunes with Acacia trees, shrublands, light woodlands, farmland, crops, dried marsh and arid scrub plains, grassy ironstone pans, and burnt savanna woodland (a).
Acrocephalus griseldis	Basra reed-warbler	EN	This avian species winters in Kenya. The preferred wintering habitat is within and near waters including coastal scrub, woodland thickets, swamps, marshes, flooded pools and grasslands, inundated ditches and the edges of rivers, ponds, lagoons and lakes [(b)].
Ethulia scheffleri	N/A	EN	This plant species occurs in swamps and along streams and in marshy grasslands characterized by lack cotton soils.
Carex phragmitoides	N/A	NT	This plant species is known from only one location in Kenya (Lake Narasha). It grows in bogs, marshes, stream sides and crater lake edges [(C)].

ENDANGERED (EN): A taxon is Endangered when the best available evidence indicates that it meets any of the criteria for Endangered, and it is therefore considered to be facing a very high risk of extinction in the wild.

VULNERABLE (VU): A taxon is Vulnerable when the best available evidence indicates that it meets any of the criteria for Vulnerable and it is therefore considered to be facing a high risk of extinction in the wild.

NEAR THREATENED (NT): A taxon is Near Threatened when it has been evaluated against the criteria but does not qualify for Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the near future.

Source:

a) BirdLife International. 2016. *Neotis denhami*. The IUCN Red List of Threatened Species 2016: e.T22691905A93327715. http://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T22691905A93327715.en. Downloaded on **23 September 2017**.

b) Beentje, H.J. 2017. *Ethulia scheffleri*. The IUCN Red List of Threatened Species 2017: e.T185356A84256222. http://dx.doi.org/10.2305/IUCN.UK.2017-1.RLTS.T185356A84256222.en. Downloaded on **24 September 2017**

c) Luke, W.R.Q. 2010. *Carex phragmitoides*. The IUCN Red List of Threatened Species 2010: e.T185414A8407060. http://dx.doi.org/10.2305/IUCN.UK.2010-3.RLTS.T185414A8407060.en. Downloaded on **24 September 2017**

The IUCN list the striped hyena (*Hyaena hyaena*) as Near Threatened (IUCN, 2017). The striped hyena is also listed by the Kenya Wildlife Service as a Priority Species (KWS, 2017). The striped hyena inhabits forest, savanna, shrublands, grasslands, and wetlands. Habitat for this species is present within the Project site and within the 10km buffer. No individuals were sited and no signs of any large mammals were identified as part of the field survey. In addition, interviews with locals did not indicate that hyena are present or nearby.

Denham's bustard (*Neotis denhami*) is listed as Near Threatened by the IUCN. This bird inhabits grasslands, grassy dunes with Acacia trees, shrublands, light woodlands, farmland, crops, dried marsh and arid scrub plains, grassy ironstone pans, and burnt savanna woodland. Suitable habitat exists within the Project site and within the 10km buffer for this species. This species was not identified during the field survey and was not documented during interviews with local people as occurring within or near the Project site.

Basra reed-warble (*Acrocephalus griseldis*) is listed as endangered by the IUCN and as a Priority Species by the Kenya Wildlife Service. This bird winters in Kenya and prefers wintering habitat within and near waters including coastal scrub, woodland thickets, swamps, marshes, flooded pools and grasslands, inundated ditches and the edges of rivers, ponds, lagoons and

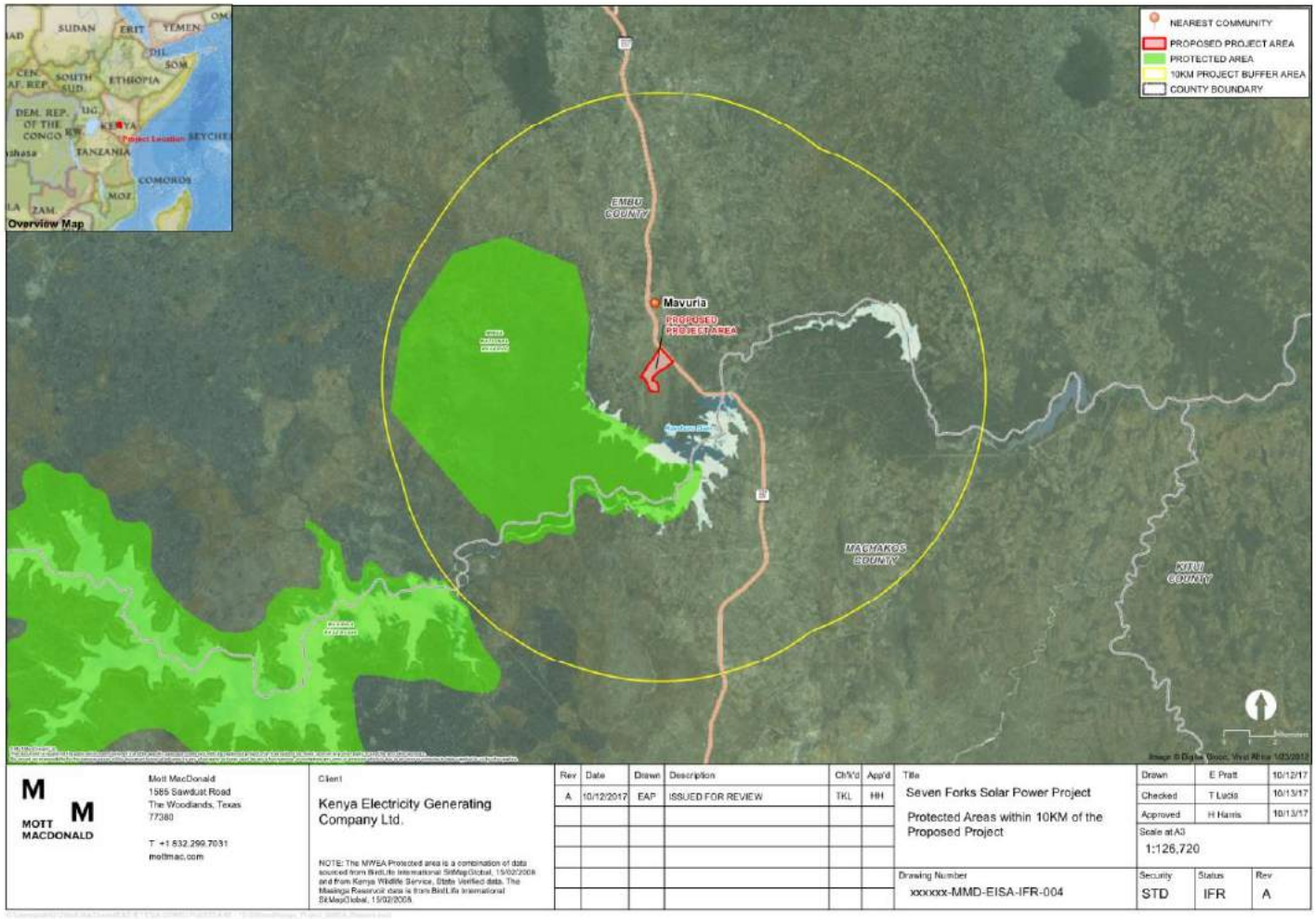
lakes. Habitat for this species exist within 10km of the Project site, particularly along the Kamburu Dam, Tana River, and Thiba River. This species was not identified during field surveys or during interviews with local residents.

Within 10km of the Project site, two plant species are listed on the IUCN Red List of Threatened Species. *Ethulia scheffleri* is listed as Endangered by the IUCN. *Carex phragmitoides* is listed as Near Threatened by IUCN. Both of these species occur within wetland habitats. These species were not identified within the Project site and suitable habitat is not present within the Project site. Within the Project AOI, there is potential habitat for these species along the edges of waterbodies. Based on aerial imagery, a large portion of habitat along the major waterbodies within the AOI have been cultivated except within Mwea National Reserve. See also section 6.3.8.13 for further discussion of these findings relative to the IFC PS6 definition of critical habitat.

6.3.8.4 Internationally recognized areas

The proposed Project is not located within a legally protected or internationally recognized area. Within 10km of the Project, is the Mwea National Reserve (Mwea), located approximately 2 km west and south of the Project site (Figure 27). Mwea is approximately 42km^2 in size and is classified as an IBA. The Tana River and Kamburu Dam lie along the eastern border of Mwea. Generally, Mwea is dominated by a savannah ecosystem interspersed with hills, bushy vegetation and scattered large trees. Along the main rivers, large Acacia and baobab trees grow. Unique to the Mwea ecosystem are the meeting point of rivers Tana and Thiba; and Kamburu and Masinga hydro-electric dams. The reserve is home to numerous large mammals including elephants, Rothschild giraffes, common zebras, lesser kudu, buffalo, water buck, bush buck, impala, gazelle and yellow baboons. Hippos and crocodiles are found along the rivers and dams. Over 200 species of birds are documented within Mwea and the reserve is popular with birders due to the numerous water and wading birds. The globally threatened Hinde's babbler is known to occur within the reserve as well as Pel's fishing owl and the white-backed night heron both of which are rare species.

Figure 27: Protected areas within 10km of the Project



Source: Mott MacDonald

6.3.8.5 Terrestrial habitats

Land cover habitat types within the Project AOI were determined using the Africover Multipurpose Landcover Database for Kenya issued in 2004. Habitat types within the Project area were also verified during field surveys conducted in October 2017. Table 26 lists the habitat types in hectares present within the AOI. A more detailed discussion of the habitats is provided below along with site specific information gathered during the field survey.

Table 26: Habitats within the Project AOI

Area	Habitat Type [1]	Total area (ha)	Project impact (ha)
Additional survey area	Woodland	20.3	0.00
Project area	Woodland	76.0	76.00
Proposed substation	Shrubland	0.43	0.43
Total Project Area		**96.72**	**76.43**
10km buffer	Herbaceous crops	9,333.93	0.00
10km buffer	Herbaceous vegetation on flooded land	302.62	0.00
10km buffer	Open woody vegetation	960.86	0.00
10km buffer	Shrub savannah	4,597.38	0.00
10km buffer	Shrubland	14,018.93	0.00
10km buffer	Tree savannah	357.27	0.00
10km buffer	Water bodies	1,470.61	0.00
10km buffer	Woodland	10,857.10	0.00
Total buffer area		**41,898.70**	0.00

[1]Habitat type within the Project area determined based on desktop and field data.

Source: Aggregated landcover database for Kenya (Africover) for tsetse habitat mapping 2007-05-22

Woodland/Open Woody Vegetation

Woodlands are more densely vegetated than acacia savanna or grassland, but not densely enough to form a closed canopy. The open canopy allows sunlight to reach the ground, and grass to grow. Three types of woodland are present within the Project AOI, Croton-Combreton woodland, Acacia-Combretum woodland, and Combretum woodland. The Croton-Combretum woodland occurs in wetter areas with volcanic soils or weathered soils on metamorphic rock derived from the Basement System. The undergrowth is dominated by grass species such as Themeda triandra (Kokwara, et al, 1979). Acacia-Combretum woodland is found in drier, hotter areas underlain by shallow soils. Tree species are dominated by the genera Acacia and Combretum with grasses including genera of Cenchrus, Eragrositis, and Heteropogon composing the understory (Kokwara, et al, 1979). Combretum woodlands typically have more broad-leaved species and grass species. Within the Project site, the Combretum woodland is the dominant vegetative community. The main species of trees and large shrubs identified during field surveys are *Combretum collinum, Terminalia brownii, Terminalia kilimandscharica, Terminalia brownii var. fresen, Uvaria scheffleri,* and *Uvaria scheffleri*. The undergrowth was predominantly grasses dominated by Cenchrus spp. (Ecoplan, 2017[35]).

Woodland has also developed as a result of tree felling for timber and charcoal. Croton species and Meru Oak have largely been harvested, and large stands are no longer

[35] Seven Forks Solar Power Project Baseline Survey Report. Available in Volume III Technical Appendix

present. These areas have been transformed to woodland communities dominated by *Croton macrostachyus* and *Combretum molle*, and *Combretum Zeyheri*.

Shrubland

In areas where rainfall decreases, the vegetation changes to shrubland. Typically, this habitat type is found on shallow soils underlain by metamorphosed Basement System rocks. Vegetation is dominated by various species of Acacia and Commiphora. This community is commonly dominated with shrub species including *Acacia melliera* with scattered baobab trees. Common shrubs include *Bridelia taitensis, Croton dichogamus*, and *Sesamothamnus rivae (Kokwara, et al, 1979)*.

Waterbodies and Herbaceous vegetation on flooded land

Open water within the Project AOI includes Kamburu Dam, Tana River, and Thiba River. Within the Project AOI, a significant portion of the floodplain habitats associated with these waterbodies lie within the Mwea National Reserve. Associated riparian forest with Mwea consists of mature acacia and baobab trees with a dense underbrush. Other common trees found in riparian areas include *Ficus sycomorus, F. natalensis, F. Quibeba, Syzgium guineense*, and *Acacia elatio*r. Herbaceous species include *Kanahia laniflora, Triumfetta tomentosa, Cardiospermum coriandum, coix lacryma-jobi*, and *Mariscus rubrotinctus*. As observed on aerial photography, outside of the reserve, much of the floodplain has been converted to cropland.

Tree Savannah

The tree savannah is similar to woodland except it has a more open canopy and fewer shrub species. The savannah consists of open grassland with sparse acacia trees and baobab trees. The savannah is covered by grasses such as Rhodes grass, red oats grass, star grass, lemon grass, and some shrubs.

Herbaceous crops

According to the Kenya Information Guide, tea, coffee and cotton are the main cash crops grown in Embu County, Kenya. However, due to their falling prices, many farmers have in recent years began planting other crops such as mango. Grain including maize, sorghum, sunflower, beans and cow peas are also common crops in Embu County.

6.3.8.6 Mammals

The IUCN Red List of Threatened Species includes four mammal species within 10km of the Project site (IUCN, 2017). Of these species, three are of Least Concern, and one is listed Near Threatened, the striped hyena (*Hyaena hyaena*) (IUCN, 2017). The striped hyena is also listed by the Kenya Wildlife Service as a Priority Species (KWS, 2017). The only mammal identified during the field survey were squirrel species (*Paraxerus spp.*). Based on these interviews, with local residents and experts, the presence of mammals has been divided into two main groups: those that historically used the general area (not necessarily the Project site) as a migratory route between Mwea Reserve and Mwingi National Reserve (Table 28) and those that have been observed within and around the Project site in recent times (Table 28).

Table 27: List of large mammals historically observed migrating through the AOI

Scientific Name	Common Name
Loxodonto africana	African Elephant
Syncerus caffer	African Buffalo
Equus buchelii	Zebras

Table 28: List of mammals seen within and around the Project Site

Scientific Name	Common Name
Hippopotamus amphibius	Common Hippopotamus
Phaeochoerus africanus	Warthogs
Cercopithecus spp	Monkeys
Gazella granti	Grants Gazelles
Aepyceros melampus	Impala
Madoqua spp	Dik Diks
Paraxerus spp.	Squirrels
Procavia spp	Rock Hyrax/ Rock badger
Lepus spp	Hare

Species listed in Table 28 as having been observed within and around the Project site are not listed on the IUCN Red list of threatened species and are not listed on Kenya Wildlife Service's Priority Species list.

Of the above listed species known to migrate within the AOI, only the African elephant is listed by the Kenya Wildlife Service as a Priority Species.

6.3.8.7 Birds

A total of 31 species of birds are listed by the IUCN as potentially occurring within 10km of the Project site. Of these, one species is listed as Near Threatened, Denham's bustard (*Neotis denhami*) and one is listed as Endangered, basra reed-warbler (*Acrocephalus griseldis*). The basra reed-warbler is also listed by the Kenya Wildlife Service as a Priority Species. Table 29 and Table 30 list birds identified during the field survey within the Project site and at the nearby Kamburu Dam.

Table 29: List of identified birds within the Project site

Scientific name	Common name
Lamprotornis superbus	Superb starling
Pogoniulus chrysoconus	Yellow Fronted tinker bird
Dioptrornis fischeri	White eyed Slaty flycatcher
Vanellus coronatus	Crowned plover
Lagonosticta senegala	Red-billed fire-finch
Streptopelia semitoquartia	Red eyed dove
Corythaixoides leucogaster	White bellied go away bird

Table 30: List of identified birds outside the Project site (at nearby waterbodies)

Scientific name	Common name
Scopus umbretta	Hammerkop
Ardea alba	Great Egret
Pelecanus onocratalus	Great White Pelican
Vanellus spinosus	Spur-winged plover
Himantopus himantopus	Black winged stilt

6.3.8.8 Migratory birds

Three flyways cross Africa: West Asian-East African Flyway, East Atlantic Flyway, and the Black Sea/Mediterranean Flyway (BirdLife Int., 2017). These flyways connect bird breeding grounds in Europe and Asia with wintering ground in Africa. These flyways overlap with the mainland of Africa but none cross over Kenya. There are no flyways that overlap with the Project AOI. However, migratory birds are present within the Project AOI, and would find foraging and roosting habitat within the Mwea National Reserve as well as along Kamburu Dam, Tana River, and Thiba River.

6.3.8.9 Herpetofauna

Two species of reptiles are listed as of concern by IUCN as potentially occurring within 10km of the Project Site: Mocquard's African ground snake (*Goniontophis capensis*) and Flower's racer (*Platyceps florulentus*) snake. Both species are listed as Least Concern on the IUCN Red List of Threatened species. These species were not observed during field surveys and were not identified during local interviews as being within or near the Project site. Reptiles observed during surveys included: Long tailed skink (*Mabuga megalura)*, Striped skink (*Mabuga striata)* and Agana *(Agana lionotus)*. Interviews with locals indicated that various species of snakes and tortoises are present in the area as well as crocodiles. No amphibians of concern are listed by IUCN as potentially occurring within 10km of the Project site.

6.3.8.10 Insects

Seven species of insects are listed by IUCN as potentially occurring within 10km of the Project site (Table 31). All of these species are listed as Least Concern on the IUCN Red List of Threatened species. There are no insect species listed as Priority Species by the Kenya Wildlife Service. Insects observed within the Project site include sugar ants (*Camponotus consobrinus),* black ants *(Monomorium minimum*), and various unidentified species of dragonflies and grasshoppers.

Table 31: IUCN Red List of insect species

Scientific Name	Common Name	IUCN Red List Category
Crenigomphus hartmanni	Clubbed talontail dragonfly	LC
Diplacodes luminans	Barbet Percher drogonfly	LC
Lestes virgatus	Smoky Spreadwing damselfly	LC
Onthophagus fuscivestis	Dung beetle	LC
Phyllomacromia pallidinervis	Clubbed cruiser dragonfly	LC
Pinheyschna rileyi	Bullseye hawker dragonfly	LC
Trithemis pluvialis	River dropwing dragonfly	LC

6.3.8.11 Fish

The IUCN does not list any fish species within 10km of the Project site. There are numerous fish species present in the Kamburu Dam, Tana River, and Thiba River. However, since there are no fish-bearing surface waters within the Project site, and the Project is not expected to impact fish near the Project site; in-depth analysis and field surveys were not conducted as part of the biodiversity assessment.

6.3.8.12 Ecosystem Services

Ecosystem services can be broadly organized into four types:

- Provisioning services: which are the products people obtain from ecosystems (such as in form of crops, water, fruits, woods)
- Regulating services: which are the benefits people obtain from the regulation of ecosystem processes (such as filtration of pollutants by wetlands, climate regulation through carbon storage and water cycling, pollination and protection from disasters
- Cultural services: which are the nonmaterial benefits people obtain from ecosystems (such as recreation, spiritual and aesthetic and education values)
- Supporting services: which are the natural processes that maintain the other services (such as soil formation, photosynthesis and nutrient cycling among others)

The biodiversity, socio-economic and cultural heritage baseline assessments have identified provisioning and potential cultural services in the area. These are addressed in the socio-economic assessment including consideration of livelihoods and loss of trees with medicinal value.

General protection of the biodiversity outlined in this Chapter will be relevant to supporting ecosystem objectives at the supporting and regulating level but no specific biodiversity related services have been noted.

During interviews with a community elder and herbalist as well as interviews with herders on site the following information regarding medicinal plants found within and around the Project site was yielded and reproduced in Table 32.

