Sosian Energy
A Diversified Energy Company

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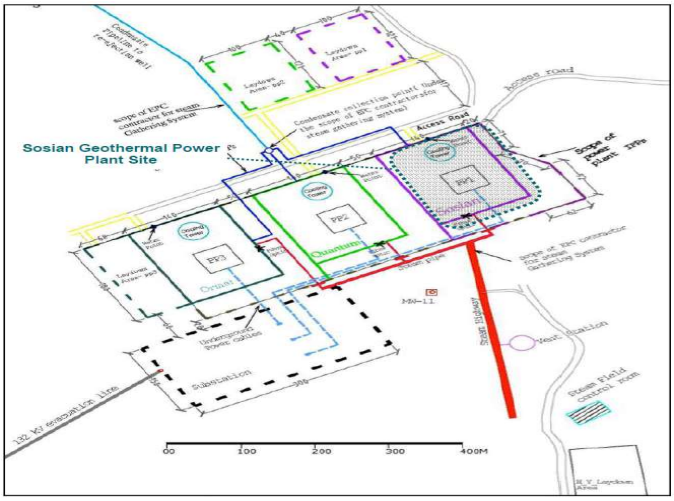
UPDATED ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT REPORT FOR THE DEVELOPMENT OF 1X35 MW GEOTHERMAL POWER PLANT IN MENENGAI



FINAL REPORT

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UPDATED ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT REPORT FOR THE DEVELOPMENT OF 1X35 MW GEOTHERMAL POWER PLANT IN MENENGAI

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ACRONYMS

ACGIH	American Conference of Governmental Industrial Hygienists
ADMS	Atmospheric Dispersion Modelling System
AfDB	African Development Bank
AIDS	Acquired Immune Deficiency Syndrome
ANSI	American National Standard Institute
AQSRs	Air Quality Sensitive Receptors
ASALs	Arid and Semiarid Lands
ASG	Atmospheric Studies Group
BOO	Build Own and Operate
CDM	Clean Development Mechanism
CEDAW	Convention on the Elimination of all forms of Discrimination against Women
CFCs	Chlorofluorocarbons
CIA	Cumulative Impact Assessment
CITES	Convention on International Trade in Endangered Species
dB	Decibels
DCS	Distributed Control System
DOSH	Directorate of Occupational Safety and Health
EA	Environmental Audit
ECD	Early Childhood Development
EIA	Environmental Impact Assessment
EIS	Environmental Impact Study
EMCA	Environmental Management and Coordination Act
EMP	Environmental Management Plan
EPC	Engineering, Procurement and Construction
ERC	Energy Regulatory Commission
ESIA	Environmental & Social Impact Assessment
FIs	Financial Intermediaries
FOMEC	Friends of Menengai Crater
GHGs	Green House Gases
GPS	Geographical Positioning System
H_2S	Hydrogen sulphide
HIV/AIDS	Human Immunodeficiency Virus / Acquired Immune Deficiency Syndrome
HVAC	Heating, ventilation and Air Conditioning system
IFC	International Finance Corporation
ILO	International Labour Organization
IMCE	Inter ministerial Committee on Environment
IPP	Independent Power Producer
IUCN	International Union for Conservation of Nature
KAP	Knowledge Attitude Practice
KEBS	Kenya Bureau of Standards
KETRACO	Kenya Electricity Transmission Company
KFS	Kenya Forest Service
KPLC	Kenya Power and Lighting Company (now Kenya Power)
KRA	Kenya Revenue Authority
KWS	Kenya Wildlife Service
LOAEL	Lowest observable adverse effect level
LPG	Liquefied petroleum gas
LRVPs	Liquid Ring Vacuum Pumps
LSA	Later Stone Age
MDBs	Multinational Development Banks
MDGs	Millennium Development Goals
MEAs	Multilateral Environmental Agreements
MoEP	Ministry of Energy and Petroleum
MSDS	Materials Safety Data Sheets
MW	Mega Watts
NACADA	National Authority for the Campaign Against Drug and Alcohol Abuse