Table 32: Medicinal plants within and around the Project site

SN	Scientific Name	Common Name
1	Olea europaea	African Olive; Muthata (Mbeere)
2	Albizia anthelmintica	Worm cure Albizia; Muvarwa (Mbeere)
3	Cissampelos pareira	Velvetleaf; Karigi (Mbeere)
4	Zanthoxylum chalybeum	Knobwood; Mukenenga (Mbeere)
5	Carissa spinarum	Bush plum; Mukawa (Mbeere)
6	Ficus sycamorus	Sycamore fig; Mukuyu (Mbeere)
7	Erythrina abyssinica	Mivote (Mbeere)
8	Ficus thonnigii	Ficus; Mugumo (Mbeere)
9	Acacia senegal	Gum acacia; Mungore (Mbeere)
10	Cordia africana	East African cordia; Muringa (Mbeere)
11	Croton megalocarpus	Croton; Mukiduri (Mbeere)
12	Piliostigma thonningii	Camel's foot tree; Mukura (Mbeere)
13	Aloe dawei	

Source: Biodiversity baseline report, October 2017

6.3.8.13 Critical habitat screening

A critical habitat assessment (CHA) is required when as stated by IFC PS6 and IFC Guidance Note 6 that the Project may represent a risk to area of high biodiversity value including:

- Habitat of significant importance to Critically Endangered (CR) and/or Endangered (EN) species
- Habitat of significant importance to endemic and/or restricted-range species
- Habitat supporting significant global concentrations of migratory species and/or congregatory species
- Highly threatened and/or unique ecosystems
- Areas associated with key evolutionary processes

Biodiversity features were screened at the species, ecosystem, and landscape levels as follows:

Species Level:

- Criterion 1 is triggered by species listed as CR or EN on the International Union for Conservation of Nature (IUCN) Red List, and nationally/regionally listed species assessed using similar criteria.
- Criterion 2 is triggered by habitats of significant importance for endemic or restricted-range species. IFC quantitative definitions (paragraph 80, GN6: IFC 2012b) were used to define restricted-range species. Global extent of occurrence was used to define range

and was determined using IUCN data (IUCN 2013), existing literature, and consultation with specialists.

- Criterion 3 is triggered by migratory and/or congregatory species occurring in the DMU. All migratory or congregatory species were screened to determine if the DMU contained irreplaceable and/or extremely vulnerable habitats used either periodically or consistently. Migratory birds were identified using information from BirdLife International (2013) and other species were identified using information from IUCN listings (IUCN 2013) and other published literature.

Criterion 1-3 were evaluated for the Project. Two species globally listed as endangered are shown as potentially occurring with 10km of the proposed Project. Based on desktop review and field surveys, it was determined that suitable habitat for these species are not present within the Project area. No species globally listed as critically endangered are within 10km of the Project site. There are no endemic species determined to present with the Project area. The Project area is not a habitat known to sustain migratory or congregatory species during any life cycle as defined by IFC Guidance Note 6.

Ecosystem Level:

- Criterion 4 is triggered by ecosystems that are threatened, house unique assemblages of biome-restricted species, or are recognized for high conservation value, including protected areas. Where data permitted, quantitative categories and criteria from Rodriguez et al. (2011) were applied to evaluate ecosystem status.

Criterion 4 was screened utilizing desktop research, stakeholder input, and field survey results. The Project is located in a natural ecosystem that has sustained moderate impacts from grazing and other man-induced influences. Habitats have been degraded as a result of human uses and there is limited ecological value. The Project is not located in an ecosystem that supports threatened species or unique ecosystems.

Landscape Level:

- Criterion 5 applies to landscape-level features that can influence key evolutionary processes. Key landscape features such as unique topography that creates unique habitats and areas important for climate change adaptation were identified using literature review, field surveys, and through consultation with local experts and stakeholders. Criterion 5 also applies at the species level for “distinct species” which include those coined as “Evolutionarily Distinct and Globally Endangered” (EDGE) (GN95 IFC 2012b; Zoological Society of London 2013).

The assessment of Criterion 5 for the Project indicates the area is typical of surrounding areas and does not have a unique influence on key evolutionary processes.

By assessing the Project’s potential impacts on Criterion 1-5, it has been determined that critical habitat is not present within the Project area and a critical habitat assessment is not required.

6.4 Socio-economic

This section presents the baseline characterisation of the Project area’s socio-economic context prior to Project implementation to enable comparison of the current situation with changes anticipated as a result of the Project. The following aspects are discussed in this Chapter:

- Administrative and political organisation and governance
- Population and demographic movement
- Economy, employment, livelihoods and use of natural resources
- Land tenure and land use

- Health
- Education
- Housing conditions
- Site access and transportation
- Water, sanitation and energy
- Tourism and recreation and culture
- Deprivation, vulnerable groups and gender relations
- Ethnicity, languages and religions
- Indigenous peoples, tribal groups and ethnic minorities
- Culture and cultural heritage

The information provided in this baseline reflects the direct AOI and to the extent possible focuses on the community around the Project site, namely: Machang'a, in Mavuria, Mbeere South Sub-County (Embu County), which is separated from the Project site by a dirt road that delineates the boundary of the KenGen land.

Fieldwork was undertaken in April, September and October 2017 to obtain primary data in the Project direct area of influence. This was done through observation of land use as well as key informant stakeholder interviews, questionnaires and FGDs with:

- Community members and leaders of the nearest settlement (Machang'a community)
- NGOs and civil society organisations present in the area
- National government agencies and ministries, including NEMA
- County government officials
- Local elected leaders
- Community members representing the following groups:
  - Women
  - The Youth and Business Group
  - Small business owners
  - Land users including agriculturists, bee keepers, herbalists (medicine men/women) and livestock owners

A comprehensive desktop review of available information was undertaken to further develop the socio-economic baseline, which includes web searches, governmental and non-governmental reports, available aerial imagery and maps of the area.

6.4.1 Administrative and political organisation and governance

Kenya is composed of Counties which have their own decentralised governments with devolved functions of the national government. Each County has its own governor who is directly elected and thereafter becomes the highest elected official in the County. Each County has its own County Assembly with MCAs (Members of the County Assembly) as representatives.

The County administrative units are divided into regional (headed by Regional County Commissioners), County (headed by County Commissioners) and Sub-County (headed by Deputy County Commissioners). The Sub-County is divided into locations (headed by chiefs) which are further subdivided into sub locations (headed by sub chiefs) and lastly to villages (headed by village elders). Considering this administrative organisation, the Project site sits in the Upper Eastern Regional County, Embu County, Mbeere South Sub-County, Mavuria location, Mavuria sub location, Karoki village.

In regard to the political organisation, the Parliament of Kenya consists of a senate (upper house) with senators elected from counties and the national assembly (lower house), which

consists of the members of parliament who are elected from constituencies from the counties. The members of parliament enact legislation for both County and national government. The Counties are divided in constituencies which are further divided in wards. Based on political organisation, the Project sits in Embu County, Mbeere South constituency, Mavuria ward.

6.4.2 Population and demographic movement

The last population census in Kenya was undertaken in 2009. The only data available for 2017 are statistical Projections. As shown in Table 33, the population of Embu County was Projected to be 577,390 (49.3% male and 50,7% female) in 2017.

Table 33: Population by gender by County in 2009 (census) and 2017 (Projections)

County	2009 (Census)			2017 (Projections)		
	Male	Female	Total	Male	Female	Total
Embu	254,303	261,909	516,212	284,441	292,949	577,390

Source: Kenya National Bureau of Statistics

Population density increased from 2009 to 2017 in Embu County. In 2017, the population density for Embu was 204 people per square kilometre, up from 183 in 2009.

According to the Mavuria chief during the site visit in September 2017, the number of households is estimated at 6,411 with 14,468 residents in Machang'a community. Not in the direct affected area but 5Km from the Project site, the second closest settlement is Kivaa community, in Machakos County, where there are 4,000 household with 20,000 residents.

There are three trends of migration in Embu namely rural-urban, rural-rural and out-migration. Rural-urban migration is migration from the rural areas to the urban centres mainly Embu, Runyenjes, Kiritiri, Kianjokoma, Manyatta and Siakago in search of economic opportunities such as miraa (the leaves and twigs of the shrub (Catha edulis), which has the effect of a euphoric stimulant) and sorghum farming.[36] Excessive subdivision of land and lack of land contributes to increased number of urban dwellers.

Rural-rural migration is also evident in the Project area where people are pushed from certain areas by factors such as excessive land subdivision into uneconomical holdings and high land costs. People resettle within the County in areas with large tracts of land at cheaper prices. For instance, people from rural areas in surrounding counties such as Machakos, Tharaka-Nithi and Kirinyaga are migrating into Embu County especially in Mbeere areas where they are mainly involved in miraa and sorghum farming. Recently, people in Embu County have been increasingly migrating out in search of better economic opportunities and tertiary education. There has been an increase in number of persons acquiring passports in the County, which indicates that, in the future, international migration may occur.

6.4.3 Economy, employment, livelihoods and use of natural resources

In Embu County, the main urban centres include Embu, Siakago and Runyenjes which host markets for agricultural farm produce. There are about 33 smaller towns and trading centres which provide a ready market for some of the agricultural produce. The closest urban centre to the Project site is Siakago.

The majority of the population in Embu County derive their livelihood from crop farming and livestock keeping. Livestock farming is gaining popularity with the revival of milk cooperatives and investment by the private sector in milk processing plants. Dairy farming is

[36] Embu County Integrated Development Plan (CIDP) for the Year 2013-2017

concentrated in the Northern parts of the County. In the lower parts of the County, indigenous breeds of cattle, goats, sheep and chicken are reared. Rabbit breeding has also become an attractive venture to the farmers. The main types of livestock kept include zebu cattle, the East African Goat, red Maasai sheep, indigenous chicken, donkeys, dairy cattle, dairy goats, chicken (layers and broilers), pigs and rabbits.

The main types of fish in Embu County include trout, tilapia, mud fish and cat fish which are available mostly in the dam reservoirs. The government through the Economic Stimulus Programme has constructed 200 fish ponds in each of the four constituencies and the fish harvest is usually sold locally.

Beekeeping activities are practised in Mbeere North and Mbeere South constituencies where there are 74,004 beehives while in Manyatta and Runyenjes constituencies, there are 26,972 beehives. Most bee keepers in Mbeere North and Mbeere South areas use traditional methods while most beekeepers in Manyatta and Runyenjes constituencies apply modern methods. According to the Mavuria chief, the number of bee hives is estimated at 700 in the Project site.

In regard to employment, wage earners represent around 50% of the total population in Embu County. Self-employment is relatively low, corresponding to 7.5% in the urban setting and 10.2% in the rural areas. Those in urban areas engage in small businesses as well as retail and wholesale businesses. The jua kali (informal) sector also contributes significantly to self-employment in urban and market centres. In rural areas, the engagement is mainly in cash crop farming including tea, coffee, miraa (khart) and dairy farming. According to Machang'a community members, they have strict divisions of labour, where youth, men, women and young girls have specific roles. It is an indication that the Project will impact on different gender and age sets. The roles identified by community members for specific livelihoods include:

- Fishing: Youth
- Grazing livestock: Old men
- Milking livestock: Women
- Fetching firewood and water: Women and young girls
- Beekeeping: 10% youth and 90% old men
- Herbalist medicine: Old men

In the Project area, children are involved in paid and unpaid work in family businesses and domestic chores and outside their families. Although culturally not seen as child labour, however it is outlawed in Kenya by the Children Act No. 8 of 2001.

In the Project area and surroundings, along the highway B7 which leads to the site, there are a range of kiosks, stalls, small enterprises, commercial activities and institutions.

Natural resources play a large role in contributions to economic development in the Project area as the basis for livelihoods, income generation and household food security. Many households rely on farming, fishing, livestock and cattle grazing. Beehives, miraa farming and sand harvesting (for house construction) are important income sources in the Project area. According to Mavuria sub location and the elders, the Project site has more than 15 species of trees and shrubs of high medicinal value such as *Combretum collinum*, *Osyris abyssinica* and *Terminalia brownii* associated with the treating of typhoid, back bone joints, flu, eye infection, diabetes, stomach disorder and livestock diseases.

6.4.4 Land tenure and land use

According to land title deed number EMBU/MAVURIA/917[37] (Appendix K), the Project site is located in land owned by KenGen.

According to the Mavuria location chief and other elders from Machang'a community, their understanding is that the proposed site was originally owned by the Kiguru clan, a clan within the Mbeere ethnic community. Although the land has not been used as a human settlement area, it has supported human production activities such as grazing, beekeeping and has been a firewood sources. The chief and elders noted that the Seven Forks dam had already been mapped by the colonial masters and missionaries in 1932. The land was in the name of the crown until 1966, when it was set apart for the implementation of a hydroelectric scheme. The land title from the crown to the government was transferred to KenGen to use the land for electricity generation and ancillary use in the interest of the public.

Between the years of 1966-1969, the Minister of Lands and Resettlement declared the Lower Mbeere land as being land under adjudication through a gazette notice. In 1972, every clan in Mbeere was given an opportunity to declare their specific locational land ownership. In 1973, a power construction company (East Africa Power Company) was contracted to construct the Kamburu power station and since then the land has been associated with the Company. Between 1978 and 1981, a land ownership transfer from East Africa Power Company to Tana & Athi Rivers Development Authority (TARDA) was completed and lastly from Kenya Power to KenGen in 1986. At some point the land was being used by the University of Nairobi's College of Agriculture and Veterinary Science for a goat Project. This was understood by the community to be an agreement between KenGen and the university to use the land for the aforementioned research.

During consultation, community members stated they were not compensated and did not receive support to resettle and they feel that KenGen still owes them a debt by virtue of operating on their communal land. However, we were also informed that the community has not legally raised a claim for this land. KenGen confirmed it is not aware of any compensation paid to the community in the past.

In regards to land use, Embu County is characterised by a predominantly rural settlement pattern. The average farm size for small scale farming is 0.8ha. In Mbeere North and Mbeere South constituencies, 10.2% of the poor population have title deeds for their parcels of land while 47.6% of the poor population do not.

The Project site does not appear to have present permanent or temporary buildings. However, local residents use portions of the land for the following activities (starting with the most common):

- As a short cut to the Kamburu Reservoir for fishing
- Livestock grazing
- Community farming
- Fetching water
- Beekeeping
- Collecting herbs for medicinal use
- Gathering firewood
- Gathering wood for charcoal burning
- Sand harvesting for house construction

[37] The title deed from 8 November 2001 states that KenGen is registered as the absolute proprietor of the land.

- Gathering wood for construction poles

The community usually uses the Project site to reach the beach as a short cut. They have created small foot paths through the Project site. KenGen allows the community to use the land. The community stated that they understand the land is owned by KenGen and are grateful for being allowed to use it, but they also expect alternatives and compensation. This is considered further in Chapter 8: Mitigation.

6.4.5 Health

The general hospital in Embu is the main referral hospital in the County. Sub-County hospitals exist at Runyenjes, Xiakago and Ishiara. Health centres, dispensaries and clinics are spread across the County, as are private health institutions and clinics. The County health facilities lack adequate equipment, land for expansion, and often face shortage of health personnel and drug supplies. Due to high poverty levels in the County, the community members are frequently unable to pay for the limited services. The road network serving health facilities especially in the rural areas is very poor. Access to health care is further worsened by inadequate health education and poor feeding habits at the household level.

Data from 2012 shows that Embu County had an infant mortality rate of 44 deaths per 1,000 live births against the national rate of 54 deaths per 1,000 live births in that year. Child mortality was 11.4 deaths/1,000 people while the under-5 years old mortality rate was 49/1000 in Embu County against 79/ 1,000 nationally. Increased immunization and drugs for prevention of mother to child transmission of HIV are available in almost all Government health facilities. Full immunization coverage in the County is now at 98%. The proportion of life delivery at health facility in 2012 stood at 83.1% far above the national performance of 4%. There are low incidences of maternal mortality in the County due to the improvement and construction of new health facilities which reduced the distance to the nearest health facility to 6.8km. This means that more expectant mothers are able to access skilled health personnel.

Embu County has a number of traditional healers who use specific flora species from the Project site to produce medicine for the community. Traditional healers learn from past generations and skills are handed down to the next generation. During the colonial era, when health centres and hospitals were not in existence except in Nairobi and Mombasa, traditional healers took up the void to heal the sick in communities. There a number of herbal facilities in the County. These are run by individual owners at shopping centres around their homes. They form about 10% of the herbalist population. About 80% of the herbalists are running home clinics. Another 10% operate mobile clinics where they carry their products in brief cases. Products from the herbalists include powder forms of ground medicinal roots, barks, and leaves, as well as capsules, soaps and creams.

6.4.6 Education

In 2014, according to the County Statistical Abstract [38] (Table 34), Embu County had a total of 1,346 public and private schools, in which 45% were pre-primary, 41% primary and 14% secondary.

Table 34: Number of pre-primary, primary and secondary schools by County in 2014

County	Pre-primary		Primary		Secondary		Total
	Public	Private	Public	Private	Public	Private	
Embu	390	220	390	160	176	10	1346

Source: County Statistical Abstract

[38] Kenya National Bureau of Statistics (KNBS). Embu County Statistical Abstract and Machakos County Statistical Abstract 2015, Available at <https://www.knbs.or.ke/publications/>.

There are six primary schools and one secondary school in Machang'a and on the other side of the reservoir, but still nearby, there are 24 primary schools and eight secondary schools in Kivaa community, Machakos County.

6.4.7 Housing conditions

As recorded in the most recent demographic survey in Kenya (2009 census report), 121,230 households in Embu County use corrugated iron sheets for roofing, while 4690 households use grass, tin and mud for roofing. 50,114 households use building stones, bricks or blocks while 74,614 households use wood, a combination of mud and wood or a combination of mud and cement for walling. 3,091 households either use tin, grass and reeds and corrugated iron sheets for walling.

The houses in the Project area have no piped water connection. The community pumps water from the reservoir. Some of the poorer households collect water from the reservoir using plastic containers. Donkeys are regularly used to transport water.

Most households have a pit latrine next to the main house in the compound to use as a toilet. Households in urban centres have a toilet and bathroom provided inside the house for family use.

6.4.8 Site access and transportation

The road that leads to the Project site (highway B7) is classified as murram (earthen surface). It is a public road maintained by the County government. Murram roads have to regularly be upgraded especially after rainy seasons. The murram road may pose challenges during the rainy season as it may be impassable especially if using a motorbike (boda boda). The community usually uses the Project site to reach the beach as a short cut. They have therefore created small paths through the Project site.

The road network in the County consists of 914.3km of earthen surface roads, 120km of tarmac roads which includes the Meru-Embu highway and Embu-Kiritiri road, as well as 548km of gravel surface roads. The County also has two airstrips. One airstrip is located at Don Bosco, in Embu town, and is currently being refurbished. It is used mainly for security purposes. The other airstrip is in Kiambere and is mainly used by KenGen and Kenya Wildlife Service.

The major means of transportation for community members comprise private cars, buses, small taxi vans (matatus), bicycles, motorbikes (boda bodas), walking, donkeys and carts. Private cars are used by individual households, government officials, tourists and travellers. Buses and small taxi vans are used by community members who do not own a vehicle. Donkeys and carts are used to ferry water from the reservoir or wares to the market. This is a cheap mode of transport and almost all households own a donkey and a cart. Motorbike riders are used for taxi rides and to carry charcoal, luggage or even to transport a goat to the market. Bicycles are slowly being phased out as people are using boda bodas more since they can carry more than one person.

6.4.9 Water, sanitation and energy

The main sources of drinking water in Embu County include rivers, piped water, wells and boreholes. The County is served by six major rivers: Thuci, Tana, Kii, Rupingazi, Thiba and Ena. All these major rivers originate from Mount Kenya forest. In Manyatta and Runyenjes constituencies, 30% of the population gets water from rivers, 36% from piped water and 21% from dug well. In Mbeere North and Mbeere South constituencies, 40% get water from rivers, 8% from piped water, 24% from dug wells and 11% from boreholes. Machang'a community has minimal or no piped water connection to households. Most households fetch water from the reservoir using donkeys and water carts.

In regards to sanitation, according to the 2009 Population and Housing Census, the majority of the people in Embu County use pit latrines for human waste disposal. In Manyatta and Runyenjes constituencies, 2,935 people used main sewer, 3,676 used septic tanks, 412 used pools, 9,067 used VIP latrines, 63,581 used pit latrines, and 267 used other methods of human waste disposal such as bucket and bush. In Mbeere North and Mbeere South constituencies, 329 persons use main sewer, 400 use septic tanks, 57 use cess pools, 3,173 use VIP latrines, 45,504 used pit latrines, and 2,082 persons used other methods of human waste disposal such as buckets and bush. Of all the urban centres in the County, only Embu has a sewage treatment plant that does not have adequate capacity to serve the whole town.

Masinga Dam is one of the Seven Forks dams which produce hydroelectricity for the National Electricity Grid and it is located within the County. Although Embu County is rich in energy endowment, only 21% of households in Runyenjes and Manyatta constituencies are connected to electricity while a mere 5% in Mbeere North and Mbeere South constituencies are connected to electricity. The main source of energy is firewood (80%). Electricity coverage is more confined to urban areas as compared to rural areas. Many trading centres have not been connected to the national grid although the rural electrification programme is reversing this scenario. Many public institutions such as schools and health facilities are hardly connected to power.

The majority of residents use paraffin as the main source of lighting. The traditional stone fire is the most prevalent cooking appliance used by the County population. Most households within the Project area are not connected to electricity and they use kerosene/gas lamps for lighting and charcoal for cooking. A distribution line crosses the Project site to provide electricity for a few houses in the Machang'a community. It will be rerouted.

During Project consultations, a group of young community members from Machang'a listed what has been their priority areas for KenGen's corporate social responsibility programming:

- Employment for both skilled and no skilled jobs
- Connection of water for community use
- Water pan (Silanga) for livestock
- Electricity connections
- School upgrading or construction
- Construction of dispensaries
- Fish ponds
- Access roads improvement
- Security for the community and for the site
- Recreation facilities for children like playing field
- Bursary for bright children

6.4.10 Tourism and recreation and culture

This region has a limited number of scattered tourist destinations, including for instance the historic caves, waterfalls, rocky hills for rock climbers at Karue hill that towers along Embu-Meru highway, and hydropower dams. Others tourist attractions include the Nthenge Njeru waterfalls near Kirimiri, with caves that are historically significant as they served as the hideouts for Mau freedom fighters, and the Kianjiru hills, a key eco-tourism and cultural

tourism site on a list of shrines, sacred places, hills, and mountains that are culturally revered by the Aembu and Ambeere people[39].

Protected areas as conservation units are also a source of attraction for tourists interested in wildlife. Two national parks (Mwea and Mount Kenya) managed by KWS have great tourism potential. The Project area borders the Mwea National Reserve which is located within the lower parts of Embu County about 200km from Nairobi. The reserve is a major attraction for wild game viewing, boat rides at Kamburu dam, hippo point, rare birds watching and a walking circuit. Thiba River separates the Project area and the reserve. Tourists are also attracted by the rich and diverse cultures in the County such as the drummers (ngutha) dance and other cultural resources including art works, crafts and culinary.

Embu town has many hotels offering a range of accommodation from luxurious to budget bed and breakfast. Some hotels have websites, take reservations online, and have modern conferencing facilities.

6.4.11 Deprivation, vulnerable groups and gender relations

For the purposes of this ESIA, are vulnerable people are identified as groups or individuals that may be directly and differentially or disproportionately affected by the Project because of their disadvantaged or vulnerable status (based on race, colour, sex, language, religion, political or other opinion, national or social origin, property, birth, or other status). Vulnerable or marginalised people are likely to experience impacts in different ways, may not be represented by mainstream groups, or may need to receive information and participation opportunities in unique ways.

Specific attention is often required to ensure women and vulnerable people have their views heard, recorded, and considered in Project planning and implementation. During the consultations for this ESIA, the Project team engaged with women and the youth to support the most complete understanding of the local context, identify the broad range of potential impacts and risks from the Project, and design effective mitigation and compensation measures for the full range of stakeholders.

Community activities most directly affected by the Project and solutions proposed during the youth and the gender focus groups are presented in Table 35.

Table 35: Affected community activities and proposed mitigation

Activity in the Project area	Most affected group	Mitigation measures proposed by the community
Fishing	The youth and men	Create access to permanent river and dam Community to be assisted in constructing individual fish ponds Community to be provided with more fish species Community training and empowerment on modern fish farming techniques
Livestock grazing	Whole community	Modern livestock farming (change from free range system to zero-grazing) Communal water pans at strategic points for livestock Training and sensitization
Farming	Men and women	
Milking	Women	
Fetching water	Women	Construction of communal water points Construction of water dams/Riparian reserve Community to be educated on rain water harvesting and storage KenGen to provide water points for the community

[39] Embu County Government. About Embu County. Available at https://www.embu.go.ke/?page_id=25

Activity in the Project area	Most affected group	Mitigation measures proposed by the community
		Piped clean water to the community
Beekeeping	Old Men 90% and Youth 10%	Sensitization and training on bee keeping Use of modern bee keeping methods Relocation of bee hives or abandon the activity
Herbalist medicine	Old men	Identification and preservation of trees for medicine Provide alternative e.g. dispensary/hospital Uprooting and re-planting trees with medicinal value Research from specialist for conservation and preservation Liaise with University of Nairobi on medicinal value Local experts to identify areas of trees/plants with medicinal values
Firewood extraction	Whole community	Rural electrification programme (drop point to every home)

Source: Focal groups with the youth and women in Machang'a Community

Even though Kenya's economy is growing, benefits are not always equally shared and Kenyan women still remain disadvantaged economically, socially and politically. Traditional ideas about the roles of girls and women hold women back from contributing to important development goals and in in decision-making processes. Spending long hours in rural activities, such as collecting water and firewood, results in poor school attendance and little time for other productive activities that would help to earn money[40]. The fact that more than 75% of Kenyan women live in rural areas increases discrepancies. In addition, Kenyan women work longer hours (12.9 hours) compared with those of men (8.2 hours) and they earn less because more of these hours are not remunerated[41].

Table 36 presents some national gender indicators that will be reflected in the living conditions of women in the direct area of influence.

Table 36: National gender indicators

Gender Equality Element	Gender Indicators
Access	Men control access to most productive assets in Kenya 3% of the land is owned by women Social stipulations prohibit a woman inheriting land in many parts of Kenya Women have less access to credit than men Yields by women farmers would increase by more than 20% if given the same education services and agricultural inputs as men farmers Access to primary and secondary education is largely equal for girls and boys
Knowledge, beliefs and perception	27% of women in Kenya have experienced female genital cutting Widespread ignorance of the gender equality laws 30% of rural women cannot read a simple sentence in their primary language
Practices and participation	47% of rural girls fail to complete primary school 36% of women 15-19 are already mothers or pregnant 17% of births in Kenya are unwanted and 26% were wanted later 27% of rural women have an unmet need for contraceptives 40% of men believe women who use contraceptives may become promiscuous Physical insecurity impacts the participation of women Social constraints for public engagement by women are common

[40] USAID, no date. Gender Equality and Women's Empowerment in Kenya. Available at: https://www.usaid.gov/kenya/gender-equality-and-womens-empowerment-kenya

[41] Cutura, Jozefina; Dione, Nouma T.; Ellis, Amanda Natalie; Gillson, Ian John Douglas; Manuel, Clare; Thongori, Judy Wanjeri. 2007. Gender and economic growth in Kenya: unleashing the power of women. Directions in development; private sector development. Washington, D.C. : World Bank Group. Available at: http://documents.worldbank.org/curated/en/665991468285651926/Gender-and-economic-growth-in-Kenya-unleashing-the-power-of-women

Gender Equality Element	Gender Indicators
Time and space	Workload: Women do 80% of the food production, 50% of cash crop production, 80% of the food storage and transport from farm to the home, 90% of weeding, and 60% of the harvesting and marketing crops The labour demands of reproductive work spatially restrict women (due to childcare responsibilities, many women cannot work far from the home) 19% of rural households spend more than one hour a day fetching drinking water. If it is women and girls who collect water, school attendance may drop
Power and decision making	9.8% of national parliament members are women 42% of women who earn cash income say they mainly decide how to spend it 26% of married women say the husband decides if she can visit her family or relatives 44% of men agree that a husband can beating his wife 45% of ever-married women reported physical or sexual violence by a husband/partner in the past 12 months (2008-2009)

Source: The Nature Conservancy Central Science[42]

During consultations, it was noted that there is gender inequality in the area because women's ability to make economic decision is constrained by the fact that they are not the owners of productive resources like land and livestock, which are often owned by men.

Women in Machang'a community expressed the perception that, so far, they have had very limited opportunities to benefit from jobs from the previous hydropower Project, despite some employment in catering and administrative jobs. They expect to be allowed to transact business during construction and operation, for instance as cooks.

In the public meeting, a disabled community member highlighted that it should be a positive discrimination to disabled people and it is addressed on Volume IV ESMP.

6.4.12 Ethnicity, languages and religions

Mbeere South constituency is home to a number of different ethnic groups. Below are the predominant ethnic groups found in the Project area, according to the County of Embu Government[43].

- Aembu: "The Aembu people, who share key cultural and traditional values with the Kikuyu and Meru, are mainly farmers. Many of them live in the well-watered northern side around Runyenjes, Embu and Manyatta towns. Tea and coffee are the community`s main cash crops. They also grow food crops such as maize, beans, sorghum, cassava, millet, horticultural crops and substantial dairy keeping."
- Mbeere: "Mbeere people are to be found around Siakago, Ishiara, Kanyuambora and Kiritiri towns. They mostly practice small scale farming, beekeeping and livestock rearing. Ishiara market is in particular popular for being the largest goat market in the region. Living on the lower side with relatively low rainfall, Mbeeres grow cash crops such as cotton and food crops such as maize, cow peas, beans, pigeon peas and green grams."
- Kamba: "The Akamba people live in lower parts of Embu County around Makima. While they are natively known for their carving and basketry skills, Kambas also do a lot of subsistence farming, bee keeping and goat rearing in Embu. Some of the crops growing in the area include cowpeas, green grams, sorghum, millet among others."
- Kikuyu: "The Kikuyu people living in Embu County are mainly traders, business people and civil servants working in government corporations and institutions. Apart from being skilful in entrepreneurship, the Kikuyus also like farming and a number of them have bought land and settled in the peripheries of Embu town."

[42] Kenya's National Gender Context and its Implications for Conservation: a Gender Analysis. 2013. The Nature Conservancy Central Science. Available at: https://www.nature.org/science-in-action/leading-with-science/kenya-gender-analysis.pdf

[43] Op. cit. Embu County Government.

According to history, the Aembu and Mbeere people lived as one Embu group and closely related to neighbouring Kamba, Meru, and Kikuyu people when considering the evidence from shared similarities in language and traditional practices. The period around AD 1600 is taken as the time when the Mbeere community became fully differentiated from their cousins, the Embu, the Kikuyu, the Chuka, the Mwimbi and the Meru.

Mbeere, Aembu, Kikuyu and Kamba languages are still well spoken in the proposed Project area. Other languages spoken in the region are Kikamba, Kijaluo, Kiembu, Kiswahili and English.

According to field assessment and consultations held with the Mavuria location chief, the majority of people living in Machang'a are Christians. There are numerous churches and ministries, with mainstream churches such Anglican Church of Kenya (A.C.K), Roman Catholic and Presbyterian Church of East Africa (P.C.E.A) having the largest following. Evangelicals in the area include Deliverance, Pentecostal Evangelistic Fellowship of Africa (P.E.F.A.) and Full Gospel Churches among others. There is also very small minority of Muslims living in Dallas estate in Embu town. Traditional religion plays an important part in the social lives of the Aembu people and other migrant groups in regard to the use of traditional medicine from tree species, weddings, prayer, christening of children and boys joining the mature adult group. There are no existing or new religious structures being built within 300m of the Project site.

6.4.13 Indigenous peoples, tribal groups and ethnic minorities

Tribal groups and ethnic minorities may be described as Indigenous Peoples (IPs). Indigenous peoples are defined by IFC PS 7 as a distinct social and cultural group possessing the following characteristics in varying degrees:

- Self-identification as members of a distinct indigenous social and cultural group and recognition of this identity by others
- Collective attachment to geographically distinct habitats, ancestral territories, or areas of seasonal use or occupation, as well as to the natural resources in these areas
- Customary cultural, economic, social, or political institutions that are distinct or separate from those of the mainstream society or culture
- A distinct language or dialect, often different from the official language or languages of the country or region in which they reside

The ethnic groups referred in subsection 6.4.11 above (Aembu, Mbeere, Kamba and Kikuyu) do not meet these criteria and there are no declared[44] indigenous peoples in the Project AOI. In Kenya, the peoples who identify with the indigenous movement are mainly pastoralists and hunter-gatherers, as well as some fisher peoples and small farming communities. They live in other counties and will not be affected by the Project. Pastoralists include the Turkana, Rendille, Borana, Maasai, Samburu, Ilchamus, Somali, Gabra, Pokot, Endorois and others and mostly occupy the arid and semi-arid lands of northern Kenya and towards the border between Kenya and Tanzania in the south. Hunter-gatherers include the Ogiek, Sengwer, Yiaku, Waata and Aweer (Boni)[45].

There is no specific national legislation on indigenous peoples in Kenya and the country has yet to adopt the UN Declaration on the Rights of Indigenous Peoples (UNDRIP) and ratify International Labour Organization Convention 169.

[44] The Indigenous World 2017. The International Work Group for Indigenous Affairs (IWGIA), 2017. Available at: https://www.iwgia.org/images/documents/indigenous-world/indigenous-world-2017.pdf

[45] Ibid

6.4.14 Culture and cultural heritage

The nearest site with international designation is Mount Kenya National Park / Natural Forest and UNESCO World heritage site. This is located more than 25 km to the outer boundary of the site. There are no known linkages (ecological or cultural) with the area.

The documents reviewed about cultural matters, including the County Integrated Development Plan[46], and the stakeholders consulted (Mavuria location chief and elders) indicate that the proposed Project site is not being used as a shrine, or for rituals, circumcisions, marriage, burial sites or any form of cultural heritage and archaeological resources. During the consultation, it was noted that shrines (which are known as Kithama in Mbeere language) are owned by clans and no clan has a shrine on the proposed Project site. Two shrines were found to be located near the Project site (see Table 37).

Table 37: Two shrines located near the Project site

Name	Point X	Point Y	Closest distance to the Project Site
Kithama kia Kamurugu	356036.1129	9910244.297	4,936 meters
Kithama kia Kabobua	350065.1104	9914036.746	1,679 meters

Source: Cultural Heritage baseline field work

From the discussions with community members about the historical and current land uses, it is clear that the site has played an important role on the livelihoods of the host community (the Mbeere people) and other communities living in the area, despite being not inhabited by anyone in recent times. The local community understands their culture and heritage. The historical narratives of land ownership and chronology of events over time and popularity of the site for herbal and traditional medicine is a clear testimony to this. In addition, they associate places with different good or bad spirits. An example of this are the shrines in Kithama kia Kyabubua associated with rains and cultural dances and Kithama kia Kamurugu being associated with evil spirits. The association of good and bad spirits helps protect natural heritage sacred places.

Natural heritage seems to be more valued than the cultural heritage. This is supported by the sound mitigation measures the community proposed during consultations for protection of the trees with medicinal values. This respect for natural heritage is in opposition to neighbouring communities where sacred trees associated with shrines are being cut down. This may be attributed to the influence of attainment of formal education and the role and influence of modern religion.

A full Cultural Heritage Resources Scoping Report is presented on Volume III.

6.5 Other development activities in the Project area

In November 2015, the Malindi Solar Group Limited submitted an EIA to NEMA for a 40MW solar energy plant at Weru Group Ranch No. 19, Lango Baya Area in Malindi, Kilifi County, which is approximately 125km northeast of Mombasa and 40km west of the centre of Malindi Town.[47] This is more than 500 miles from the Project site.

There are two known energy infrastructure Projects planned for Embu County:

- Kleen Energy, in collaboration with several partners, plans to install a 6.8MW hydropower plant along the Rupingazi River in the Njukiri Forest in Embu County by the

[46] Embu County Integrated Development Plan (CIDP) for the Year 2013-2017.

[47] Moses, F and Ng'eny, KB. 2015. Environmental Impact Assessment Study Report for the Proposed Malindi Solar Power Plant (40MW) Project in Weru Group Ranch No. 19 in Lango Baya Location, Malindi District in Kilifi County. Available at https://www.nema.go.ke/images/Docs/EIA-1240-1249/EIA-1244_%20Malindi%20solar%20power%20study%20report.pdf

beginning of 2019. The Project plans include a 25-year agreement with KWS and a 20-year power purchase agreement with Kenya Power Company.[48]

- In April 2017, KenGen suspended construction on a 400MW wind power Project in Meru County, north of Embu County. The Project was planned to be located on a 7,500ha site in the Tigania East Sub-County. The Project was estimated to be completed by December 2017 but has been delayed by ongoing land discussions.[49]

We are also aware that Embu County has conceptual plans to develop an industrial hub in Embu County around the Mberee south sub-County. Currently no solid plans are in place for this Project.

[48] Wanyoro, C. 2017. Embu Gets its Fifth Hydropower Plant of 6.8 Megawatts. Business Daily Africa. Available at http://www.businessdailyafrica.com/news/Embu-gets-its-fifth-hydro-power-plant-of-6-8-megawatts-/539546-3929690-x24d04z/index.html

[49] Aboo, A. 2017. KenGen Suspends Construction of Sh6.9bn Power Project in Meru. Daily Nation. http://www.nation.co.ke/counties/meru/KenGen-suspends-Sh69bn-power-Project-in-Meru/1183302-3878742-p55ntl/index.html

7 Impact Assessment

7.1 Overview

This Chapter provides the environmental and social assessment of the potential impacts resulting from the Project activities including: i) construction (including site establishment and PV installation) ii) operation, and iii) decommissioning.

The assessment considers the extent, duration and magnitude of impacts, against the sensitivity of the number of people or size of resource affected by the predicted changes as described in the baseline section.

The appropriate mitigation, compensation and enhancement measures that will be implemented as part of the Project are presented in Chapter 8 along with final residual significance (post application of mitigation).

7.2 Socio-economic

7.2.1 Introduction

This section predicts social impacts expected to occur because of the Project and assesses the beneficial and adverse effects by predicting their significance prior to mitigation.

7.2.2 Impact identification

Impacts have been considered and assessed for the site establishment and construction, installation, operations, and where relevant decommissioning phases as listed below and discussed in subsequent sections:

Construction

- Employment generation (direct and indirect)
- Occupational health and safety risks and labour rights
- Project induced in-migration
- Public health, community safety and security risks
- Archaeological and cultural heritage impacts

Operation

- Land use change and economic displacement
- More stable and diversified electricity network / clean energy generation / reduction in national GHG emissions

7.2.3 Sensitivity and magnitude

The significance of the social impacts has been determined through consideration of the level of vulnerability (sensitivity) of Project affected individuals, households, communities and other social groups (social receptors), and the magnitude of the impact experienced by them. Significance attribution uses the matrix presented in section 4.5.3. Criteria for determining the sensitivity of social receptors and the magnitude of social impacts are described below.

The sensitivity of social receptors has been determined through consideration of their vulnerability to social impacts. Sensitivity considers receptors' capacity to cope with impacts that affect their access to or control over additional or alternative social resources of a similar nature, ultimately affecting their wellbeing. Sensitive or vulnerable people are generally considered to have less means to absorb adverse changes or shocks than less-

sensitive or less-vulnerable receptors. Similarly, they may be less able to maximise and build on beneficial changes to their resource bases.

When considering sensitivity to social effects, the response to resource change takes into account the type of receptor. For example, a community's vulnerability is generally measured in terms of its resilience to loss of community facilities, whereas an individual's or household's vulnerability considers their resilience to deprivation and loss of livelihood, assets or opportunities (such as jobs, productive land or natural resources). Impacts that increase impoverishment risks contribute to vulnerability. Impoverishment risks include landlessness, joblessness, homelessness, marginalisation, increased morbidity and mortality, food insecurity, loss of access to common property resources and social disarticulation. Table 38 below presents the guideline criteria that have been used to categorise sensitivity of receptors.

Table 38: Social receptor sensitivity criteria

Sensitivity	Definition
High	An already vulnerable social receptor with very little capacity and means to absorb proposed changes or with very little access to alternative similar sites or services.
Medium	An already vulnerable social receptor with limited capacity and means to absorb proposed changes or with little access to alternative similar sites or services.
Low	A non-vulnerable social receptor with some capacity and means to absorb proposed changes and with some access to alternative similar sites or services.
Negligible	A non-vulnerable social receptor with plentiful capacity and means to absorb proposed changes and with good access to alternative similar sites or services.

The magnitude of the social impacts has been determined by consideration of the extent to which social receptors gain or lose access to or control over socio-economic resources, resulting in a beneficial or adverse effect on their individual and collective wellbeing. Wellbeing is considered as the financial, physical and emotional conditions and quality of life of people and communities. For beneficial impacts, the extent to which local wellbeing can be enhanced is considered. This is in accordance with the international movement in social impact assessment (SIA) practice towards an increased focus on enhancing long-term development benefits for local communities' sustainability, as opposed to only considering mitigation of adverse impacts. As such, the magnitude criteria include consideration of the extent to which benefits are shared with and or realised by local people and communities.

The assessment of magnitude has been undertaken in three steps. Firstly, the impacts have been identified. Then the nature of the impact has been considered as to whether it is beneficial or adverse, direct or indirect, transboundary or cumulative, or a combination of any of the above. Finally, the magnitude of impacts has been categorised as major, moderate, minor or negligible, based on consideration of parameters including likelihood, duration, number of people or groups affected, and spatial extent along with professional judgement as presented in Table 39 below.

Table 39: Magnitude criteria

Categorisation	Definition
Major	A highly likely impact that would have implications beyond the Project life affecting the wellbeing of many people across a broad cross-section of the population and affecting various elements of the local communities', or workers', resilience.
Moderate	A likely impact that continues over a number of years throughout the Project life and affects the wellbeing of specific groups of people and affecting specific elements of the local communities', or workers', resilience.
Minor	A potential impact that occurs periodically or over the short term throughout the life of the Project affecting the wellbeing of a small number of people and with little effect on the local communities', or workers', resilience.
Negligible	A potential impact that is very short lived so that the socio-economic baseline remains largely consistent and there is no detectable effect on the wellbeing of people or the local communities', or workers', resilience.

Unlike other topics within the ESIA, the potential health and safety impacts will not be assigned formal magnitude and sensitivity ratings and significance of predicted effects will not be identified. Individuals respond to impacts on their health in different ways, influenced by a range of health determinants which includes their genetics, lifestyle, environment, and many others. Therefore, it is common to consider changes associated with the Project as changes to health risks. These health risks can be ranked in terms of their importance, considering the likely scale of change and the population groups which experience the change. Mitigation and enhancement measures are identified to minimise risks and optimise beneficial opportunities created by the Project.