NACC	National AIDS Control Council
NARUWASCO	Nakuru Rural Water and Sanitation Company
NAWASSCO	Nakuru Water Sanitation Services Company
NCGs	Non condensable Gases
NEMA	National Environment Management Authority
NET	National Environment Tribunal
NFPA	United States National Fire Protection Association
NSRs	Noise Sensitive Receptors
ODS	Ozone Depleting Substances
OS	Operational Safeguard
OSHA	Occupational Health and Safety Act
OTTL	Orpower Twenty-Two Limited
OTTL	Orpower Twenty-Two Limited
PAPs	Project Affected Persons
PES	Payment for Environmental Services
PISSA	Project Implementation and Steam Supply Agreement
PPA	Power Purchase Agreement
PPE	Personal Protective Equipment
ppm	Parts per million
QPEA	Quantum Power East Africa
RTI	Respiratory Tract Infections
RVWSB	Rift Valley Water Services Board
SACCOs	Savings and Credit Cooperative Societies
SEAs	Strategic Environmental Assessment
SERC	Standards and Enforcement Review Committee
STI	Sexually Transmitted infection
TLV	Threshold Limit Value
TOR	Terms of Reference
UN	United Nations
UNESCO	United Nations Educational, Scientific and Cultural Organisation
UNIDO	United Nations Industrial Development Organization
USGS	United States Geological Survey
VECs	Valued Environmental and Social Components
WB	World Bank
WHO	World Health Organization
WIBA	Work Injury Benefits Act
WRMA	Water Resources Management Authority
WRUA	Water Resource Users Association

EXECUTIVE SUMMARY

E1 Project Background and Components

Sosian Geothermal Power Plants Ltd (here after referred to as Sosian) was awarded a tender by Geothermal Development Corporation (GDC) through competitive bidding to install and operate 1x35MW Geothermal Modular Power Plant in Menengai Geothermal Field in Nakuru County for 25 years on a Build - Own - Operate (BOO) basis. The purpose of the Power Plant Project is to increase the power generation capacity of Kenya to enhance socio- economic development and diversify sources of power supply by developing the country's huge geothermal potential. The justification for the site is the availability of Steam from the Geothermal Wells; the primary fuel for the project.

The project area is bounded by 36°01'E and 36°07'E and 0°09'S and 0°15'S. Administratively, the Menengai Geothermal field lies within Rongai and Nakuru North Sub Counties of Nakuru County and approximately 188km from Nairobi. The geothermal power plant will be constructed within the caldera area which falls in Mercy Njeri sub location. Menengai crater forest reserve is a public land under the management of Kenya Forest Service (KFS). GDC has a memorandum of understanding with KFS on the development of geothermal resources within the reserve.

The power plant will be driven by steam owned by the GDC and supplied to the Power Plant under the terms in the Project Implementation and Steam Supply Agreement (PISSA) to generate a net electrical capacity of 35MW.

GDC has already drilled over twenty wells within the Menengai Caldera, each with an estimated production of 5 to 10MW. Ancillary infrastructure already developed by the GDC includes the steam gathering and distribution systems, brine sump ponds, reinjection wells, access roads, boreholes and water pipelines. The Steam System comprise high-pressure steam piping of carbon steel with 3 mm corrosion allowance, rock wool insulated with aluminium cladding. The design pressure and temperature of the main steam system is 11 barg and 190°C.

The design of the Plant is based on a single-flash steam cycle with a condensing turbine. Nominal gross capacity will be 37.7 MW and Guaranteed Net Plant Output is 35 MW. The main plant system components include:

- A turbine generator unit with power output rating of 37.63 MW as measured at the generator terminal;
- Condenser and turbine drain system;
- Non-Condensable Gas (NCG) dispersion system through cooling towers;
- Main and Auxiliary cooling water circuit;
- Compressed air system: for air supplies to pneumatic operated valves;
- Electrical system: voltage levels in the system are 415V, 690V, 11kVand132kV, 50Hz; connected power is dimensioned to 50MVA at the main transformer with11kV at the MV side and 132kV at the HV side; and the Generator power output is 37.63MW electrical power;
- Earthing and Lightning protection;
- Transformers: Step Up transformer rated at 11/132 kV, 50 MVA; Station Service transformer rated at 11/0,69 kV, 4 MVA; and Auxiliary transformer rated at 690/415 V, 315 kVA;
- Instrument and control system;
- Process Control System for the total power plant based upon Distributed Control System (DCS), including the SCADA functionality with I/O, internal and external communication;
- Fire, Security and Detection System;
- Heating, ventilation and Air Conditioning (HVAC) system;

- H_2S safety system: for both human hazard detection system and equipment protection system

The construction process is scheduled to start seven days after an updated effective date between GDC/KPLC and Sosian Geothermal Power Plants Ltd in the mutually agreed Project Implementation and Steam Supply Agreement (PISSA) and is estimated to take 2 years. Power generated will be supplied to Kenya Power Company (KPLC) under the terms in the Power Purchase Agreement (PPA). The power will be generated at 11kV and stepped up to 132kV and evacuated by transmission line, an associated facility, already constructed and commissioned by Kenya Transmission Company (KETRACO).