7.2.4 Employment generation

The construction and operation of the Project will create some employment opportunities. Estimated jobs are described in section 2.4.1.2. The Project will aim to capture workers locally to maximise this potential positive impact for the local area. However, the directly affected area (Machang'a community) is not expected to fulfil all jobs due to the limited education levels and technical skills. Consequently, it is expected to be challenging to find the required technical skills and unskilled employees locally. Therefore, the recruiting process will also include Machakos County. Most of the technical skills needed should be available nationally. Some highly skilled roles are likely to be filled by the EPC contractor but may be recruited nationally or internationally. It will be necessary to put in place measure to maximise local recruitment potential and to prepare the local people to take advantage of these opportunities.

Benefits will occur mainly during construction. Short-term employment generation in the construction phase may provide secondary socio-economic development benefits resulting from the injection of money into communities, such as increasing local business activities and increasing people's ability to pay for health care and education. It has the potential to contribute to a reduction in local poverty levels, especially if vulnerable local people are employed, particularly youths and women, as they are currently suffering from the greatest percentage of unemployment as outlined in the baseline, but also disabled people. Although the jobs created by the Project will be temporary, the skills and experience gained would benefit future job prospects.

The sensitivity of the affected population is considered to be medium as unemployment and subsistence living are common in the local area. The magnitude of the impact is considered to be minor as the number of jobs to be created is low when compared to typical large-scale infrastructure Projects and most of the workers will not be able to be sourced locally. Work is temporary, plus there is a low ability to take advantage of opportunities based on the current skill set. Together, the medium sensitivity of the workers with minor magnitude, means that construction employment is a minor positive impact and it requires further support to become a major or substantial change.

7.2.5 Occupational health and safety risks and labour rights

The main activities involved in site establishment and installation pose potential risks to the health, safety and security and therefore well-being of construction workers if not managed appropriately. There are potentially OHS risks related to personal accident or injury on any construction site. If working conditions and labour relations are not carefully managed and monitored, in particular overtime use, the OHS risks increase. Some of the OHS risks which are likely to arise during the exploration phase of the Project are typical to many construction sites, include:

- Exposure to physical hazards from use of heavy equipment
- Trip and fall hazards
- Exposure to dust, noise and vibrations

- Falling objects
- Exposure to hazardous materials
- Exposure to electrical hazards from the use of tools and machinery
- Exposure to extreme heat during summer
- Exposure to wild and poisoned animals

Local workers may be more susceptible and require very specific instructions. For example, workers may have never worn personal protective equipment (PPE) before and may need training in its use.

During construction, non-local workers will be accommodated within existing accommodation facilities in the area or the KenGen accommodation at Matendeni. Health and safety issues associated with the use of this accommodation include those relating to sanitation, disease, fire, cultural alienation, sleeping space, quality and quantity of food, personal safety and security, temperature control and recreation, amongst others should be verified at the time of construction, but for this assessment it is assumed to be in line with IFC PS2 as will be required in Project contracts. No temporary worker accommodation is envisaged.

Whilst workers on the Project are vulnerable to risks to their health safety and wellbeing on a daily basis, the Kenyan regulatory standards provide some protection. Workers employed by subcontractors are particularly vulnerable as their rights and relevant safeguards measures for them are often overlooked as they are not directly employed by the Sponsor. Appropriate planning and execution of health and safety management planning, workforce management measures and accommodation management in line with the IFC PS2 and IFC EHS Guidelines will be undertaken by KenGen to reduce the risks as far as possible.

While the sensitivity of skilled workers is considered low (and therefore not assessed further), for local, non-skilled and low skilled subcontractors' workers the sensitivity is considered high. The magnitude is considered moderate because it will last during the Project construction and operation but will not have implications beyond the Project life and its spatial extent is within the site and effects only workers related to the Project.

Combining high sensitivity with moderate magnitude, OHS risks and labour rights is considered to be major adverse and therefore a significant impact that requires specific consideration for mitigation.

7.2.6 Project induced in-migration

Some infrastructure schemes create Project induced in-migration. The rate and magnitude of in-migration is determined by Project characteristics. See Table 40 for the Project's likely potential for creating influx.

Table 40: Key factors leading to high rates of influx

Factor	Factor affecting magnitude of impacts from in-migration	This Project
Scale of Project (Project construction and operation, labour goods and services requirements)	Larger Projects attract more migrants. Larger Projects lead to a greater impact of in-migration; small Projects lead to a lesser impact of in-migration	Small: This Project has a 14-month construction period and a relatively small potential construction workforce of 35 – 50 people on average, as such it is considered unlikely to attract large number of migrants.
Area capacity to meet Project needs/population density of Project area	Low capacity leads to a greater impact of in-migration; high capacity leads to a lesser impact of in-migration	Medium: Even though Embu centre is not far (less than a one-hour drive), it has limited economic activity/diversity of economic alternatives. Local people will be unable to meet Project demand of medium skilled labour and services.

Factor	Factor affecting magnitude of impacts from in-migration	This Project
		But the Project will provide the accommodation and amenities required by the relatively small number who will come from other parts of the country or internationally.
Tendency towards concentration	High concentration leads to a greater impact; low concentration leads to a lesser impact of in-migration	Low: Population density in the direct AOI is low.
Opportunities for compensation and benefits speculation	Many opportunities lead to a greater impact of in-migration; few opportunities lead to a lesser impact of in-migration	High: This community has high expectations. Machang'a community members have a high expectation of the benefits that may be incurred by the community development plan which targets existing local needs. Also, there is an opportunity for affected people to use existing CSR programmes in order to receive benefits in the wider area of influence.
Proximity to large population centres	Projects far from urban centres lead to a greater impact of in-migration; Projects close to urban centres lead to a lesser impact of in-migration	Low: The Project site is easily accessible to the Embu and Kiritiri centres

Source: Factors are from IFC's Handbook for Addressing Project-Induced In-Migration (2009), analysis by Mott MacDonald

Overall, the Project may attract some opportunistic economic migrants during the construction phase, but this is not thought to result in significant population influx. Therefore, the magnitude is considered minor. Based on high sensitivity of the neighbouring communities in the direct and indirect area of influence and minor magnitude, Project induced in-migration is considered an impact of moderate adverse impact and therefore significant, which requires specific consideration for mitigation.

7.2.7 Public health, community safety, and security risks

Typically, there is potential for disease and or community tensions to be introduced by any non-local workforce. The Project will create a small potential risk for the occurrence of accidents and transmission of disease among community members due to the influx of workers and followers, including potential exposure to health risks such as HIV/AIDS and other sexually transmitted infections.

These risks and associated hazards require management measures. During site establishment and installation, if not managed, the following activities could cause disturbance or impact the health, safety and security of neighbouring villages and local community members:

- Project truck and vehicle movements will increase existing traffic volumes
- Nuisance impacts from increased noise and dust related to exploration activities
- Risks to the health and safety of local community members trying to gain access to the site
- Construction site storage of hazardous materials
- Anti-social behaviour (behaviour nor customarily accepted in society) which can be instigated by increase in wages. For instance, substance abuse that causes accidents and injuries are prostitution, domestic violence, teenage pregnancy and others
- Harm caused through use of inadequately trained security personnel (the Project's existence will create a small security presence)
- Community unrest as a result of unfulfilled expectations surrounding Project benefits (such as employment opportunities and CSR activities)

KenGen will ensure that sufficient security guards, fencing and signage is present in order to discourage people from purposely or accidently entering the site. Hazardous materials will be adequately stored on site with appropriate signage in order to mitigate the potential risks to local communities.

People to be affected by health, safety and security risks are a highly sensitive social receptor due to their very little capacity and means to absorb changes and with very little mobility to access public health services. The magnitude is considered minor due to the measures the Project will incorporate into Project contracts (via the Project SEP - Volume IV and ESMP - Volume IV) to minimise risks to the community and because most of the effects will be felt temporarily (during the construction phase). During operation, the risks will be mostly eliminated. In addition, its spatial extent is within the site and directly affecting only Machang'a community and is reversible without significant intervention.

Combining high sensitivity with minor magnitude, community health and safety is considered to be a moderate adverse impact in particular with regard to security, traffic management (see also section 7.8) and fugitive dust emissions (7.5.4).

7.2.8 Archaeological and cultural heritage

This section assesses the cultural heritage impacts and assesses the beneficial and adverse effects by predicting their significance prior to mitigation. Cultural heritage, both of intangible and tangible resources, may be threatened by construction phase work.

Ground work, undertaken at the construction phase, provision of services, below ground site civil works connected with the foundations (2m) for the racking system has the potential to damage or remove in-situ cultural heritage remains. The same work phase has the potential to affect the landscape (or setting) within which the Project will be located which can lead to adverse impacts on the setting. Further impacts can be created by removing important associations through the changing of visual reference points and the removal of important associated remains.

The following cultural and natural heritage items have been considered and assessed through consideration of value, status and importance (to derive sensitivity):

- Above ground sensitive features / cultural sites (e.g. including burial sites, religious sites, circumcision sites, sacrificial sites)
- Potential for survival of archeologically artefacts or resources
- National or international designated features of cultural significance e.g. monuments
- Intangible cultural heritage (e.g. oral traditions, cultural landscape, customs, and customary laws, leadership structure, indigenous value, language)
- Natural heritage (e.g. medicinal plants)

Construction activities could lead to the following effects on the one or more of the above cultural resource:

- Total or partial loss/damage of known and unknown or undefined tangible heritage assets through construction-related excavation
- Temporary alteration and/or visual intrusion into the historic setting/character of a designated site or undesignated site of national significance
- Temporary effects on the access to, and amenity of, designated sites or undesignated sites of national significance
- Opportunity to investigate and record archaeological remains and areas of historic interest within proximity to the development.

No above ground features of importance or cultural sites were noted in the direct AOI. The site is not noted as a place that represents or indicates a historical event or occurrence nor is it considered to contribute to our understanding of the history of the local or national

interest. The consultation and data collection did not indicate that any cultural or social events take place in the AOI and the site is not noted as having any aesthetic appeal to the local or national stakeholders and communities that we consulted with. Therefore, a low sensitivity is considered appropriate for cultural heritage impacts, with minor magnitude and minor significance and therefore not significant.

The area is subject to limited formal archaeological investigation. The baseline information collated indicates an unknown probability for archaeological artefacts. Information during the site visit does not indicate that this landscape represents a particular cultural landscape. Adopting a conservative approach, we consider the sensitivity of archaeological impacts to the receiving environment to be medium, with the impact moderate and therefore moderate significance and therefore significant.

No sites of national or international designated features of cultural significance are identified in the Project direct or indirect AOI and therefore we consider the sensitivity to be negligible, the impact magnitude to be negligible and therefore insignificant.

The Project area has not been used as a human settlement area, but it supports human settlement related activities such as grazing, bee-keeping, fetching firewood and as an access route to the river for fishing among other things. The site has been used by locals for livelihoods rather than for cultural functions (and impact on livelihoods is addressed in section 7.2.9). No reviewed document on cultural matters including the County Integrated Development Plan identifies or rates the proposed Project site with any form of cultural heritage. The site has been used in the past by the University of Nairobi for livestock research although this is no longer ongoing. Through our discussions with local members we understand the site was originally associated with the Kavuri clan of Mbeere ethnic community and although it has been registered to KenGen since 2001 local elders still reflect on an historical linkage to the site and the wider area although the site has been recognized as KenGen property for some time and there has been no encroachment except for some informal land use activities performed with the permission of KenGen. For this historical linkage, we note a medium sensitivity to a change in the land use at the site, moderate impact and moderate sensitivity.

The wider area (including Mbeere, Embu and Kikuyu) is very rich in oral traditions and local customs and languages are well maintained even though they are under threat from modern religions and formal education, We consider the ability of the community to maintain oral traditions, traditional customs, leadership or language traditions to be possible with the Project and therefore the sensitivity of intangible cultural heritage is low, the magnitude of impact to be low and significance negligible.

In regards to the use of herbal medicine products found from trees/plant species within the site, the overall sensitivity of this aspect is medium as there are medicinal trees that the community will still have access to in close proximity (around the site boundaries). Given that there is complete removal of vegetation including medicinal trees from the site (except the buffer zone), the magnitude of the impact is major as all trees in the Project area will be removed giving an overall impact significance of major adverse and therefore significant.

It is necessary to address the mitigation / compensation of this impact in line with section 10(2) of the National Museums and Heritage Act; which states that:

- *'Any existing trees, shrubs, plants and flowers shall be replaced with the species selected with regard to the preservation of the original character of the protected area.'*
- *66 (d) Minister may prescribe conditions for the protection, preservation, alteration and access to and use of areas of natural heritage.*

Once the site is operational additional impacts on tangible cultural heritage are not envisaged, however, effects from the operational phase of the scheme may arise as a result of the adverse or beneficial impacts based on the special historic interest in its setting,

character or appearance e.g. keeping herds of livestock and use of traditional herbal medicine and historical linkages.

Decommissioning of the Project will have no impact upon the cultural heritage resource because the activities associated with decommissioning will be confined to areas previously impacted during the site establishment phase of the Project or result in a return of the landscape to its original state.

7.2.9 Land use change and economic displacement

The Project components/infrastructure will extend over an area approximately 80 to 100ha on undisputed land owned by KenGen. Permanent or temporary buildings do not appear to exist in the Project site and no additional land take over and above that which is already assigned to KenGen is required. There has been no physical encroachment into the KenGen area and no physical displacement is expected. A limited negative impact will be due due to loss of access to land on which the project is located given that Machang'a community members informally use portions of the Project site as a short cut to the Kamburu Reservoir for fishing and for rural activities with the knowledge of KenGen. This loss of access to the land could lead to reduced income sources and means of livelihood. However the community will still be able to use KenGen land adjacent to the project site and will still be able to access to Kamburu reservoir.

The Project will impact on different gender and age sets. The activities developed by members of this community for specific livelihoods and division of roles include:

- Fishing: Youth
- Grazing livestock: Old men
- Milking livestock: Women
- Fetching firewood and water: Women and young girls
- Beekeeping: 10% youth and 90% old men
- Herbalist medicine: Old men

KenGen and its contractors will be responsible for identification and replacement of herbal medicine trees and bee hives and the creation of a footpath around the Project site that people will be able to use to maintain access the Kamburu Reservoir. These actions are included in the ESMP and will form part of the embedded mitigation for the contractor to implement to minimise impacts on livelihoods.

The number of bee hives is estimated at 700 in the Project site. The number of families that use the land for this and the other activities and will be affected is unknown. But the number of households in Machang'a community is estimated at 6,411 with 14,468 residents and it is understood that almost all families are dependent on subsistence livelihoods. Due to the large amount of land available and access to water (during the wet season), it is expected that a large parcel of the community uses KenGen`s land.

People to be affected by land use change and economic displacement are a highly sensitive social receptors due to their dependency on subsistence livelihoods developed on KenGen`s land. The magnitude is considered moderate because it is a fundamental change to collective wellbeing and the loss will be in a long term but will not have implications beyond the Project life, its spatial extent is within the site and affecting only Machang'a community and is reversible without significant intervention.

Combining high sensitivity with moderate magnitude, land use change and economic displacement is considered to be a major adverse impact and significant.

7.2.10 More stable and diversified electricity network / clean energy

The Kenyan Government's generation expansion plan (Kenya Vision 2030) calls for an additional 23,000 MW of power generation capacity by 2030. This target takes into account current under capacity, economic growth potential. Renewable energy generation can help meet Kenya 2030's goals with a more diverse, sustainable, and robust energy matrix. During operation, electricity would be generated and transmitted to the Kenya National Transmission System (KNTS).

At the local level, the Project will transmit electricity past communities in areas where electrification is valued however there will be no direct electrification benefits associated with the Project. The magnitude of the beneficial impact for local communities from electricity generation will be negligible resulting in an insignificant beneficial impact. The Project will be required to put in place enhancement Projects to drive this benefit at the local level to moderate or major beneficial impact.

7.2.11 Summary of significance

Table 41 summarizes the findings of the impact assessment pre-mitigation. Chapter 9 elaborates on how significant impacts may be enhanced, eliminated, reduced, offset, managed or mitigated to acceptable levels. Anything moderate, major or substantial is considered a significant negative impact requiring mitigation. Anything with an insignificant or minor benefit should be reviewed to see if they may be enhanced though further action to drive a greater positive benefit.

Table 41: Summary of impacts – Socio-economic and Archaeology and cultural heritage

Potential impact	Adverse /Beneficial	Sensitivity	Magnitude	Impact evaluation (pre-mitigation / enhancement)
Socio-economic				
Construction				
Employment generation (direct and indirect)	Beneficial	Medium	Minor	Minor beneficial
Occupational health and safety and labour rights (unskilled / low skilled workers)	Adverse	High	Moderate	Major adverse
Occupational health and safety and labour rights (skilled workers)	Adverse	Low	Moderate	Minor adverse
Project induced migration	Adverse	High	Minor	Moderate adverse
Community health, safety and security (traffic, nuisance, material storage, antisocial behaviour, public health)	Adverse	High	Minor	Moderate adverse
Land use change and economic displacement	Adverse	High	Moderate	Major adverse
Archaeology and cultural heritage				
Above ground features	Adverse	Low	Minor	Minor adverse

Potential impact	Adverse /Beneficial	Sensitivity	Magnitude	Impact evaluation (pre-mitigation / enhancement)
Unknown artefacts	Adverse	Medium	Moderate	Moderate adverse
Designated sites	Adverse	Negligible	Negligible	Insignificant
Cultural land use (recognition of historical linkage)	Adverse	Medium	Moderate	Moderate adverse
Oral traditions	Adverse	Low	Minor	Minor adverse
Medicinal value trees	Adverse	Medium	Major	Major adverse
Operation				
Employment generation (direct and indirect)	Beneficial	Medium	Minor	Minor beneficial
Electricity diversification and clean energy – National level	Beneficial	Medium	Moderate	Moderate beneficial
Electricity diversification and clean energy – local level	Beneficial	Low	Negligible	Insignificant

7.3 Biodiversity

7.3.1 Introduction

This section presents the identification and assessment of the following potential beneficial and adverse biodiversity impacts of the Project.

7.3.2 Impact identification

We have addressed Projects impacts separately for each activity construction (site establishment, installation), operation, and decommissioning and for each key receptor. This section provides an overview of the impacts that will arise during each activity.

7.3.2.1 Construction (including site establishment, installation)

During site establishment, vegetation will be cleared, areas filled or excavated as needed, the terrain graded, and access roads established resulting in potential for:

- Terrestrial habitat and flora loss and degradation (permanent and temporary)
- Accidental introduction and dispersal of invasive species
- Disturbance to terrestrial animal species (e.g. noise, artificial light)
- Injury or death of terrestrial animals
- Habitat fragmentation

During installation, materials and equipment will be brought to the site and installation of all Project components will be completed. This will include solar panel installation, fence installation, road improvements, and installation of the switching station structure and impacts will be as above including an increase in road kills and injuries of wildlife (installation).

7.3.2.2 Operation and maintenance

- Disturbance to terrestrial animal species (e.g. glint and glare)
- Accidental introduction and dispersal of invasive species

7.3.2.3 Decommissioning

- Increase in road kills and injuries of wildlife
- Accidental introduction and dispersal of invasive species
- Disturbance to terrestrial animal species (e.g. noise, artificial light, vibration)
- Injury or death of terrestrial animals

7.3.3 Sensitivity and magnitude

The magnitude of the potential impacts upon each ecological feature is assessed for the Project. Criteria for determining the magnitude of impact are outlined in section 4.5. In accordance with IFC PS6, the conservation importance (sensitivity) of each ecological feature which occurs within the Project AOI needs to be assessed and this is defined in Table 42.

In order to categorize the sensitivity on the basis of biodiversity-specific criteria typically adopted for the assessment of ecological impacts, the sensitivity ranking presented in Table 42 slightly differs from the evaluation matrix presented above by including the conservation importance category “Very High”. A “High” or “Very High” sensitivity (conservation importance) is however equivalent to the general category “High” for receptor sensitivity in the impact evaluation matrix in section 4.5.

Significance of impacts has been determined by the interaction between the magnitude of impacts and the sensitivity of receptors affected, as depicted in the impact evaluation matrix shown in section 4.5.3.

Table 42: Criteria for determining receptor sensitivity (conservation importance)

Conservation importance (sensitivity)	Detail	Species criteria	Habitat or site criteria
Very high	*Very high importance and rarity. International scale with limited potential for substitution.*	*IUCN Critically Endangered and Endangered species.*	*Internationally designated sites (or equal status). Habitats of significant international ecological importance.*
High	High importance and rarity, national scale, or regional scale with limited potential for substitution, species of international status but not within designated areas.	IUCN Vulnerable species. Nationally threatened/protected species of significant population size and importance.	Nationally designated sites (or equal status). Areas of habitats of national ecological importance and natural habitats of significant ecological importance and/or high biodiversity with limited potential for substitution.
Medium	High or medium importance and rarity, local or regional scale and limited potential for substitution, species of national status but not within designated areas.	Nationally threatened/ protected species or rare species, but not a significant population size and not of national importance.	Regionally important natural habitats. Natural habitats. Modified habitats with high biodiversity or under significant threat of loss within the region.
Low	Very low or low importance and rarity and local scale.	IUCN Near Threatened /Least Concern. Species of local national importance.	Undesignated sites and habitats of natural habitats of some local biodiversity and cultural heritage interest. Modified habitats with limited ecological value. Other sites with little or no local biodiversity and cultural interest. Modified habitats with limited biodiversity value.
Negligible	Very limited ecological importance.	IUCN Least Concern species. Species of no national importance.	Highly modified habitats of no biodiversity value.

7.3.4 Construction

7.3.4.1 Impact to protected areas

No direct impacts from site establishment will be incurred to protected areas as a result of the Project. The Project is located approximately 2km north of Mwea National Reserve but is with a 10km buffer zone and therefore is considered to have a high sensitivity to the Project. The magnitude of impacts on Mwea National Reserve are considered to be negligible due to the distance from the Project. The resulting impact is therefore **minor adverse**.

7.3.4.2 Disturbance, degradation and destruction of habitats and flora

Table 26 lists hectares of impact by habitat type as a result of the Project. Approximately 76.4 hectares of woodland will be permanently impacted during site establishment. Due to the nature of solar panel construction, the majority of the woodland habitat will be permanently converted to herbaceous vegetation. The alteration of habitats may affect plant pollination and seed dispersal patterns, and reduction of the vegetative cover in the area may result in the displacement of wildlife species. Introduction or spread of non-native and invasive species is also a risk during site establishment due to the movement of vehicles through the Project area.

The conservation importance of this habitat type is considered to be low except for the loss of medicinal trees which is addressed separately in section 6.4.14. For other habitat, since the area of disturbance is relatively small. An altered habitat will still be present in the immediate environment. The neighbouring habitats are of similar or better quality, and it is considered will be able to compensate for the loss of the habitat within the Project site. The magnitude of the impact is considered to be moderate, and based on a low sensitivity, the resultant impact is therefore **moderate adverse** significance and therefore significant.

There is one Endangered plant species, *Ethulia scheffleri,* and one Near Threatened species, *Carex phragmitoides*, listed as potentially occurring within 10km of the Project site. Both species occur in wetland habitats which do not exist within the Project area. These species are considered to be of high and medium conservation importance. Since habitat for these species is not present within the Project site, the impact magnitude is expected to be negligible resulting in insignificant impact.

All plant species recorded within the Project area are of low conservation importance. Impacts on recorded flora are likely to be of moderate magnitude. The resulting impact significance is therefore **minor adverse** without mitigation and therefore not significant.

7.3.4.3 Disturbance and habitat loss/degradation - mammals

Mammals are likely to be affected by site establishment through habitat loss and degradation, habitat fragmentation, or death owing to clearance of vegetation and increased traffic.

One globally Near Threatened mammal species were identified as potentially occurring within 10km of the Project area, the striped hyena (*Hyaena hyaena*). Striped hyenas are nomadic and generally move about between water sources. Although no signs of the striped hyena were identified during the field survey, it is possible that this species utilizes the Project area for foraging. In the event that a striped hyena entered the Project area site establishment, the individual would move through the area to more suitable foraging habitat. The conservation importance of this species is low. Impacts are considered to be minor; the resulting impact is therefore minor adverse without mitigation.

The African Elephant is listed as a Priority Species and has been documented within the Project indirect AOI and elephants are understood to migrate across the Thiba river during

periods of low water while watering, there is a low possibility that elephants may migrate into the wider Project area, but consultation with communities do not indicate this is a regular occurrence. Specifically, the African Elephant as well as African buffalo and zebra are known to migrate between Mwea National Reserve and Mwingi National Reserve. Construction of the Project would not impact these species ability to travel between foraging areas. The conservation importance of these species is high. Impacts to these species are considered to be minor magnitude (due to the potential to encroach on elephant movements) and negligible for other animals, the resulting impact is moderate adverse (for elephants) without mitigation.

All other mammal species recorded in the Project area are of low conservation importance. The construction impacts described above are considered to be of moderate magnitude and the resulting impact is **minor adverse**.

7.3.4.4 Disturbance and habitat loss/degradation - birds

Bird species are likely to be affected by loss/degradation of breeding/feeding habitat and disturbance (presence of people, artificial lighting, noise and vibration).

Denham's Bustard (*Neotis denhami*) is globally listed as Near Threatened and determined to potentially be present within 10km of the Project area. This bird species prefers grasslands, grassy dunes with Acacia trees, shrublands, light woodlands, farmland, crops, dried marsh and arid scrub plains, grassy ironstone pans, and burnt savanna woodland. The majority of the habitat within the Project area is considered to be woodland; therefore, suitable habitat does exist for this species within the Project area; however, no individuals were identified during the field survey. Adopting a conservative approach, we deem medium sensitivity species and the impacts are likely to be of moderate, and the resulting impact is **moderate adverse** without mitigation.

Basra reed-warble (*Acrocephalus griseldis*) is globally listed as Endangered and determined to potentially be present within 10km of the Project area. This species is not a resident bird species, but does winter in Kenya. The preferred wintering habitat is within and near waters including coastal scrub, woodland thickets, swamps, marshes, flooded pools and grasslands, inundated ditches and the edges of rivers, ponds, lagoons and lakes. Habitat for this species is not present within the Project area. Therefore, impacts are considered to be neutral, and the resulting effect is insignificant.

The remaining bird species known to be in the Project area are common and widespread and of low conservation importance. The construction impacts described above are likely to be of minor magnitude and therefore the resulting effect is **minor adverse** without mitigation.

7.3.4.5 Disturbance and habitat loss/degradation - herpetofauna

Reptiles and amphibians in the Project AOI are likely to be affected by the Project as result in habitat loss/degradation, habitat fragmentation, disturbance (presence of people, artificial lighting, noise and vibration) injury or death owing to clearance of vegetation and increased traffic.

There are no globally listed herpetofauna species potentially occurring within 10km of the Project area. The herpetofauna species identified during field surveys in the Project area are considered to be of low conservation importance. It is expected that the existing surface water pond (used primarily for watering farm animals will be retained). No other permanent water bodies are present on site. Construction impacts will be of minor magnitude and the resulting impact t is **minor adverse**.

7.3.4.6 Disturbance and habitat loss/degradation - insects

Insects are likely to be affected by the site establishment through habitat loss and disturbance (presence of people and vibration) injury or death owing to clearance of vegetation.

The insect species identified during field surveys in the Project area are considered to be of low sensitivity in that they are listed by IUCN as being a Least Concern species and can function in modified habitats. Construction impacts will be of minor magnitude and there resulting effect is **minor adverse**.

7.3.5 Operation and maintenance

Impacts from operations include disturbance to animal species and potential introduction of invasive species.

7.3.5.1 Impacts to protected areas

No direct impacts from operations will be incurred to protected areas as a result of the Project. The Project is located approximately 2km north of Mwea National Reserve. Impacts on Mwea National Reserve are considered to be negligible due to the distance from the Project. The resulting effect is therefore insignificant.

7.3.5.2 Disturbance, degradation and destruction of habitats and flora

The impacts on habitat and flora are largely restricted to the site establishment and installation phases. Operational impacts will result from maintenance activities within the site such as ongoing vegetation (new) clearing through brush cutting from under PV arrays and from the internal road network.

The conservation importance of woodland habitat type is considered to be low since the area of disturbance is relatively small and the fact that an herbaceous habitat will be maintained during operation of the facility. The neighbouring habitats are of similar or better quality, and will be able to compensate for the loss of the woodland habitat within the Project site. The magnitude of the impact is considered to be moderate, and the resulting effect is therefore **moderate adverse** without mitigation.

Protected plant species were discussed in detail in section 7.3.5.2 above. Suitable habitat for the Endangered *Ethulia scheffleri,* and Near Threatened *Carex phragmitoides* is not present within the Project site. No ongoing impact to these species will be incurred as a result of operation activities; therefore, the resulting effect is insignificant.

All other plant species recorded within the Project area are of low conservation importance. Impacts on recorded flora are likely to be of moderate magnitude. The resulting effect is therefore **moderate adverse** without mitigation.

7.3.5.3 Habitat fragmentation and increased traffic injuries/fatalities - mammals

Mammals are likely to be affected by operations through permanent habitat fragmentation, or death due to increased traffic.

Since the site will be fenced, large mammals are not expected to be present within the Project site. The result will be some fragmentation of the area with adjacent habitats. However, because of the small size of the site and the extent of adjacent similar habitats, the sensitivity of mammals to fragmentation are expected to be low and the overall resulting effect to be **minor adverse** minor without mitigation.

The striped hyena is not known to occur within the Project site, but suitable habitat does exist. Because of the wandering nature of the hyena, it is likely that disturbance from operation would result in the hyena moving to a less disruptive environment, and the

magnitude of impact from installation would be negligible. The resulting impact would also be minor without mitigation.

The African Elephant (Kenya Priority Species) as well as African buffalo and zebra are known to migrate between Mwea National Reserve and Mwingi National Reserve. Installation activities would not impact these species ability to travel between foraging areas. The conservation importance of these species is High. Impacts to these species are considered to be minor magnitude and the resulting effect is **insignificant.** However, from discussions with the local community, it has been noted that elephants may stray into the Project area when waters are low and therefore from a worker and infrastructure health and safety perspective it will be necessary to acknowledge this possibility.

7.3.5.4 Collision mortality - birds

There is the potential for indirect impacts from operations related to bird kills associated with collision due to reflective surfaces. The Project is proposing to utilize PV panels that are designed to reduce glare and reflection. Solar PV panels are constructed of dark-coloured materials and covered with an anti-reflective coating. Based on the BirdLife South Africa *Guidelines to minimise the impact on birds of Solar Facilities and Associated Infrastructure in South Africa*, PV solar facilities primary impacts to birds is related to displacement and construction noise. For PV solar facilities BirdLife's guidelines indicate that no impacts are expected related to reflective surfaces, mirror collisions, scorching, or water pollution.

Denham's Bustard (*Neotis denhami*) is globally listed as Near Threatened and although not documented within the Project site, suitable habitat does exist for this species. If present, operation activities would have the potential to deter foraging activities, and there would be an increased chance of death due to increased vehicular traffic. However, it is likely that this species would move to nearby suitable habitat where there is less activity. Project impacts on this species are likely to be of low magnitude, and the resulting effect is **minor adverse** without mitigation.

Habitat for the basra reed-warble, globally listed as Endangered, does not exist within the Project area. Therefore, impacts are considered to be neutral, and the resulting effect is **neutral**.

The remaining bird species known to be in the Project area are common and widespread and of low conservation importance. The operation impacts described above are likely to be of low magnitude and therefore the resulting effect is **minor adverse** without mitigation.

7.3.5.5 Habitat degradation, fragmentation, disturbance, and increased traffic injuries/fatalities - herpetofauna

Reptiles and amphibians in the Project AOI are likely to be affected by operations as result of habitat degradation, habitat fragmentation, disturbance (presence of people, artificial lighting, noise and vibration) injury or death owing to increased traffic.

There are no globally listed herpetofauna species potentially occurring within 10Km of the Project area. The herpetofauna species identified during field surveys in the Project area are considered to be of negligible conservation importance. Operations impacts will be of low magnitude and therefore the resulting effect is **negligible**.

7.3.5.6 Habitat disturbance and increased traffic injuries/fatalities - insects

Insects are likely to be affected by installation through habitat disturbance and injury or death owing to increased traffic.

The insect species identified during field surveys in the Project area are considered to be of negligible sensitivity in that they are listed by IUCN as being a Least Concern species and

can function in modified habitats. Installation impacts will be of low magnitude and therefore resulting effect is **negligible**.

7.3.6 Decommissioning

Impacts related to decommissioning will be similar to those incurred during installation. The PV arrays will be removed, the switching station dismantled, roads blocked as necessary, and topographic contours restored. As a result, there will be increased road traffic and noise, potential for introduction of invasive species, soil compaction, and potential of leaks of hazardous liquids from equipment.

7.3.6.1 Impacts to protected areas

No direct impacts from site establishment will be incurred to protected areas as a result of the Project. The Project is located approximately 2km north of Mwea National Reserve. Impacts on Mwea National Reserve are considered to be neutral due to the distance from the Project. The resulting effect is therefore negligible.

7.3.6.2 Cessation of clearing activities (potential conversion to woodland) - habitats and flora

At the time of decommissioning, the site habitat will have been transformed into a grassland. It is not anticipated that significant amounts of clearing will be required since operations will have maintained the site in an herbaceous state. In the absence of this maintenance, the site will revert back to a woodland. Species prefer grassland habitats would have moved-in and may experience an increase in preparation and altered food sources as a result of removing the PV arrays and site fencing. The magnitude of the impact is considered low since the changes to habitats and flora would be minor and over a long period of time. The resulting effect is therefore minor adverse without mitigation.

7.3.6.3 Temporary habitat degradation, increased traffic, and removal of habitat fragmentation - mammals

Mammals will be impacted by decommissioning by temporary habitat degradation, increased noise and traffic, and removal of habitat fragmentation. The overall impacts are expected to be beneficial with the conservation importance of low. The resulting effect is therefore minor beneficial significance.

7.3.6.4 Temporary habitat degradation, increased traffic, and removal of habitat fragmentation - birds

Birds will be impacted by decommissioning by temporary habitat degradation, increased noise and traffic, and removal of habitat fragmentation. The overall impacts are expected to be beneficial with the conservation importance of low. The resulting effect is therefore minor beneficial.

7.3.6.5 Temporary habitat degradation, increased traffic, and removal of habitat fragmentation - herpetofauna

Herpetofauna will be impacted by decommissioning by temporary habitat degradation, increased noise and traffic, and removal of habitat fragmentation. The overall impacts are expected to be beneficial with the conservation importance of negligible. The resulting effect is therefore negligible.

7.3.6.6 Temporary habitat degradation, increased traffic, and removal of habitat fragmentation - insects

Insects will be impacted by decommissioning by temporary habitat degradation, increased noise and traffic, and removal of habitat fragmentation. The overall impacts are expected to

be beneficial with the conservation importance of negligible. The resulting effect is therefore negligible.

7.3.7 Summary of significance

Table 43 summarises the findings of the impact assessment pre-mitigation. Chapter 9 elaborates on how significant impacts may be avoided, reduced, or offset.

Table 43: Summary of impacts – biodiversity

Potential Impact	Adverse / beneficial	Sensitivity	Magnitude	Significance (pre-mitigation)
Construction				
Impact to protected areas – Mwea National Reserve	Adverse	High	Negligible	Insignificant
Disturbance / destruction of flora – Endangered *Ethulia scheffleri*	Adverse	High	Negligible	Insignificant
Disturbance / destruction of flora – Near Threatened *Carex phragmitoides*	Adverse	Medium	Negligible	Insignificant
Disturbance, degradation, destruction and fragmentation – Woodland habitat	Adverse	Medium	Moderate	Moderate adverse
Disturbance, degradation, destruction and fragmentation – Other plant species	Adverse	Low	Moderate	Minor adverse
Disturbance and habitat loss/degradation – Near Threatened striped hyena (*Hyaena hyaena*)	Adverse	Low	Minor	Minor adverse
Disturbance and habitat loss/degradation – Kenya Priority Species African Elephant	Adverse	High	Minor	Moderate adverse
Disturbance and habitat loss/degradation – Other mammal species	Adverse	Low	Moderate	Moderate adverse
Disturbance and habitat loss/degradation – Near Threatened Denham's Bustard (*Neotis denhami*)	Adverse	Medium	Moderate	Moderate adverse
Disturbance and habitat loss/degradation – Endangered Basra reed-warble (Acrocephalus griseldis)	Adverse	High	Negligible	Insignificant
Disturbance and habitat loss/degradation – Other bird species	Adverse	Low	Minor	Minor adverse
Disturbance and habitat loss/degradation – Herpetofauna	Adverse	Low	Minor	Minor adverse
Disturbance and habitat loss/degradation – Insects	Adverse	Low	Minor	Minor adverse
Operation				
Impact on protected areas – Mwea National Reserve	Adverse	High	Negligible	Insignificant
Disturbance and habitat loss/degradation – Woodland habitat	Adverse	Low	Moderate	Moderate adverse
Disturbance and habitat loss/degradation – Other plant species	Adverse	Low	Moderate	Moderate adverse
Disturbance / destruction of flora – Endangered *Ethulia scheffleri*	Adverse	High	Negligible	Insignificant

Potential Impact	Adverse / beneficial	Sensitivity	Magnitude	Significance (pre-mitigation)
Disturbance / destruction of flora –Near Threatened *Carex phragmitoides*	Adverse	Medium	Minor	Minor adverse
Disturbance and habitat loss/degradation – Near Threatened striped hyena (*Hyaena hyaena*)	Adverse	Low	Minor	Minor adverse
Disturbance and habitat loss/degradation – Kenya Priority Species African Elephant	Adverse	High	Minor	Moderate adverse
Disturbance and habitat loss/degradation – Other mammal species	Adverse	Low	Minor	Minor adverse
Disturbance and habitat loss/degradation – Near Threatened Denham's Bustard (*Neotis denhami*)	Adverse	Low	Minor	Minor adverse
Disturbance and habitat loss/degradation – Endangered Basra reed-warble (Acrocephalus griseldis)	Adverse	Medium	Negligible	Insignificant
Disturbance and habitat loss/degradation – Other bird specie	Adverse	Low	Low	Minor adverse
Disturbance and habitat loss/degradation – Herpetofauna	Adverse	Negligible	Low	Negligible
Disturbance and habitat loss/degradation – Insects	Adverse	Negligible	Low	Negligible
Decommissioning				
Impact on protected areas – Mwea National Reserve	Adverse	High	Negligible	Insignificant
Disturbance and habitat loss/degradation – Woodland/grassland habitat	Adverse	Low	Minor	Minor adverse
Disturbance and habitat loss/degradation – Mammals	Adverse	Low	Minor	Minor beneficial
Disturbance and habitat loss/degradation – Birds	Adverse	Low	Minor	Minor beneficial
Disturbance and habitat loss/degradation – Herpetofauna	Adverse	Negligible	Minor	Insignificant
Disturbance and habitat loss/degradation – Insects	Adverse	Negligible	Minor	Insignificant

7.4 Water resources, surface water run off and water quality

7.4.1 Introduction

This section assesses the impacts from Project activities on water resources within the AOI.

7.4.2 Impact identification

Project activities relevant to the water resources assessment are summarized as:

- General construction activities and siting of laydown area and installation of site drainage
- Vegetation removal leading to increased sediment run off and soil erosion
- Site grading and foundation works
- Water abstraction from existing KenGen abstraction point at Kamburu reservoir
- Run-off and discharges from site buildings and facilities (operational center, materials storage yard)
- Rehabilitation of earthen road and new site perimeter road

The following impacts have been considered and assessed:

Construction

- Increased water abstraction for construction water requirements
- Changes to natural drainage pathways caused by vegetation clearance, road development or land levelling and site works; leading to increased runoff, erosion and increased sediment load in ephemeral water courses and Kamburu reservoir
- Contaminated surface water runoff from construction site leading to pollution of surface water (ephemeral streams) due to either accidental spills or inappropriate disposal of wastewater from construction activities
- Surface water runoff leading to sediment increase from soil erosion
- Foul water discharges
- Soil erosion from surface water run-off

Operation

- Increased water abstraction for operational domestic water use and panel cleaning resulting in potential conflict with existing local users)
- Contaminated surface water runoff (during panel cleaning, abnormal events) into Kamburu reservoir
- Foul water discharges
- Soil erosion from surface water run-off

Decommissioning

- Contaminated surface water runoff from construction site into nearby surface water bodies) (permanent and ephemeral)
- Reduction in water abstraction conflict

7.4.3 Sensitivity and magnitude

The sensitivity of the water features that are likely to be affected by the Project have been evaluated in accordance with Table 44.

Table 44: Sensitivity of receptors (considers duration of the impact, spatial extent, reversibility and ability to comply with legislation)

Sensitivity	Criteria	Examples
High	Has very limited or no capacity to accommodate	Surface water body of international or national environmental importance with little or no capacity to absorb proposed changes

Sensitivity	Criteria	Examples
	physical or chemical changes; or, Is nationally or regionally important resource.	or minimal opportunities for mitigation. Groundwater, springs, rivers and lakes used for regional or urban water supply Rivers, lakes and wetlands at high risk of flooding, drought and/or and increased siltation Groundwater located within a protection zone or close to a potable supply source
Medium	Has limited capacity to accommodate physical or chemical changes or influences. Is a locally important resource.	Surface water body of international or national environmental importance with some capacity to absorb proposed changes. Groundwater, springs, rivers and lakes locally important for water supply to villages or water dependent businesses Water body important for fisheries Groundwater located close to a non-potable supply source (e.g. livestock / irrigation)
Low	Has moderate capacity to accommodate physical or chemical changes. Is used intermittently or sparsely as a resource	Surface water body of regional environmental importance with some capacity to absorb proposed changes Groundwater, springs, rivers and lakes used for supply to individual dwellings Groundwater located within the total catchment area for a groundwater source Soil and agricultural land use may be affected by flooding/change in hydrological conditions
Negligible	Is generally tolerant of physical or chemical changes. Is not used as a resource	Groundwater, springs, rivers and lakes not used for water supply and that are generally tolerant of physical or chemical changes Soil and agricultural land use not sensitive to some change in hydrological regime (e.g. grazing)

Source: Mott MacDonald

For the purposes of this assessment, the magnitude criteria have been divided into four categories as set out in Table 45.