GIBB Africa Ltd as a Firm of Experts Registered by NEMA was commissioned by Sosian Geothermal Power Plants Ltd, to undertake an ESIA Study update for the proposed 1x35 MW Modular Geothermal Power Plant so that the report would comply with Multinational Development Banks (MDBs) and the International Finance Corporation (IFC) performance standards, and equator principles among other international best practices. The ESIA Study was initially undertaken by the University of Eldoret on behalf of Geothermal Development Company Limited (GDC) for all the proposed 3x35 MW Modular Geothermal Power Plant. The initial ESIA study report was submitted to National Environment Management Authority (NEMA), application reference no. EIA/872 and approved in November 2012 vide NEMA license registration No. 0014205. The update study was conducted through: desktop review of earlier reports and other related literature to identify gaps; baseline socio-economic survey; eight (8) public meetings with communities in the project area; interviews with key informants including various government agencies; and specialist impact modelling for hydrogen sulphide dispersion using Atmospheric Dispersion Modelling System version 4.2 (ADMS 4) as well as noise modelling using the Calculation of Sound Propagation by the Concave method' (SANS 10357, 2004).

E2 Policy, Legal and Regulatory Framework

The role of the environment in sustaining national heritage is recognized in the Constitution of Kenya, 2010 as a heritage of inter-generational benefit. Section 69 of the constitution explains each and every citizen's obligations in respect of the environment. It obligates the state to sensure sustainable exploitation, utilisation, management and conservation of the environment and natural resources, and ensures the equitable sharing of the accruing benefits. The main legal and institutional framework for the management of environment and for matters connected therewith and incidental thereto for environmental management in Kenya is Environmental Management and Coordination Act (EMCA), 1999 as amended in 2015. EMCA has provided for the development of several subsidiary legislations and guidelines which govern environmental management and are relevant to the project implementation. These include;

- The Environmental (Impact Assessment and Audit) Regulations, 2003 Legal Notice No. 101;
- The Environmental Management and Coordination (Waste Management) Regulations, 2006 Legal Notice No. 121;
- The Environmental Management and Coordination (Water Quality) Regulations, 2006 Legal Notice No. 120;
- The Environmental Management and Coordination (Noise and Excessive Vibration Pollution) (Control) Regulations, 2009 Legal Notice No. 61;
- The Environmental Management and Coordination (Conservation of Biological Diversity and Resources, Access to Genetic Resources and Benefit Sharing) Regulations, 2006 Legal Notice No. 160;
- The Environmental Management and Coordination (Controlled Substances) Regulations, 2007 Legal Notice No. 73; and
- The Environmental Management and Coordination (Air Quality Control) Regulations, 2014 Legal Notice No. 34.

The new Constitution and EMCA therefore obligates the Sosian Geothermal Power Plants Ltd and its contractors to work in a clean environment and not to contravene the right of any person within its zone of influence, to this entitlement. National environment Management Authority is

the lead EMCA enforcement agency. The Occupational Safety and Health Act, 2007 provides for the safety, health and welfare of all workers and all persons lawfully present at workplaces and hence promote healthy environments and is enforced by Directorate of Occupational Safety and Health Services (DOSHS). Other relevant legislations with provisions cross-cutting the project's implementation and environmental, management have also been reviewed in the main ESIA report.

With reference to AfDB safeguards, the project triggers all the five AfDB Operational Safeguards (OS). Under EMCA, the project is categorised as High Risk (geothermal power generation above 10MW) which is comparable to the guidelines within the Bank's ESAP for all power generating plants exceeding a generating capacity threshold of 30MW. Accordingly, OS 1 on Environmental Assessment has been triggered because the component activities have the potential to generate significant environmental and social impacts to identified receptors within its area of influence. An EIA license has already been granted by NEMA against original study by GDC in 2012. OS2 has been triggered given that section of the 15km 132kV T-line which is an Associated Facility implemented by KETRACO led to land acquisition that affected 25 individuals and government institutions. Apart from land acquisition, no physical displacement resulted from the process. OS 3 is triggered because the project is sited within a nationally gazette public forest land. OS 4 on Pollution Prevention and Hazardous Substances is triggered since construction and operation phases will involve use of fuels and possibly some hazardous materials including discharge of brine. Finally, OS 5 on Labour, Working Conditions, Occupational Health and Safety is triggered since the construction will involve a significant number of construction workers and the operation phase has potentially significant occupational health hazards.