Table 45: Magnitude of impacts summary table

Magnitude (positive or adverse)	Definition (considers duration of the impact, spatial extent, reversibility and ability to comply with legislation)
Major	Fundamental change to the specific environmental conditions assessed, resulting in long term or permanent change, typically widespread in nature (regional, national and international). Would require significant intervention to return to baseline; likely to exceed national standards and limits.
Moderate	Detectable change to the specific environmental conditions assessed, resulting in non-fundamental temporary or permanent change typically affecting the local area; possibly exceeding national standards and limits.
Minor	Detectable but minor change to the specific environmental conditions assessed that is temporary in nature, with high capacity to return to the baseline conditions; unlikely to exceed national standards and limits.
Negligible	No perceptible change to the specific environmental conditions assessed.

Source: Mott MacDonald

From the baseline data collection (desk based and site observations), it has been concluded that the water resource receptors located within the area of influence and their sensitivity to change are as set out in Table 46.

Table 46: Summary of receptor sensitivity – water resources

Receptor	Assumed Hydrological Regime	Sensitivity	Justification
Groundwater	No groundwater was observed at the site[50]	Negligible	Geotechnical study did not encounter groundwater above 29mdepth.

[50] Based on geotechnical investigation where boreholes were dropped to between 29 and 35m depth.

Receptor	Assumed Hydrological Regime	Sensitivity	Justification
Kamburu reservoir	Permanent man-made reservoir	Low	Possibility of sediment transfer from the hillside directly to Kamburu reservoir under extreme conditions. Additional abstraction for domestic water use is likely to be within current permit limits and option to truck water in if not (for panel cleaning).
Ephemeral watercourses / ravine	Because of the high infiltration rate there are no permanent watercourses within the study area except for ephemeral streams that flow during periods of heavy rainfall	Medium	Ground under the PV panels will remain permeable and surface water run off from the panels will retain sheet flow so as to minimise changes to infilltrarion under the panels. Sediment transfer to reach the river (which leads to the Kamburu Dam) is possible during heavy rainfall.
Livestock pond (in current location)	Contains water only during the wet season	Negligible	Sediment or other transfer to the pond during high rainfall is unlikely given the location of the pond relative to gradient of the site.

7.4.4 Construction

7.4.4.1 Surface water pollution (Kamburu dam / ephemeral streams)

During site establishment and construction, a surface water management plan and a hazardous material management plan will be in place as a minimum to ensure that equipment is maintained in working order however it is still possible that leaks and spillages from machinery could occur resulting in contaminated run-off. Small volumes of liquid are likely to be attenuated within the soil zone, with no discernible effect on surface water or groundwater resources. However, should there be a catastrophic failure of any bulk storage container, there is potential for serious impacts on water down-gradient of the construction area or during extreme weather events. The contractor will be required to develop an emergency response plan (ERP) that deals with potential for spills to be cleaned up and larger abnormal events, this is further defined in the ESMP (Volume V) but will include spill kits and other measure to contain contaminated run-off should it arise. Inappropriate disposal of any significantly contaminated water from containers such as skips or tanks could result in similar impacts. Soil information to date do not indicate the land is contaminated or that there is a likelihood to encounter hazardous materials. The sensitivity is considered to be low, magnitude to moderate resulting in minor adverse impact. No impact on groundwater is predicted the groundwater level is more than 20m below ground.

7.4.4.2 Surface water runoff leading to soil erosion

During the construction works the vegetation at the site will be stripped and for a temporary period will be highly susceptible to soil erosion and potential increase in sediment laden run-off. Measures for controlling this are defied in the ESMP and include terracing and levelling of the Project site aligned with natural contours, partial clearance of undergrowth, advancing re-vegetation on a phased basis. The sensitivity of the receiving environment is deemed low. The potential impact (pre-mitigation) is deemed to be high resulting in an overall impact significance of moderate adverse.

7.4.4.3 Foul water run-off

No sewerage system is present at the site, it is not indented to install a foul drainage system connected to the network. The Project description describes a bio-digester package system that would treat all waste water to acceptable standards before discharge to standards acceptable for irrigation. The sensitivity of the receiving environment (ground) is considered to be low. The treatment will reduce impacts to acceptable levels as set out in standards for

irrigation and therefore magnitude of the impact is considered negligible resulting in an insignificant impact.

7.4.4.4 Reduced water availability / conflict with other water users

KenGen currently has a permit with an abstraction limit for water use. Whilst the water needs of the Project are insignificant compared to the total available water in the Kamburu Dam, the area is in severe drought and the energy generation is the primary objective for water in that reservoir. During construction water will be required for the following activities:

- Foundations (cement batching)
- Dust control
- Domestic water use (cleaning / cooking / staff welfare)

The current permit has an abstraction license to take 1,200m^3 per day for domestic water use (in addition to abstraction for hydropower generation). It is not expected that the construction phase will exceed this domestic water use license.

For construction related activities (dust control, cement production) the Project will truck water in under local permit or seek to include construction water under the current permit. No new borehole or groundwater abstraction is envisaged. Given that the Project will work within existing permit conditions or truck water in from elsewhere under permit, a low sensitivity is appropriate with moderate magnitude resulting in minor adverse significance.

7.4.5 Operation and maintenance

7.4.5.1 Changes to Natural Drainage Pathways

The installation of a new drainage system will have the purpose of collecting run-off that passes through the site and diverting it in manmade channels to the existing ravine which routes to ground.

The area displaced by the solar panels is still considered impervious as it will allow water to run off the panels to the ground as it currently does to the pervious layer below. Panels will be positioned to allow stormwater to run off their surfaces and collection and concentration of stormwater flow from the panels will be avoided.

The Kamburu reservoir is permanent man-made reservoir with low sensitivity to water quality changes. The magnitude of the impact is expected to be moderate reflecting that water is already naturally routed to a natural ravine where water run-off towards the reservoir. The planned drainage system will seek to reflect this a much as possible. The area underneath the panels will remain vegetated and continue to allow infiltration, although there will be some additional hard surfaces and run off these will only represent less than 5% of the operational area. Where possible options for harvesting and storage of rainwater will be designed for the O&M buildings (this is elaborated in the mitigation Chapter and ESMP, Volume V) and to minimise the effect of channelling run off into the drainage system the use of detention and or retention ponds will be considered. The changes to the drainage pathways will be of moderate magnitude, resulting in minor adverse impact on existing drainage pathways.

7.4.5.2 Reduced water availability

KenGen currently has a permit with an abstraction limit for domestic water use. Whilst the water needs of the Project are insignificant compared to the total available water in the Kamburu Dam, the area is in severe drought and the energy generation is the primary objective for water in that dam. During operation water will be required for the following activities:

- Domestic water use (cleaning / cooking / staff welfare facilities)

- Panel cleaning
- Irrigation

The current permit has an abstraction license to take 1,200m^3 per day for domestic water use (in addition to abstraction for hydropower generation). It is not expected that the PV plant operation phase water demand will exceed this domestic water use license and this will be managed under a variation to the current permit.

For PV panel cleaning it is expected to truck water in from off-site under relevant permits for this work. Panel cleaning is expected to be once or twice per year and an estimate of water consumption would be 180 m^3 to 360 m$^{3.}$ For landscaping and irrigation (in particular while vegetation is being established) it is expected that water will be used from the Kamburu abstraction permit. In addition, treated water from the foul water treatment plant may also be used for irrigation purposes although additional options for water provision will be required. We consider water availability for irrigation to be medium sensitivity with a moderate magnitude impact resulting in potential moderate adverse impact prior to mitigation.

Given that the Project will work within existing permit conditions or truck water in from elsewhere under permit, we assign a low sensitivity with moderate magnitude, resulting in minor adverse significance.

7.4.5.3 Contaminated surface water runoff (during panel cleaning, abnormal events)

During operation, a surface water management plan and a hazardous material management plan will be in place to ensure that panel cleaning and maintenance works is undertaken in such a way as to minimise risk to the environment, however it is still possible that leaks and spillages from machinery could occur resulting in contaminated run-off. Small volumes of liquid are likely to be attenuated within the soil zone, with no discernible effect on surface water or groundwater resources. No cleaning solutions are proposed to be used for panel cleaning. Hazardous materials stored on site will be minimal and will be bunded storage units that will stop release of contaminates to ground. No herbicides will be used to manage vegetation growth instead mowing or other manual techniques will be employed.

There is potential for impacts on ground or water down-gradient of the operational area or during extreme weather event. The sensitivity of the environment is low, but the potential magnitude under abnormal scenarios or extreme weather events to be moderate resulting in a potential minor adverse significance.

7.4.5.4 Foul water run-off

No sewerage system is present at the site, it is not indented to install a foul drainage system connected to the network. A bio-digester package system that will treat all waste water to acceptable standards before discharge to standards acceptable for irrigation. The sensitivity of the receiving environment (ground) is considered to be low. The Project is only expected to have facilities for five persons (permanent O&M staff) and the treatment will reduce impacts to acceptable levels as set out in standards for irrigation and therefore magnitude of the impact is considered negligible resulting in an overall insignificant impact.

7.4.6 Decommissioning

During decommissioning there is a potential hazard from dismantling of any equipment which may contain residual fluids, particularly if the site has been abandoned for a lengthy period prior to restoration.

7.4.7 Summary of significance

Table 47 summarizes the findings of the impact assessment pre-mitigation. Chapter 9 elaborates on how significant impacts may be eliminated, reduced, offset, managed or mitigated to acceptable levels.

Table 47: Summary of impacts – water resources and water quality

Potential impact	Adverse/ beneficial	Sensitivity	Magnitude	Impact evaluation (pre-mitigation / enhancement)
Construction				
Surface water runoff decrease in water quality (pollution)	Adverse	Low	Moderate	Minor adverse
Surface water runoff leading to soil erosion	Adverse	Low	High	Moderate adverse
Foul water discharges	Adverse	Low	Negligible	Insignificant
Reduced water availability due to abstraction from the Kamburu Dam	Adverse	Low	Moderate	Minor Adverse
Operation				
Changes to natural drainage pathways	Adverse	Low	Moderate	Minor adverse
Increased water abstraction for operational domestic water use and panel cleaning and irrigation leading to conflict with other water users.	Adverse	Medium	Moderate	Moderate Adverse
Contaminated surface water runoff (during panel cleaning, abnormal events)	Adverse	Low	Minor	Minor adverse
Uncontrolled foul water discharges	Adverse	Low	Negligible	Insignificant
Decommissioning				
Surface water runoff decrease in water quality (pollution)	Adverse	Low	Minor	Minor adverse
Foul water discharges	Adverse	Low	Negligible	Insignificant

7.5 Air quality impact assessment

7.5.1 Introduction

This section presents the identification and assessment of the following potential beneficial and adverse fugitive air quality impacts and risks of the Project. No consideration has been given to direct operational impacts as per the scoping report and ESIA TOR.

7.5.2 Impact identification

The key potential air pollutants which are the focus of this assessment are particulate and other fugitive emissions associated within the construction phase. Impact during the construction phase which have the potential to affect local air quality include:

- Oxides of nitrogen (NO_x) emissions associated with on-site plant and vehicles (combustion of fuel
- NO_x emissions associated with construction traffic on the local road network (combustion of fuel
- On-site dust emissions arising from construction activities. Dust can be mechanically transported (either by wind or re-suspension by vehicles). It can also arise from wind erosion on material stock piles and earth moving

These emissions are likely to disperse rapidly leaving no noticeable change on the ambient air quality of the Project area although they may have impact on worker respiratory and nearby properties so will need to be managed. Therefore, it is assumed that impacts on air quality arising from emissions from construction site activities are unlikely to occur more than 200m from the location in which they are carried out.

Dust refers to particulate matter in the size range 1-75 microns. Dust from these activities is mainly associated with the movement and handling of material and is therefore predominantly composed of the larger fractions of this range which do not penetrate far into the respiratory system. The primary air quality issue associated with dust emissions from the construction phases is therefore loss of amenity and/or nuisance caused by, for example, soiling of buildings, vegetation and laundry and reduced visibility

All Project activities have the potential to cause dust related impacts through the construction phase and through the resuspension of dust from vehicles. The activities with a potential to raise dust at the site have been identified in Table 48.

Table 48: Generic construction phase dust emitting activities

Activity	Description	Potential dust raising activities
Setup and enabling works	Rerouting of utilities	Excavation works
Roads and Infrastructure	Installation of new roads as required (temporary and permanent)	Excavation works. Creation of borrow pits Transport of materials Resuspension of dust on unsurfaced roads.
Site clearance and ground works	Preparation of the site e.g. levelling, removal of vegetation	Earthmoving Excavation Transport of materials Wind Resuspension of dust on unsurfaced roads Concrete batching
Construction switching station infrastructure	Details of exact building materials required not yet known.	Transport of materials Storage of materials Preparation of materials (cutting etc.) Resuspension of dust on unsurfaced roads.

Effects from construction transport and plant would be localised and are likely to include:

- Emissions associated with site plant and vehicles – typically particulate matter (PM_{10}) and oxides of nitrogen (NO_x) due to combustion of diesel fuel
- Dust arising from construction activities and vehicle movements – dust generated by construction activities can be mechanically transported off site (by wind or re-suspension by vehicles) where it can soil properties and vegetation. It can also arise from wind erosion of material stock piles and earth moving.

Any potential air quality impacts relating to these sources have been considered qualitatively in the assessment with reference to the construction periods, potential activities and local receptors.

7.5.3 Sensitivity and magnitude

Sensitive receptors with the potential to be significantly affected by construction phase dust emissions have been identified based on field observations and are primarily residential homes and farms (refer to 49). The actual distances from source that dust impacts are highly site specific and would depend on the extent and nature of incorporated mitigation measures, prevailing wind conditions, rainfall and the presence of natural screening by, for example, vegetation or existing physical screening such as boundary walls on a site. However, research indicates that impacts from unmitigated construction activities that generate dust are generally limited to within 150-200 metres of the site boundary.

Table 49: Receptor classification

High	Medium	Low	Negligible
Hospitals and clinics Technology industries	Residential areas Food retailers	Farms Light and heavy industry	No receptors

High	Medium	Low	Negligible
		Outdoor storage	

Table 50 provides the criteria upon which the receptor sensitivity to dust impacts from the construction and decommissioning phases have been determined.

Table 50: Determination of receptor sensitivity - construction phase

Receptor Categorisation	Distance to Construction Site			
	0-50m	50-100m	100-200m	200-500m
High	High	High	Medium	Low
Medium	Medium	Medium	Low	Low
Low	Medium	Low	Low	Low
No Receptors	Negligible	Negligible	Negligible	Negligible

Table 51 presents the approach used to define the magnitude of dust impacts from the construction phase.

Table 51: Determination of impact magnitude – construction phase

Dust Raising Potential(a)	Duration	Impact Magnitude
High	Any	Major
Medium	> 3 Months	Moderate
Medium	< 3 Months	Minor
Low	Any	Negligible

7.5.4 Construction

7.5.4.1 Construction dust (including dust from traffic movements)

The soil is mainly sand and silt and therefore there is high potential for dust to be generated at the Project site when vegetation cover is removed during the site establishment phase and grading of access roads and perimeter roads. The impact magnitude of dust during site establishment activities is conservatively described as ‘high’ for the whole duration. However, not all construction activities have a high dust-raising potential and therefore it can be considered that potential dust episodes may only occur over short periods during the construction phase and therefore moderate is considered to be acceptable. Once the construction phase moves into installation and commissioning, dust raising potential is deemed to be low.

Dust resuspension can also be caused by movement of heavy goods vehicle (HGV) on tracks and muddy roads during access road construction works. Once roads are complete, the Project site will be accessed via paved. Dust impacts of these improvements to road infrastructure are expected to last for a short duration only. The

Construction activities have the potential to result in a low dust emitting potential (magnitude), during all construction phases, except the site preparation phase which has the potential to be high.

There are some sensitive receptors located within 50m of the north and to the east of the Project site. Receptor sensitivity is deemed to be medium. Overall, worst-case dust effects are therefore anticipated to be temporary minor adverse without mitigation measures during site preparation and site enabling works. All other phases would be insignificant.

7.5.4.2 Fugitive gas emissions

Due to the temporary nature of the proposed works, the location of nearby receptors, and low background pollutant concentrations in the study area, air quality effects as a result of on-site vehicle and plant exhaust emissions are considered to be insignificant.

Nevertheless, as with the impacts identified above, best practice mitigation measures have been identified to reduce emissions and environmental effects. These are identified in the ESMP.

7.5.5 Operation

None noted.

7.5.6 Decommissioning

As for construction.

7.5.7 Summary of significance

Table 52 summarizes the findings of the impact assessment pre-mitigation. Chapter 9 elaborates on how significant impacts may be eliminated, reduced, offset, managed or mitigated to acceptable levels.

Table 52: Summary of impacts – air quality

Potential impact	Adverse /beneficial	Sensitivity	Magnitude	Impact evaluation (pre-mitigation)
Construction				
Dust from site establishment works	Adverse	Medium	Moderate	Moderate adverse
Dust from other construction works (installation / commissioning)	Adverse	Medium	Minor	Minor adverse
Dust from traffic movements	Adverse	Medium	Moderate	Moderate adverse
Fugitive gas emissions	Adverse	Medium	Negligible	Insignificant
Decommissioning				
Dust from site decommissioning works	Adverse	Medium	Moderate	Moderate adverse
Dust from other decommissioning works	Adverse	Medium	Minor	Minor adverse
Dust from traffic movements	Adverse	Medium	Moderate	Moderate adverse
Fugitive gas emissions	Adverse	Medium	Negligible	Insignificant

7.6 Glint and glare (solar reflection)

7.6.1 Introduction

The reflective properties of solar PV panels vary from different manufacturers. Solar panels vary in their reflectivity and include ‘anti-glare’ properties, there is potential that solar panel may not absorb 100% of the incoming light. Therefore, any solar PV panel has the potential to produce a solar reflection. The relative absorptive properties of a solar panel should be considered on a case-by-case basis. This assessment screens potential receptors for the potential for glint and glare effects.

7.6.2 Impact Identification

Glint and glare are typically defined as follows:

- Glint – a momentary flash of bright light
- Glare – a continuous sources of bright light

Glint is generally a problem for moderate of fast moving receptors (e.g. road users) while glare is a potential impact for static or slow-moving receptors.

The term ‘solar reflection’ is used to refer to both reflection types i.e. glint and glare.

The key receptors with respect to glint and glare are residents in surrounding dwellings road users, and aviation infrastructure (including pilots and air traffic controllers).

For the purpose of this assessment we have defined the following AOI for glint and glare:

- Dwelling within approximately 1km of the development that may have a view of the solar panels
- Roads within approximately 1km of the development that may have a view of the solar panels

During the scoping phase it was identified that the nearest airfields and specifically the air control towers are more than 5km from the Project site so these receptors have been scoped out. A submission to Kenya FAA for review and approval of this assumption has been submitted and at the time of submission of this report, no concerns have been raised.

Dwellings within 1km of the site are located to the north and east of the site and road users along Route B7 travelling from the north and south may be impacted.

7.6.3 Impact assessment

The layout of the site shows that the panels will be mounted in rows on tracking systems from a minimum height of 8 - 10 feet above ground level (agl), at an elevation of 1,066 to 1,106 feet. The tilt / azimuth is +/- 60 degrees/180 degrees (due South). The panels will be orientated to maximize electrical generation on a tracking system that will rotate above the horizontal with the panels facing southwards towards the Kamburu reservoir.

To help identify potential glint and glare impacts, consultation with the following stakeholders has been performed:

- Kenya civil aviation authotity (KCAA)
- Operators at the Masinga Airfield

The assessment indicates that approximately 30 dwellings and points along a 2km section of roads may be affected by solar reflection without considering any evaluation of location or altitude or orientation.

Impact to receptors is considered to be limited as it will only be received if the panels are visible and on the same elevations. From review of the landscape it can been seen that much of the dwellings have vegetation between their location and the site. As such it is considered that there are limited stationary receptors at the right elevation or within the AOI.

It is also assumed the PV design will be required to maximise absorbance and will be required to be coated with anti-glare surface to reduce the sun’s reflection from PV panels to below 5%.

In addition, impacts to stationary receptors are typically intermittent and change based on the time of day, cloud cover, orientation and the time of year and are not considered to be permanent impacts. Based on this assessment we consider the sensitivity of the receptors to be medium and the impact moderate resulting in overall moderate impact magnitude.