E3 Existing Project Environment

The project area administratively lies within Nakuru North and Rongai sub counties of Nakuru county. The area is classified into two main agro-climatic zones. The lowland areas of Mogotio and Kisanana in the north are located in semi-arid zone IV with an annual rainfall of 800 mm and mean temperatures of 30°C. Bahati and parts of Kampi ya Moto divisions with an altitude of between 1800 m and 2400 m above sea level and average rainfall of between 760 mm and 1270 mm per year fall within a dry sub-humid equatorial climatic zone.

As per the last (2009) national housing and population census, Nakuru North and Rongai sub counties have a total population of 211,691 (103,316 males and 108,375 females) and 163,864 (82,665 males and 81,199 females) respectively. Nakuru North and Rongai are predominantly agricultural sub counties in the suburbs of Nakuru town with maize and wheat crops being the predominant crops grown and cattle rearing for milk production, especially in areas neighbouring the project area.

A total of 119 species in 48 families were identified during the initial vegetation surveys. Indigenous species recorded were as follows: trees (23), shrubs (40), sedges (3), parasitic plants (1), herbs (33), climbers (6), ferns (3), and grass (10). *Nicotiana glauca* (a shrub), *Eucalyptus spp*. (a tree) and *Grevillea robusta* (a tree) were recorded as exotic species. *Tarchonanthus camphoratus* was the dominant shrub species. The most common tree species were *Protea gaguedi*, *Faurea saligna, Hymenodictyon parvifolium* and *Agauria salicifolia.* Common shrubs in the Caldera include *Rumex usambarensis*, *Conyza newii*, *Anthospermum welwitschii*, *Lippia javanica* and *Rhus natalensis*. *Fimbristylis exilis* commonly known as geothermal grass is present in the Menengai Caldera. The grass is associated with areas having geothermal manifestations hence a potential indicator of geothermal resources.

Menengai crater is not listed as a wildlife conservation area. However, it hosts few wild animal species. This is because large parts of the area outside the caldera are farmlands with no open grazing and dispersal areas. Representatives 13 mammalian species, 23 herpertofauna species and 237 species of aves were noted in the caldera. Of the mammals know to occur in the caldera, Leopard *P. pardus* and stripped hyena *Hyaena hyaena* are nationally listed in the Wildlife Conservation and Management Act, 2013 as endangered. *P. pardus* is classified as Vulnerable and *H. hyaena* as Near Threatened (IUCN, 2019). Species under CITES listing include *Panthera leo, Papio anubis* and *Cercopithecus aethiops* in Appendix II and *Mellivora capensis, Civettictis civetta* and *Hyaena hyaena* in Appendix II. No wildlife population monitoring

data is available for the caldera and it is therefore important that GDC undertakes seasonal mammal population survey within the caldera, liaising with the KWS Nakuru office and KFS as necessary.

Four reptile families (Chamaeleonidae, Agamidae, Boidae and Elapidae) have been encountered in the project area. Among the reptiles found in the area, African Rock Python is nationally listed as endangered while Puff Adders and green mambas are listed as protected reptiles. However, internationally both of these reptiles are listed as of Least Concern (IUCN, 2019). No wildlife migratory corridors have been established in the project area. There are no recorded archaeological sites and no surface artefacts were seen on the proposed development site.

The caldera is not pristine and already various types of infrastructure are developed through the preceding geothermal exploration, drilling of steam production wells and a number of activities related activities are still ongoing. Pre-project noise levels were established to be already higher than legal thresholds provided in Environmental Management and coordination (Noise and Excessive Vibration Pollution) (Control) Regulations of 2006.

At the proposed plant site, the vegetation cover was generally interspersed comprising stunted trees, shrubs and tufted herbs. Common woody species at this site included *Acacia hockii, Monsonia angustifolia, Rhus natalensis, Pappea capensis and Protea gaguedi* while common herbacios species were *Myrsine africana and Oldenlandia wiedemannii*. Open spaces between the vegetation had light trails indicating foraging visit by herbivores, mainly livestock as were noted nearby during the site visit. While the proposed plant site exhibited limited previous disturbance, the adjacent QPEA site had been cleared and levelled in anticipation of power construction works and both the steam connection interface and KETRACO substation had been constructed nearby. Similarly, the common access road to all the three IPP sites had been cleared of vegetation. Only the power plant construction remains to complete the overall project realisation.

E4 Assessment of Project Impacts

The project will have both positive and negative impacts as summarised below.

i. Positive Impacts

During construction, the key positive impacts will be creation of employment opportunities for estimated 200 construction staff for a period of about two years; income generation activities to the local communities through sale of local construction materials and food by women; improvement in local economy from increased trade activities and potential diffusion and transfer of communication and knowledge from specialist construction staff to the local participants.

During operation phase, the most significant positive impact of the project will be the realization of its objective by injecting addition 35 MW of electric energy into the national grid. This will enhance the country's energy supply and security through a relatively more environmentally friendly energy generation process. Similarly, it is in line with enabling the energy sector make strides towards the policy directions envisaged in the Vision 2030.

Further, the operation phase is anticipated to: create 15 direct permanent job opportunities in the plant management and maintenance and numerous other indirect opportunities; generate income to the IPP and local power distributor; potentially attract Clean Development Mechanism funding; and enhance tourism including educational tours within the Menengai caldera.

ii. Negative Impacts

The proposed project will be associated with a number of negative impacts both at construction and operation phases. At the construction phase, major impacts will be the common construction environmental and safety issues including: limited vegetation clearance within the plant area to be replaced by infrastructure; generation of construction dust, occupational and

general public safety and health hazards emanating from construction traffic, working at heights, exposure to heat and elevated H_2S and excessive noise and vibrations; potential disturbance of encountered wildlife including the endangered and protected flora and fauna species noted within the caldera; and increased risks of wildfires within the caldera.

Other potential negative impacts include:

- Impact from materials quarry sites;
- Construction waste generation;
- Potential spread of HIV/AIDs and other Sexually Transmitted Infections;
- Impact on flora: spread of invasive *Datura stramonium* and exposure to escaping steam containing Non-Condensable Gases (NCGs);
- Impacts on Soils
    - Soil erosion and increased sedimentation
    - Soil pollution
    - Soil compaction;
- Visual and landscape impacts; and
- Pressure of existing water Resources

Given absence of recorded archaeological sites or observed artefacts within the project site, no potential impacts on archaeological features are anticipated. However, a chance find procedure has been developed as a precautionary measure for use during construction excavation works.

During the operation phase, the major negative impact of the power plant will be associated with discharge of Non-Condensable Gases (NCGs) into the atmosphere and noise generation from the steam turbine, generator and other associated plant equipment. NCGs constitute 3.3% to 4% of the geothermal steam from Menengai and hydrogen sulphide (H_2S) and carbon dioxide (CO_2) are the predominant NCGs. H_2S presents an unpleasant, typically “rotten eggs” odour at relatively low concentrations and is toxic in higher concentrations. CO_2 is not significant in terms of direct impact to human health in open environments but is a greenhouse gas. Specialist air quality (H_2S) and noise impact modelling established the area is dominated by winds from the SSE and NNW. Any long-term air quality and noise impacts are therefore expected to be the most significant to the NNW and SSE of proposed plant site. Several potential air quality sensitive receptors (AQSRs), mainly rural settlements and small rural centres, are situated within the vicinity of the proposed power plant.

H_2S dispersion modelling was conducted considering different scenarios of dispersing the gas through either a single stack or cooling tower fans and considered both incremental impacts of Sosian plant alone as well as cumulative impacts with the two other proposed plants. The results showed that the WHO daily guideline value of 150 µg/m³ (same as Kenyan guideline value) is not exceeded at any of the current AQSRs when Sosian plant is considered both in isolation and together with the other two power plants envisaged in the same location. This indicates that no adverse public health impacts are anticipated with H_2S emissions from the plant’s operation relative to WHO and Kenyan standards.

On the likely impacts on occupational health of power plant workers, the modeling results indicate that the anticipated levels are not likely to exceed the WHO Lowest Observable Adverse Effect Level (LOAEL) of 10 ppm. Sosian should thus incorporate H_2S safety systems and equipment protection system designed for H_2S detection. With regard to odour impacts, the modelling results indicate that the WHO odour annoyance threshold of 0.005ppm (7 µg/m³) will be exceeded at some of the nearby AQSRs located outside the caldera with possibility of causing odour annoyance under certain meteorological conditions. Relative to New Zealand odour guideline value (70 µg/m³ for geothermal areas) the modelling results indicate that odour impacts may only be experienced at two potential receptors locations in Rigogo and Marigo areas. Due to natural occurrence H_2S in the project area, the anticipated odour impacts are therefore not deemed to be significant under the current proposed development scenario.