Glint for road users travelling north or south on Route B7 from the PV panels is deemed possible although the impact is deemed to be intermitted confined to certain times of the day based on time of year, cloud cover and elevation. As road traffic volume is low we consider the sensitivity of road users to be low, with impact magnitude as minor resulting in a minor significance impact.

There are three airfields within the 10km AOI and consultation with aviation authorities has indicated that solar reflection from the Project at the altitude that the planes will be flying at in this location will be the same similar as the adjacent water body (Kamburu reservoir).

Based on this we consider the receptor sensitivity (capacity to deal with this change) to be low, the magnitude to be minor resulting in a minor adverse significance pre-mitigation.

7.6.4 Summary of significance

Table 52 summarizes the findings of the impact assessment pre-mitigation. Chapter 9 elaborates on how significant impacts may be eliminated, reduced, offset, managed or mitigated to acceptable levels.

Table 53: Summary of impacts – glint and glare

Potential impact	Adverse /Beneficial	Sensitivity	Magnitude	Impact evaluation (pre-mitigation)
Operation				
Glint for road users travelling north / south on B7	Adverse	Low	Minor	Minor adverse
Glare for receptors to the north east and west of the site	Adverse	Medium	Moderate	Moderate adverse
Glare for receptors to the east / south of the site	Adverse	Medium	Minor	Minor adverse
Glint and glare aviation infrastructure	Adverse	Low	Minor	Minor adverse

7.7 Landscape and visual impacts

7.7.1 Introduction

This section presents a qualitative identification and assessment of the following potential beneficial and adverse landscape and visual impacts of the Project.

7.7.2 Impact identification

Potential impacts on the landscape character and visual amenity will be:

- Removal of vegetation, soil stripping, temporary stockpiling of excavated materials and other earthworks,
- Visual impact from the long-term installation of the solar PV cells.

7.7.3 Construction

7.7.3.1 Landscape character and visual amenity

The site establishment works, including construction traffic and associated noise would adversely affect the setting and the tranquillity; however, it would be of temporary nature and relatively local in scale. The construction works would temporarily change the local landscape character, due to the presence on the site of plant equipment and construction activities. Light pollution due to artificial lighting used on construction site would negatively change the night time character.

The activities associated with the first stage of site establishment including site preparations, construction of materials storage and rehabilitation of access roads, which would only be visible from the closer viewpoints. The excavation of materials will have the greatest visual impact as excavated areas would break up the continuous landscape.

7.7.4 Operation

7.7.4.1 Landscape character and visual amenity

The presence of the Power Plant will cause a permanent change in the local landscape character.

The visual receptors affected by the Project would include residents located around the proposed site and potentially users of the roads including tourists.

7.7.5 Summary of significance

Table 54 summarises the findings of the impact assessment pre-mitigation. Chapter 9 elaborates on how significant impacts may be eliminated, reduced, offset, managed or mitigated to acceptable levels.

Table 54: Summary of impacts – landscape and visual impact

Potential impact	Adverse /Beneficial	Sensitivity	Magnitude	Impact evaluation (pre-mitigation)
Construction				
Impact to landscape character	Adverse	Medium	Low	Minor adverse
Impact to visual landscape	Adverse	Medium	Low	Minor adverse
Operation				
Impact to landscape character	Adverse	Medium	Moderate	Moderate Adverse
Impact to visual landscape	Adverse	Medium	Moderate	Moderate Adverse

7.8 Traffic and transportation

7.8.1 Introduction

This section predicts traffic and transportation impacts expected to occur as a result of the Project and assesses the beneficial and adverse effects by predicting their significance prior to mitigation.

7.8.2 Impact identification

The assessment is structured around the consideration of potential impacts upon the following sensitive receptors:

- Increased traffic flow on road network and congestion for local road users (direct AOI)
- Deterioration on road infrastructure and transport infrastructure condition
- Impact on local community in wider area of influence and community health and safety

The impacts of construction traffic are likely to be temporary, lasting only for the duration of the construction phase. The peak construction period is anticipated to last approximately four months (between months four to eight) when major civil works and delivery of equipment is scheduled.

Designated traffic routes are proposed for the transportation of HGVs that avoid congested towns such as Embu and the market town of Kiritiri and therefore it is assumed that all traffic will approach the site along Route B7 from the south. The impact to existing ‘A’ roads is not considered as these are deemed to be capable of handling the volumes of traffic required for this Project.

A qualitative assessment has been completed based on the peak month of traffic generation. The environmental impact at all other times should therefore be less than or equal to the impacts identified.

7.8.3 Sensitivity and magnitude

Receptors sensitive to operational and safety impacts, together with consideration of the possible impacts, are identified in Table 55.

Table 55: Determination of receptor sensitivity

Receptor (Potential Impact)	High Sensitivity	Medium Sensitivity	Low Sensitivity	Negligible Sensitivity
Community (Impacts upon local quality of life e.g. safety, disruption to local events)	-	Pedestrians/ cyclists in local settlements – temporary exposure to increased traffic flows on local road network during construction.	-	-
Highway (Impact of additional traffic on traffic flow and road users)	-	Secondary/tertiary roads - temporary delays due to increased traffic flows on local road network during construction	Primary roads - temporary delays due to increased traffic flows on local road network during construction	-
Highway (Impacts from 'wear and tear' to existing infrastructure)	-	Secondary/tertiary roads – reduction in 'physical quality' i.e. breaking up of road surfaces from deliveries of construction materials	Primary roads – reduction in 'physical quality' i.e. breaking up of road surfaces from deliveries of construction materials	-

7.8.4 Construction

7.8.4.1 Impact upon local road users and traffic flow

It is expected that peak traffic flow would be experienced during month four to six of construction. The following assumptions have been employed:

- All traffic loads bound for Project construction areas would be transported by road within Kenya
- All vehicles would originate from and return to Nairobi
- Aggregate required would be sourced from local borrow pits located within Embu County as close to the work site as possible and so would not be imported
- Only existing earthen roads would be upgraded as necessary to ensure they can accommodate Project traffic, the tarmac roads are considered suitable condition
- Cement batching would be completed at the Project site
- No abnormal loads are required
- Switching station and PV plant would be constructed simultaneously
- A new switching station would take approximately four months to construct
- Construction works would be completed over a 10-hour working day, 30 days per month;
- Assumed that construction works continues through the rainy season (rainy season extends from approximately October to March)

During this period the development could potentially add 80-100 vehicles and 160-200 movements to immediate local area (Machang'a). It is expected that all loads bound for the site would travel north along Route B7 increasing general traffic as follows:

- Labour work traffic (20 vehicles per day multiplied by 60 days) = 2,400 movements
- HGV traffic (20 vehicles per day multiplied by 60 days) = 2,400 movements

Existing traffic levels on the local roads are low, and the Project may increase traffic movements temporarily as a result of trucks and vehicles transporting the construction material and infrastructure. No abnormal sized loads are envisaged. It is estimated that up to 4000 heavy-load truck loads will transport materials to the Project site assuming each truck capacity is 15m^3 plus additional trucks movement.

This is deemed to create a moderate impact upon road users and local traffic flow. Current road use is low and does include HGV's vehicles so low sensitivity, however the majority of local traffic users are on foot, bikes, motorcycles, or slow-moving agriculture vehicles and communal vans that stop frequently. The sensitivity of the other road users is considered to be medium. The resulting significance is deemed to be moderate adverse and therefore significant prior to mitigation.

7.8.4.2 Construction upon local community (indirect AOI)

The routes proposed for the transportation of personnel and materials to the construction area are expected to utilise the primary and secondary roads. It is expected that all loads bound for the site would travel north along A roads and then north along Route B7 increasing general traffic as follows:

- Labour work traffic (20 vehicles per day multiplied by 60 days) = 2400 movements
- HGV's traffic (20 vehicles per day multiplied by 60 days) = 2400 movements

Primary roads are amongst the most highly used within Kenya and as such those living by the roads would be accustomed to relatively high levels of traffic flow including HGV's. There are no acceleration lanes for re-joining the carriageway and there are few protective barriers or formal crossing points.

The negative impact on other road users and those living near the primary road sections (A roads) of the route is considered to be negligible and their sensitivity to this increase in traffic movements negligible resulting in an insignificant impact.

It is expected that all loads bound for the site would travel north along Route B7. The addition of approximately 20 vehicles per day (40 movements) to this Route is considered to be moderate with the sensitivity of the road users and communities along the route consider to be low. On secondary route sections with lower levels of baseline traffic, the impact is expected to be minor adverse significance.

7.8.4.3 Construction traffic impact to local road infrastructure (direct and indirect AOI)

Route B7 is a well maintained secondary road, it is thought that an increase of 80-100 vehicles a day over a short period would have a negligible impact on route infrastructure. In the local area (direct AOI) where traffic movements around the site and around Machang'a road wear and tear may be more prevalent and therefore of minor adverse significance without mitigation.

7.8.5 Operation

Scoped out, no further assessment

7.8.6 Decommissioning

The impacts of Project decommissioning are expected to be less than or equal to those resulting from Project construction. Due to the minimal amounts of information currently available, it is recommended that an assessment of decommissioning impacts is completed at a future date when the period of decommissioning is known. This will require further

consideration of baseline traffic movements at that time and may require the need for an accurate traffic baseline to be developed.

7.8.7 Summary of significance

Table 56 summarizes the findings of the impact assessment pre-mitigation. Chapter 9 elaborates on how significant impacts may be eliminated, reduced, offset, managed or mitigated to acceptable levels.

Table 56: Summary of impacts – traffic and transportation

Potential impact	Adverse /beneficial	Sensitivity	Magnitude	Impact evaluation (pre-mitigation)
Construction				
Construction impact upon road users and traffic flow (local / direct AOI)	Adverse	Medium	Moderate	Moderate adverse
Construction traffic impact to local community (indirect AOI)	Adverse	Medium	Minor	Minor adverse
Construction traffic impact to local road infrastructure (wear and tear) (indirect AOI)	Adverse	Medium	Moderate	Moderate adverse
Construction traffic impact to local road infrastructure (wear and tear) (direct AOI)	Adverse	Low	Minor	Minor adverse

7.9 Waste and materials

7.9.1 Introduction

The assessment approach taken included desktop study of readily available information on the Project activities, site visit to the various Project components and discussions with staff at the construction sites during the site visit.

The World Bank Group EHS Guidelines and the IFC Performance Standard 3 state that the client will avoid, minimise the generation of hazardous and non-hazardous waste materials as far as is practicable. Where waste generation cannot be avoided but has been minimised, the client will employ the waste hierarchy or where waste is hazardous the client will explore reasonable alternatives for its environmentally sound disposal considering the limitation applicable to its transboundary movements. Where waste disposal is conducted by third parties, the client will use contractors that are reputable and legitimate enterprises requiring licences by relevant regulatory authorities.

7.9.2 Impact identification

Waste is defined as “any solid, liquid or contained gaseous material that is being discarded by disposal, recycling, burning or incineration”.

The main potential impacts which can arise from the generation of waste and handling of materials are as follows:

- Biomass during site clearance
- Contamination of receiving environments (particularly surface watercourses, groundwater and soils) due to leakage and spillage of wastes associated with poor waste handling and storage arrangements during construction
- Contamination of receiving environments (land) from general waste from operational buildings and general and hazardous waste during maintenance work

Three general classifications of wastes have been applied for the assessment; namely non-hazardous wastes, hazardous wastes and inert wastes. Each waste stream has been identified as belonging to one of the following classifications:

- Inert construction wastes are wastes that are solid and when disposed of are not expected to undergo physical, chemical or biological changes to such an extent as to produce substances that may cause an adverse effect. Such wastes include but are not limited to debris, concrete, glass, ceramic materials, unpainted scrap metal, and dry timber or wood that has not been chemically treated
- Non-hazardous wastes are all wastes that are not hazardous wastes and are not inert construction wastes. This includes common garbage, office wastes, construction wastes such as boxes, and treated sewage effluent and sewage sludge
- Waste materials are classified as hazardous wastes when they exhibit on or more of the characteristics such as explosive, flammable, spontaneous combustion potential, oxidizing potential, toxic, and corrosive

7.9.3 Sensitivity and magnitude

The significance of potential impacts is a function of the presence and sensitivity of receptors, and magnitude of the impact. The assessment also considers the following factors:

- The 'treatability' of the waste generated by the Project, which is determined by its physical and chemical characteristics (i.e. whether the waste can be treated with minimal residual waste, such as recycled waste, or whether the waste requires a specialised treatment with potentially toxic residual waste)
- The availability of suitable facilities within the local area to treat the waste generated
- Compatibility of the Best Practical Environmental Option (BPEO) for the waste within the context of the waste hierarchy, i.e. whether generation of the waste can be minimised, recycled, landfilled
- Potential environmental health effects or human health risks associated with the waste e.g. if it is hazardous etc.

Typical receptors in relation to waste generation and management for the Project are outlined in

Table 57: Table 57 and general comments on the capacity of that receptor are provided below. Further elaboration in relation this Project is provided in subsequent sections.

Table 57: Waste management resources and receptors

Resource/Receptor	Description	Comment on capacity of receptor
Land (terrestrial environment)	Un-protected dumps.	Land is uncontaminated and should be protected.
Local residents	'informal' recycling and reuse	Local community typically adopts a no-disposal approach to waste identifying alternative uses for many materials. The nature of some of the materials that will be identified as waste is such that they may present health and nuisance impacts if not managed properly and therefore re-use and recycling opportunities within the local environment will require careful management.
Waste receiving facilities	Includes recycling and sorting facilities, reprocesses and waste transfer stations	There are limited facilities available in Embu County so this has to be considered as not available. NEMA regulated facilities are located in Nairobi.
Waste transportation providers	Includes waste haulage vehicles, waste carriers and skip container providers	NEMA Regulated waste providers do exist within Kenya. Capacity to support waste generation associated with the Project will be limited.

Resource/Receptor	Description	Comment on capacity of receptor
Waste disposal facilities	Includes waste treatment facilities, landfill, open burning etc.	Facilities for dealing with hazardous waste – capacity to accept waste from the Project is low to non-existent. NEMA regulated facilities are located in Nairobi.

Table 58 defines the magnitude of impacts for waste applied to this assessment.

Table 58: Magnitude categories for waste impacts

Magnitude Attribution	Description
Major Adverse	Large increase in the quantity of waste generated compared to existing levels. The quantity of waste generated does not assist in the achievement of local and regional recycling and composting targets and significantly increases annual waste generation figures; waste is hazardous and requires incineration or landfilling resulting in permanent environmental effects; waste cannot be disposed of within reasonable proximity of the working sites.
Moderate Adverse	Moderate increase in the quantity of waste generated compared to existing levels. The quantity of waste generated does not prevent the achievement of local and regional recycling and composting targets; waste is hazardous but can be recovered with pre-treatment resulting in temporary environmental effects; waste can be disposed of in reasonable proximity of the working site.
Minor Adverse	Small increase in the quantity of waste generated compared to existing levels; waste is non-hazardous or inert and can be recycled or composted within reasonable proximity of the working site.
Negligible	No obvious change in the quantity of waste generated compared to existing levels.

7.9.4 Construction

7.9.4.1 Material use and management

No materials that are banned under the following conventions and guidelines will be used in connection with Project works.

- Materials defined as Annex A or Annex B materials under the Stockholm Convention
- Chemicals listed in Annex III of the Rotterdam Convention of prior informed consent for certain hazardous chemicals and pesticide in international trade

All handling of materials and waste will be in accordance with NEMA regulations as a minimum.

No materials with the potential to release significant toxic, hazardous, flammable or explosive material. It is not considered that a hazard and operability study (HAZOP) analysis is required in connection with the proposed Project works.

Materials used during site establishment will principally comprise the items of equipment for the Project, as well as materials used for site preparation such as steel assemblies and concrete. Materials required for the construction of the PV solar plant may include:

- Cement
- Gravels
- Sand
- Steel reinforcement

Similar materials will be used during the rehabilitation works on the perimeter road.

All the wastes should be minimised, sorted, reused and recycled wherever practicable. There may be the opportunity of further community benefit through waste reuse where practicable. Special care will be given to food waste, which will be kept separate in enclosed areas to avoid pest and odour, or composted / disposed of rapidly.

This will be an impact posing a risk to the terrestrial environment and soils resulting from leakages and spillages of materials (such as fuel, oils and other chemicals) and corresponding wastes, due to poor handling and storage techniques on site during construction activities. The magnitude of such impact is considered to be 'moderate adverse as it will cause a detectable change to the receiving environment and it will result in a non-fundamental and temporary change. The environmental receptors identified in this ESIA, are considered to be of 'medium' sensitivity resulting in a moderate adverse impact resulting in a moderate adverse impact significance.

7.9.4.2 Waste management resulting in potential contamination to the environment

During construction, the majority of the waste would be generated within the immediate environs of the works area and equipment laydown areas. Table 59 below summarises waste streams that are expected to be generated as part of the Project as well as their potential impacts, how wastes will be handled/stored and the method of disposal for each waste stream. All waste taken off site will be done so in accordance with NEMA regulations and certified contractors to certified disposal sites which may be in Nairobi.

Table 59: Wastes streams

Waste Type	Potential Impact	Handling / Storage Method
Excavation spoil	Contamination of receiving environments such as sedimentation of water bodies Fugitive dust emissions Disposal of spoil and excavation material which results in land take	Temporary storage in stock piles for further use on site or removal. Excess material will be disposed of in spoil disposal sites or used to level off the site. Community re-use
Concrete mix	Fugitive dust emissions Disposal to landfill, where waste re-use or recovery is not feasible Increased waste miles from transporting waste materials from the Project site	To be segregated and suitably stored on a temporary basis in a waste management area. Using it in other work locations or returning unused cement to the vendor can minimise the volume of waste Community re-use
Concrete washings	Contamination of receiving environments such as sedimentation of water bodies	Wash water which cannot be immediately reused is to be stored in an open lined pit or open tanks so as to aid sedimentation or other on-site treatment as appropriate.
Cement	Contamination of receiving environments	Segregated and suitably stored on a temporary basis in a waste management area. Community re-use
Iron and steel scrap	The use of landfill, where waste re-use or recovery is not feasible Visual amenity impacts associated with poor storage of waste Increased waste miles from transporting waste materials from the Project site.	Segregated and suitably stored on a temporary basis in a waste management area. Community re-use
Non-ferrous scrap	The use of landfill, where waste re-use or recovery is not feasible Visual amenity impacts associated with poor storage of waste Increased waste miles from transporting waste materials from the Project site.	Segregated and suitably stored on a temporary basis in a waste management area. Community re-use
Packaging	The use of landfill, where waste re-use or recovery is not feasible Visual amenity impacts associated with poor storage of waste Increased waste miles from transporting waste materials from the Project site.	Segregated and suitably stored on a temporary basis in a waste management area. Certified offsite disposal
Pallets	The use of landfill, where waste re-use or recovery is not feasible Increased waste miles from transporting waste materials from the Project site.	Segregated and suitably stored on a temporary basis in a waste management area. Certified offsite disposal

		Community re-use
Glass	The use of landfill, where waste re-use or recovery is not feasible Increased waste miles from transporting waste materials from the Project site.	Segregated and suitably stored on a temporary basis in a waste management area Certified offsite disposal Community re-use.
Paper and cardboard	The use of landfill, where waste re-use or recovery is not feasible Visual amenity impacts associated with poor storage of waste Increased waste miles from transporting waste materials from the Project site.	Segregated and suitably stored on a temporary basis in a waste management area. Certified offsite disposal Community re-use
Timber	The use of landfill, where waste re-use or recovery is not feasible	Segregated and suitably stored on a temporary basis in a waste management area. Certified offsite disposal Community re-use
Non-Hazardous Construction waste		
General domestic waste	The use of landfill, where waste re-use or recovery is not feasible Visual amenity impacts associated with poor storage of waste Increased waste miles from transporting waste materials from the Project site.	To be segregated and suitably stored on a temporary basis in a waste management area. Certified offsite disposal
Plastics	The use of landfill, where waste re-use or recovery is not feasible Visual amenity impacts associated with poor storage of waste Increased waste miles from transporting waste materials from the Project site.	To be segregated and suitably stored on a temporary basis in a waste management area. Certified offsite disposal
Drums, barrels and containers from non-hazardous materials	The use of landfill, where waste re-use or recovery is not feasible Visual amenity impacts associated with poor storage of waste; and Increased waste miles from transporting waste materials from the Project site.	Segregated and suitably stored on a temporary basis in a waste management area. Certified offsite disposal
Hazardous wastes		
Oils and lubricants	Hazardous. Contamination of receiving environments The use of landfill, where waste re-use or recovery is not feasible	Hazardous. Collected on a temporary basis in bunded, segregated marked drums within a designated waste management area. Certified offsite disposal
Oil contaminated cloths	Hazardous. Contamination of receiving environments The use of landfill, where waste re-use or recovery is not feasible	Hazardous. To be segregated and suitably stored on a temporary basis in a waste management area. Certified offsite disposal
Batteries	Hazardous. Contamination of receiving environments The use of landfill, where waste re-use or recovery is not feasible	Hazardous. To be segregated and suitably stored on a temporary basis in a waste management area. Certified offsite disposal
Chemicals	Hazardous. Contamination of receiving environments The use of landfill, where waste re-use or recovery is not feasible.	Hazardous. Collected in bunded, segregated drums and suitably stored on a temporary basis within a waste management area. Certified offsite disposal
Used solvents	Hazardous Contamination of receiving environments	Hazardous. Collected in bunded, segregated drums and suitably stored on a temporary basis within a waste management area. Certified offsite disposal
Tyres	The use of landfill, where waste re-use or recovery is not feasible Visual amenity impacts associated with poor storage of waste; and Increased waste miles from transporting	Segregated and suitably stored on a temporary basis in a waste management area. Certified offsite disposal

	waste materials from the Project site.