To ensure the lowest possible impact on AQSRs and the environment, it is recommended that Sosian adopts the cooling tower technology in the plant’s design for dispersion of NCGs. Given the envisaged operation of two other power plants in the same locality, it is recommended that

in addition to plant-specific air quality management plan, Sosian collaborates with GDC and other IPPs in implementing and jointly monitoring the air quality management plan covering the entire Menengai geothermal field and the nearby sensitive receptors. This air quality management plant shall include:

- The mitigation of sources of emission;
- The management of associated air quality impacts;
- Ambient air quality monitoring;
- Training of all workers on the dangers of exposure to elevated H2S levels;
- Installation of H_2S monitors with alarm system including use of personal monitors by staff in potentially dangerous areas;
- Strategy for communication with communities who may be affected by odour nuisance.

Noise impact modelling results indicate that even with all the three power plants operating simultaneously the overall maximum increase in noise level over the baseline will be less than 3 dBA at around 1.72 km from the boundary of operations. As expected, the noise impact would be most notable at night when baseline noise levels are lower and assessment criteria more stringent. Since the closest potential Noise Sensitive Receptors (NSRs) are situated at least 3 km away from these sites, it is unlikely a change in day or night time noise levels due to the plants will be detected at these locations. The relatively small impact area is the combined result of the baseline noise levels (already in exceedance of assessment criteria), the design specifications of the facilities (i.e. galvanised steel sheet cladding of building that contains major noise sources), and the absence of permanent NSRs within 2 km radius from site.

To further manage potential noise generation, it is recommended that:

- Equipment vendors must be required to guarantee optimized equipment design noise levels;
- Acoustic attenuation devices should be installed on all ventilation outlet and high-pressure gas or liquid should not be ventilated directly to the atmosphere, but through an attenuation chamber or device;
- Vibrating equipment must be on vibration isolation mountings;
- Develop a plan to monitor noise levels both within the plant boundary and sensitive receptors' location and respond to complaints and mitigate impacts;
- Noise producing machines should be well maintained and serviced to minimise the amount of noise produced.

From the above impact modelling outcomes, no resettlement of community for safety reasons is envisaged in the project implementation process. Other negative operation impacts include: accidental chemical spills; operation wastes; impacts on groundwater resources; impact on air quality; and operation noise impacts.

E5 Environmental Management and Monitoring Plans

A detailed ESMP to manage the environmental and social impacts associated with the project implementation following identification and analysis of all the identified potential environmental and social impacts. The ESMP identifies mitigation measures developed in line with the hierarchy of mitigation with their associated cost and responsibilities. To evaluate the effectiveness of the proposed mitigation measures, a monitoring regime for the adopted performance indicators and evaluation to assess both compliance and performance are summarized. The management and monitoring plans are presented in the tables overleaf.

The geothermal development area of Menengai has multiple players. For implementation of the ESMP, Sosian will take the lead in implementing the ESMP within its Power plant site whereas GDC will to take the lead on aspects covering the entire Caldera which host majority of the project associated facilities as well as lead coordinating collaborations between all the IPPs, as necessary.

Table 1: ESMP for construction, operation and decommissioning phases

Environmental and Social Aspects	Recommended mitigation and/ or management measure	Location	Responsibility for implementation	Cost (KES)
During Construction Phase of the Project				
Impact on flora	• Any sandal wood identified on site should be marked out and made known to the engineers and contractor; • Re-vegetate disturbed areas along roads, pipelines and steam lines and other construction sites by planting native trees such as *Croton megalocarpus.* • Create awareness among the local communities and discourage them from engaging in charcoal burning; • Monitor regeneration of natural vegetation as well as the appearance/spread of invasive or opportunistic species within the disturbed areas. Monitoring should include spotting and uprooting of unwanted germinating plants.	Construction site Menengai Geothermal Field	Contractor, Sosian Geothermal Power Plants Ltd, GDC, KFS	500,000
	• Ensure that construction site is clearly demarcated and there is selective clearing of the vegetation to allow future re-growth and regeneration to ensure minimal disruption of wild fauna's natural movement, territoriality, and other ecological processes;	Construction Site	Contractor Sosian	
Impact on micro fauna	• Erection of bumps and signage to Limit speed of construction traffic within the caldera; • Vehicular disturbances such as hooting should be discouraged accordingly; • Incident records (of poaching, accidents and other human wildlife conflicts etc) should be kept by monitoring and taking of corrective measures; • Roads into/out of the Caldera area should be maintained as routes for tourist's activities and wildlife management; • Access for earthmoving machines should be regulated; • Brine ponds should be located close to the source. Distant flow should be piped to prevent animal or vegetation contact;	Construction site Menengai Geothermal Field	Contractor Sosian Geothermal Power Plants Ltd GDC	500,000
	• Monitor wildlife abundance, distribution and movement in relation to this infrastructural development during construction and operation stages to aid in decision making; and	Menengai Geothermal Field	KWS	
	• Ensure that forest rules are enforced within the caldera throughout;		KFS, GDC, Contractor, Sosian Geothermal Power Plant Ltd	
Impact on Avifauna	• High heat points and emission vents within the project area should be sheltered or fitted with inhibitors to deter birds which may get killed as a result of using such areas	Construction site	Contractor Sosian, Geothermal	1,500,000

Environmental and Social Aspects	Recommended mitigation and/ or management measure	Location	Responsibility for implementation	Cost (KES)
		Menengai Geothermal Field	Power Plants Ltd, GDC	
	• High voltage transmission lines should be fitted with wire markers and flappers to alert birds on flight; and		GDC and KETRACO	
	• Develop and implement an avifauna monitoring scheme, assessing bird population trends and direct hazards relating to the project.		KWS, FOMEC	
Impact Herpetofauna and invertebrates	• Capture any reptiles encountered hiding under rocks and sheltered terrains such as *Python sebae* and safely release them in suitable habitats; and • Re-vegetation of the cleared areas and landscaping the plant site.	Construction site Menengai Geothermal Field	Contractor, Sosian Geothermal Power Plants Ltd, GDC, and KWS	
Livestock access to brine ponds	• Fence off any constructed ponds; and	Menengai Geothermal Field	GDC and Sosian	
	• Control access to the caldera by herders.		KFS	
Landscape and visual intrusion impacts	• Limitation of vegetation clearance and earthworks to construction areas only Implementation of soil conservation measures; • Re-vegetation of the cleared vegetation as soon as feasible; • Colour of structures within the site should be carefully selected to reduce visual impact. The use of Neutral, non-reflective colours is encouraged; • Pipeline colouring should be green or given appropriate colour • Minimise lighting of working areas and site compounds light when necessary and switch off the lights when they are not required; • Preparation of a landscaping plan for the entire project area comprising of 75% indigenous species and to be rid of any invasive species. • Stripped topsoil to be preserved and used during landscaping; and • All embankments to be vegetated or stone pitched to prevent soil erosion.	Construction site Menengai Geothermal Field	Contractor, Sosian Geothermal Power Plants Ltd, GDC	2,000,000

Environmental and Social Aspects	Recommended mitigation and/ or management measure	Location	Responsibility for implementation	Cost (KES)
Soil erosion	• No grey water runoff or uncontrolled discharges from the site/working areas; • Water containing pollutants such as cements, concrete, lime, chemicals and fuels shall be discharged into a conservancy tank for removal from site; • Potential pollutants of any kind and in any form shall be kept, stored and used in such a manner that any escape can be contained and the water table not endangered; • Wash areas shall be placed and constructed in such a manner so as to ensure that the surrounding areas (including groundwater) are not polluted. • *Digitaria sp* a native grass commonly growing at the site can be very used in checking soil erosion especially on loose soil dumps or bare slopes created during construction.	Construction site	Contractor Sosian Geothermal Power Plants Ltd	1,000,000
Impact on natural sources of construction materials	• Obtain appropriate authorisation including from NEMA and Mines and Geology department to do or use any proposed borrows pits and quarries will be obtained before commencing activities; • Any new borrow pits and quarries shall be located more than 100 meters from watercourses in a position that will facilitate the prevention of storm-water runoff from entering the watercourse; • Notice will be given 14 days to nearby communities of intention to excavate in the borrow pits or quarries; • Borrow areas' rehabilitation plans will be prepared prior to use and approved by the local authorities; • Storm-water and groundwater controls through appropriate drainage shall be implemented to prevent runoff entering streams and the slumping of soil from hillside above; • The use of borrow pits or quarries for material spoil sites must be approved by the local authorities (and/or with the appropriate consent of the "landowner"). these borrow pits shall be profiled to fit into the surrounding landscape covered with topsoil and re-vegetated. and • In the event that blasting for rock will be done: o A current and valid authorisation from the Department of Mines prior to any blasting activity shall be obtained; o A qualified and registered blaster by the Department of Mines and Geology shall supervise all blasting and rock-splitting operations at all times; o The Contractor shall ensure that appropriate pre blast monitoring records are in place (i.e. photographic and inspection records of structures in close proximity to the blast area); o Sosian Geothermal Power Plants Ltd and the Contractor shall ensure that emergency services are notified, in writing, a minimum of 24 hours prior to any blasting activities commencing on Site; o Sosian Geothermal Power Plants Ltd and the Contractor shall take necessary precautions to prevent damage to special features and the general environment, which includes the removal	Quarry site	Contractor	1,000,000