Excavation materials from access road, foundation excavation, and cable trenching will potentially represent the largest volume of waste. It should be possible to use the material for landscaping purposes and this will be undertaken where ever possible or as part of re-instatement plans in the case of temporary infrastructure.

Storage / disposal sites for excavated materials should be such as to prevent risk of landslide, presenting a health and safety impact. Materials will be disposed to extracted borrow pits away from any sensitive or productive land.

The sensitivity of disposal options to receiving Project waste is shown in Table 60.

Table 60: Receptor Sensitivity of Waste Disposal Options

Disposal Option	Sensitivity	Comment
Export for disposal	Low	Has alternative impacts in relation to transport emissions, removes potential positive impacts in relation to re-use that may be exploited in-country.
Set up arrangement with existing hazardous site (Nairobi)	High	Potential restricted availability.
Landfill disposal (non-hazardous) within Kenya generally (Nairobi)	High	A number of landfills are unmanaged and unregulated and already over-used or unable to mange existing waste streams.
Re-use or recycling within the local community	Medium (positive and negative)	Will require careful management in relation to managing community health and safety and security measures but does offer a potential positive impact.
Burial of non-hazardous waste in unlined excavations near to Project site	Medium	Not allowed
Use of KenGen incinerator for oily wastes	Medium	Authorised for the hydropower plants only but may have spare capacity and authorised by NEMA
Burning	High	Not Allowed.

Any re-use, recycling or treatment (i.e. crushing of concrete for foundation works) will, wherever practicable take place on site or adjacent to the works area. However, it is possible that some disposal and treatment of materials may be required either locally or further afield. It also considers that the disposal and treatment of materials outside this area would take place in the wider zone of influence in demarcated areas. It is noted that where recovery options are identified as feasible that this may result in waste being taken outside Kenya to be dealt with in the country of origin (e.g. packaging waste).

Typical hazardous wastes that may be generated through Project activities is outlined in Table 61. Hazardous wastes will be collected and stored for onward disposal to an existing certified hazardous waste disposal facility in Kenya.

Table 61: Hazardous Waste

Category	Description / Examples	Typical Volumes (magnitude)
Oils and solvents	Empty containers, oily rages, thinners, solvents, degreasers, hydraulic fluids, lube oils, used oil, spill clean up absorbent materials	Across whole Project – estimate 2 tonnes per week
Paints	Primers, paints and empty cans	
Coatings	Used for coating joints or repairing factory joints applied coatings	
Batteries	Vehicles, portable equipment	

Sensitivity of the impact to receptors from waste generation (hazardous and non-hazardous) is considered to be medium due to the location, availability and suitability of NEMA certified

disposal options. The magnitude of the impact is considered to moderate resulting in an overall impact pre-mitigation of moderate adverse significance.

7.9.5 Operation

7.9.5.1 Waste generation and management resulting in contamination to the receiving environment

All the waste material types specified could be classified as inert, non-hazardous or hazardous under national and international definitions and depending on their nature, will require appropriate handling, treatment and disposal. Any inert or non-hazardous materials have the potential to be reused and recycled either on-site or off-site. During operation it is identified that the following categories of hazardous waste would be generated.

- Oils from maintenance
- Scrap metal
- Oily rags and overalls
- Spent safety equipment

It is considered unlikely that there would be production of large quantities of hazardous wastes. Oily rags may be treated at the KenGen incinerator facility (attached to the hydropower operations). Other waste will be required to go to a NEMA certified landfill or re-used within the community. Volumes are expected to be small. As such the sensitivity of the available waste disposal options to accommodate this waste is considered to be low and the magnitude minor resulting in an overall impact significance of minor.

7.9.6 Decommissioning

Impacts in relation to these activities are considered in Table 62.

Table 62:Decommissioning

Activity	Waste Stream	Estimated Volume (magnitude - (major, moderate, minor)	Potential impact	Disposal option currently available	Sensitivity	Significance
Decommissioning concrete waste	Redundant equipment concrete foundations	Moderate	Operational contamination	Community re-use	Low	Minor
Other non-hazardous waste (steel, cabling)	**Redundant equipment**	**Moderate**	**Operational contamination**	**NEMA regulated disposal site**	**Medium**	**Moderate**
Contaminated excavation waste	Contaminated material excavated during expansion works from operational area.	Negligible	Operational contamination	NEMA regulated disposal site	High	Insignificant
Removal of PV panels	**Redundant equipment**	**Moderate**	**Hazardous waste**	**Storage in Kenya in anticipation of export for appropriate disposal Supplier " end of life recycling"**	**Medium**	**Moderate**

Activity	Waste Stream	Estimated Volume (magnitude - (major, moderate, minor)	Potential impact	Disposal option currently available	Sensitivity	Significance
				progam NEMA regulated disposal site		

Should Thin-film modules be considered it will be necessary to revisit end of life options for disposal as cadmium is a heavy metal and disposal of this toxic waste when the product reaches the end of its life can be costly.

7.9.7 Summary of significance

Table 63 summarises the findings of the impact assessment pre-mitigation. Chapter 9 elaborates on how significant impacts may be eliminated, reduced, offset, managed or mitigated to acceptable levels.

Table 63: Summary of impacts – waste management

Potential impact	Adverse /Beneficial	Magnitude	Sensitivity	Impact evaluation (pre- mitigation)
Waste and Materials				
Construction				
Material use contaminate receiving environment	Adverse	Moderate	Medium	Moderate adverse
Waste generation contaminate receiving environment	Adverse	Moderate	Medium	Moderate adverse
Operation				
Waste generation contaminate receiving environment	Adverse	Low	Minor	Minor adverse
Decommissioning				
Waste generation contaminate receiving environment	Adverse	Moderate	Medium	Moderate adverse
End of life disposal of PV panels	Adverse	Moderate	Medium	Moderate adverse

7.10 Noise

7.10.1 Introduction

This section predicts noise impacts expected to occur as a result of the Project and assess the beneficial and adverse effects by predicting their significance prior to mitigation. Impacts have been considered and assessed for the site preparation and where relevant decommissioning. No noise impacts are expected during operation.

7.10.2 Impact identification

Construction work is transient in nature and generally includes both stationary and moving sources of noise. Stationary sources include construction plant positioned at a given location on a temporary basis while moving sources normally comprise mobile plant and vehicles. Heavy plant such as trucks, excavators, and piling rigs typically generate the highest levels of noise. Key activities during the construction phase that could give rise to noise impacts are:

- Perimeter road upgrade
- Internal access road development
- Site preparation, in particular forestry clearance, piling and excavation works
- Transportation of construction plant and Project components
- Assembly of Project components
- Site employee vehicles

The noise levels generated during construction activity depend on plant in use and operational mode.

No operational impacts are envisaged.

Key activities during the decommissioning phase that could give rise to noise impacts are:

- Demolition of plant and electrical systems
- Removal of plant and electrical system materials from site
- Structural foundation removal
- Decommissioning plant item movements

7.10.3 Sensitivity and magnitude

The sensitivity criteria relating to noise impacts are detailed in Table 64.

Table 64: Construction noise receptor sensitivity criteria

Sensitivity	Receptor
High	Residential areas, hospitals, schools, colleges or universities, places of worship, recreational areas
Medium	Offices, recreational areas, isolated residences, major roads, footpaths/cycle paths, agricultural land
Low	Scrub land, public open space, minor roads, industrial areas, car parks
Negligible	Derelict land

For the purposes of this assessment, all sensitive receptors in the AOI are considered to be of medium sensitivity.

The magnitude of the impact estimates the predicted level of noise received at a sensitive receptor and the duration of exposure due to construction activity. The magnitude criteria have been derived from guidance provided by the WHO and other applicable bodies and is presented in Table 65.

Table 65: Assessment of magnitude for construction noise

Magnitude of Impact (positive or negative)	Definition	Duration	Construction noise at receptor dB(A)
Major	A significant change in conditions	Months	65 – 70
		Weeks	70 – 75
		Days	> 75
Moderate	A material but non-significant change in conditions	Months	60 – 65
		Weeks	65 – 70
		Days	70 – 75
Minor	A perceptible but restricted change in conditions	Months	55– 60
		Weeks	60 – 65
		Days	65 – 70
Negligible	A potentially perceptible but non-significant change	Months	< 55

Magnitude of Impact (positive or negative)	Definition	Duration	Construction noise at receptor dB(A)
	in conditions	Weeks	< 60
		Days	< 65

7.10.4 Construction

Typically noise from activities drops off at distances up to 200m from the source of noise. Beyond 200m, the reliability of any calculations reduces due to the influence of meteorological effects on how noise propagates in the environment (mainly due to wind direction). During baseline data collection works, baseline noise levels have been taken so that in the future if noise impacts are realized a quantitative assessment may be performed.

7.10.4.1 General site establishment works and perimeter road upgrade

The activities of the various site establishment works and the installation of the PV plant will cause noise impacts to the human and ecological receptors. Activities that will create noise are listed below and they are expected to be in operation approximately 25% of the time for a total of eight months during site establishment (three months) and construction (five months):

- Distribution of material: dump truck (tipping fill)
- Rolling and compaction: vibratory roller
- Excavation for foundations and drainage channelling: excavator

There are a number of uncertainties in terms of equipment to be used and techniques to be employed at the Project site. The closest sensitive receptors are located within 200m of the site boundary. Based on a highest predicted construction noise of 75dB(A) 200m from the worksite and a duration of three months, a major magnitude is expected, with receptors being of medium sensitivity, resulting in moderate to major adverse significance without mitigation.

7.10.4.2 Construction traffic noise

The flow of traffic is expected to be variable and intermittent such that it would not be possible to make a meaningful quantitative assessment of the associated noise impacts. The anticipated change in noise produced by construction traffic is assumed to be minor magnitude, based on intermittent vehicles which will deliver the equipment to site.

The nearby properties could be adversely affected from a small number of movements or even the passage of a single heavy vehicle in close proximity to receptors at a sensitive time of the day and therefore a medium sensitivity is applied. The impact significance is moderate adverse significance.

7.10.4.3 Operational impacts

No noise impacts were identified during operation.

7.10.4.4 Decommissioning plant equipment

The potential noise impacts of the decommissioning phase are similar in nature to those of the construction phase including potential impacts from the decommissioning of the plant and then the traffic activity. Decommissioning noise is however typically less intrusive due to a reduced need for heavy plant and a shorter duration of works and this is assumed as minor impact. The sensitivity of the receptors is the same as during construction (medium sensitivity). Based on the findings of the construction traffic assessment, it is likely that the received noise levels from decommissioning work would be of minor significance.

7.10.4.5 Decommissioning traffic noise

The potential decommissioning traffic noise impacts are likely to be similar to those of the construction phase. A lesser impact is, however, anticipated from decommissioning traffic movements due to reduced traffic volumes and a shorter duration of work and this is assumed as minor impact. The sensitivity of the receptors is the same as during construction (medium sensitivity). Based on the findings of the construction traffic assessment, it is likely that the received noise levels from decommissioning traffic activity would be of minor significance.

7.10.5 Summary of significance

Table 66 summarises the findings of the impact assessment pre-mitigation. Chapter 9 elaborates on how significant impacts may be eliminated, reduced, offset, managed or mitigated to acceptable levels.

Table 66: Summary of impacts – noise

Potential impact	Adverse /Beneficial	Sensitivity	Magnitude	Impact evaluation (pre-mitigation)
Construction				
General site works	Adverse	Medium	Moderate to high	Major adverse
Traffic noise	Adverse	Medium	Moderate	Moderate adverse
Decommissioning				
General site works	Adverse	Minor	Moderate to high	Minor adverse
Traffic noise	Adverse	Minor	Moderate	Minor adverse

7.11 Climate and Greenhouse gas (GHG) emissions

7.11.1 Introduction

There area some aspects of the Project that can affect the climate. IFC PS3 requires any Project to seek to reduce Project related GHG emissions (IFC 2012) in addition large solar arrays can have the effect of creating microclimates under the panels.

7.11.2 Impact identification

Greenhouse gas emissions will both be avoided and generated by the Project from displacement of heavy fuel oil (HFO) generators and the need to employ GHG emitting activities during the construction and operation phase.

It is possible that solar Projects can have the consequence for microclimates and carbon cycling. The physical presence of solar parks will impact solar radiation fluxes (and thus temperature), wind speed and turbulence (and thus the exchange of biogenic gases and water vapour) and the distribution of precipitation within the solar park[51].

7.11.3 Impact assessment

7.11.3.1 Greenhouse gas emissions

Based on information calculation in the Seven Forks Development Impact Assessment, June 2017 it is estimated that approximately 267 MWh of HFO / diesel generation would be displaced daily and approximate 97.62 GWh of diesel / HFO generation would be displaced annually. Avoided emission for carbon dioxide (CO_2), nitrogen oxides (NO_x), sulphur oxides (SO_X) and carbon monoxide (CO) have been calculated by multiplying the heat rate for the diesel generators (assumed to be 8,000Btu/kWh by the emission factors [(a)] for diesel fuel. The results are reproduced in Table 67.

Table 67: Avoided emissions [(b)]

Description	Emission Factors (kg/MMBtu)	Heat rate (Btu/KWh) [(c)]	Yearly generation displaced (gwh)	Amount (metric tons)
CO_2 avoided	73.32	8,000	97.62	57,257
NO_x avoided	2.00	8,000	97.62	1,565
SO_X avoided	0.13	8,000	97.62	103
CO avoided	0.43	8,000	97.62	337

Source: K&M Advisors Seven Forks Solar Power Project Development Impact Assessment, September 2017

Notes:

(a)US Environmental Protection Agency, Emission Factor and AP-42, Volume 1 Chapter 3, Station internal Combustion Engine sources,

(b) Annual emission avoided = emission factor x heat rate x yearly generation

(c) K&M assumptions

This calculation indicates 57,257 tCO_2 eq of GHG emission offset by the Project annually, not accounting for direct and indirect GHG emissions resulting from the Project lifecycle carbon count.

The following estimated direct and indirect emissions during the construction and operation of the Project have been applied to relevant activities:

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- Transportation movements: 100 trucks during construction from Nairobi (220km), multiplied by two to account for two-way trip each time, running on diesel fuel: Est. total 500 tCO2 eq / year
- Electricity consumption from the grid (during construction): Est. total 2,000 tCO_2 eq / year

In addition, IFC assumes that:

- 29.20 tCO_2eq/MW of "other" GHG emissions beyond the Project boundary: Total: 1,314 tCO_2 eq/ per year

Using very conservative assumptions, the combined GHG emission is 4,814 tCO_2 eq / year which is well below the 25,000 tCO_2 eq / year range cited by IFC PS3 resulting in a minor magnitude against a high sensitivity receptor resulting in minor adverse impact.

7.11.3.2 Microclimates

The changes in microclimate (temperature, wind, moisture and humidity may be affected by the installation of a solar plant. Based on review of existing literature the evidence suggests that impacts are predominantly localized. Generally it is believed the solar panels exacerbate diurnal or seasonal variability making temperatures in winter and summer colder or warmer than normal although the variation in temperatures on a daily basis under the panels is less than without the panels. The resultant impact may include reduced growing productivity. Other considerations include solar park management, in particular that relating to the vegetation (i.e. seeding, mowing, grazing and fertilizer addition), as this will be a strong determinant of ecosystem response. In addition, this site it is noted that the presence of the reservoir (large water body) adjacent to the site already has already modified the microclimate of this area.

Given the activities at the site and adjacent to the site we consider the sensitivity of the ecosystem to these changes to be low noting that bees will be translocated) and the magnitude of the impact to be minor resulting in an overall significance of minor.

7.11.4 Summary of significance

Table 68 summarizes the findings of the impact assessment pre-mitigation. Chapter 9 elaborates on how significant impacts may be eliminated, reduced, offset, managed or mitigated to acceptable levels.

Table 68: Summary of impacts – GHG

Potential impact	Adverse /Beneficial	Sensitivity	Magnitude	Impact evaluation (pre-mitigation)
Avoided CO_2 emissions	Beneficial	High	Moderate	Major beneficial
GHG emissions (per year)	Adverse	High	Low	Minor adverse
Change in microclimate	Adverse	Low	Minor	Minor adverse

7.12 Summary of all impacts (pre-mitigation)

The following table summarises all the impacts defined and their impact significance pre-mitigation.

Those with moderate adverse impact or higher will be the focus of mitigation in Chapter 8.

Table 69: Summary of significance – all impacts

Potential impact	Adverse /Beneficial	Sensitivity	Magnitude	Impact evaluation (pre-mitigation / enhancement)
Socio economic				
Construction				
Employment generation (direct and indirect)	Beneficial	Medium	Minor	Minor beneficial
Occupational health and safety and labour rights (unskilled / low skilled workers)	Adverse	High	Moderate	Major adverse
Occupational health and safety and labour rights (skilled workers)	Adverse	Low	Moderate	Minor adverse
Project induced migration	Adverse	High	Minor	Moderate adverse
Community health, safety and security (traffic, nuisance, material storage, antisocial behaviour, public health)	Adverse	High	Minor	Moderate adverse
Land use change and economic displacement	Adverse	High	Moderate	Major adverse
Archaeology and cultural heritage	Adverse			
Above ground features	Adverse	Low	Minor	Minor adverse
Unknown artefacts	Adverse	Medium	Moderate	Moderate adverse
Designated sites	Adverse	Negligible	Negligible	Insignificant
Cultural land use (recognition of historical linkage)	Adverse	Medium	Moderate	Moderate adverse
Oral traditions	Adverse	Low	Minor	Minor adverse
Medicinal value trees	Adverse	Medium	Major	Major adverse
Operation				
Employment generation (direct and indirect)	Beneficial	Medium	Minor	Minor beneficial
Electricity diversification and clean energy – National level	Beneficial	Medium	Moderate	Moderate beneficial
Electricity diversification and clean energy –local level	Beneficial	Low	Negligible	Insignificant
Biodiversity				
Construction				
Impact to protected areas – Mwea National Reserve	Adverse	High	Negligible	Insignificant
Disturbance / destruction of flora – Endangered *Ethulia scheffleri*	Adverse	High	Negligible	Insignificant
Disturbance / destruction of flora –Near Threatened *Carex phragmitoides*	Adverse	Medium	Negligible	Insignificant
Disturbance, degradation, destruction and	Adverse	Medium	Moderate	Moderate adverse

Potential impact	Adverse /Beneficial	Sensitivity	Magnitude	Impact evaluation (pre-mitigation / enhancement)
fragmentation – Woodland habitat				
Disturbance, degradation, destruction and fragmentation – Other plant species	Adverse	Low	Moderate	Minor adverse
Disturbance and habitat loss/degradation – Near Threatened striped hyena (*Hyaena hyaena*)	Adverse	Low	Minor	Minor adverse
Disturbance and habitat loss/degradation – Kenya Priority Species African Elephant	Adverse	High	Minor	Moderate adverse
Disturbance and habitat loss/degradation – Other mammal species	Adverse	Low	Moderate	Moderate adverse
Disturbance and habitat loss/degradation – Near Threatened Denham's Bustard (*Neotis denhami*)	Adverse	Medium	Moderate	Moderate adverse
Disturbance and habitat loss/degradation – Endangered Basra reed-warble (Acrocephalus griseldis)	Adverse	High	Negligible	Insignificant
Disturbance and habitat loss/degradation – Other bird species	Adverse	Low	Minor	Minor adverse
Disturbance and habitat loss/degradation – Herpetofauna	Adverse	Low	Minor	Minor adverse
Disturbance and habitat loss/degradation – Insects	Adverse	Low	Minor	Minor adverse
Operation				
Impact on protected areas – Mwea National Reserve	Adverse	High	Negligible	Insignificant
Disturbance and habitat loss/degradation – Woodland habitat	Adverse	Low	Moderate	Moderate adverse
Disturbance and habitat loss/degradation – Other plant species	Adverse	Low	Moderate	Moderate adverse
Disturbance / destruction of flora – Endangered *Ethulia scheffleri*	Adverse	High	Negligible	Insignificant
Disturbance / destruction of flora –Near Threatened *Carex phragmitoides*	Adverse	Medium	Minor	Minor adverse
Disturbance and habitat loss/degradation – Near Threatened striped hyena (*Hyaena hyaena*)	Adverse	Low	Minor	Minor adverse
Disturbance and habitat loss/degradation – Kenya Priority Species African Elephant	Adverse	High	Minor	Moderate adverse
Disturbance and habitat loss/degradation – Other mammal species	Adverse	Low	Minor	Minor adverse