Environmental and Social Aspects	Recommended mitigation and/ or management measure	Location	Responsibility for implementation	Cost (KES)
	of fly-rock. Environmental damage caused by blasting/drilling shall be repaired at the Contractor's expense; o The Contractor shall ensure that adequate notification is provided to the local communities prior blasting. Preferably signals and warning/informative signage/billboards be erected at the site indicating operation hours as well as commencement and end of operations; o Sosian Geothermal Power Plants Ltd and the Contractor shall use blast mats for cover material during blasting. Topsoil shall not be used as blast cover. o Precautionary and corrective measures will be taken to avert defacing and deformation of the land features.			
Impact on water resources	• GDC and the Contractor shall ensure that necessary approvals/permits from the water authorities for the abstraction of water is adhered to;	Menengai Geothermal Field	WRMA, GDC, Sosian Geothermal Power Plants Ltd contractor	
	• Accidental leakages and bursts of water supply pipelines should be reported and repaired immediately; • Recycle water as much as possible should be encouraged for example water used for curing of concrete can be used for spraying dusty roads; • Control of the water flows and the water consumption records must be kept and availed to the supervising and Sosian Geothermal Power Plants Ltd Resident Engineers at the end of working day; • All employees should be sensitized on water usage practices like discouraging unnecessary opening of taps; • Monitoring of taps and their efficiency should be done regularly; • Where feasible, curing of concrete should be done in conservancy tank to avoid wastage; • Harvest water during rainfall times to complement other sources; • Continued monitoring of underground water levels;		GDC Contractor Sosian Geothermal Power Plant Ltd	
	• The Contractor will be required to comply with the water quality regulations; • No grey water runoff or uncontrolled discharges from the site/working areas (including wash-down areas) to adjacent watercourses and/or water bodies shall be permitted; • Water containing pollutants e.g. cements, concrete, lime, chemicals and fuels shall be discharged into a conservancy tank for removal from site; and • The Contractor shall instruct their staff and sub-contractors that they must use toilet provided and not the bush or watercourses.		Contractor, Sosian Geothermal Power Plant Ltd	

Environmental and Social Aspects	Recommended mitigation and/ or management measure	Location	Responsibility for implementation	Cost (KES)
Air quality and dust	• All construction machinery shall be maintained and serviced in accordance with the manufactures' specifications; • Workers shall be trained / sensitized on dust minimization techniques and management of air pollution from vehicles and machinery; • The removal of vegetation shall be avoided until such time as clearance is required and exposed surfaces shall be re-vegetated or stabilized as soon as practically feasible; • Frequent watering of exposed surfaces and piles of soil to prevent airborne dust emissions; • All vehicles accessing the site shall observe low speed limits; • Minimize vehicles idling time; • Incorporate dust/fumes arrestors in the batching plant e.g. use of dust nets • Provision of appropriate protective personal equipment including respirators and aprons to affected personnel.	Construction site	Contractor Sosian Geothermal Power Plants Ltd	1,000,000
Solid waste	• Apply the 3R (Reduce, Reuse and Recycle) principles. Diligence on the part of the Contractors during construction activities will minimise the amount of debris, and also will ensure that debris is disposed of in a sensible manner, at a specified and approved dump site; • The tender documents should specify the proper disposal of waste during construction; • The tender documents should also ensure that the contractor leaves the site in a clean condition on completion of works. The Contractors should be required to restore and landscape all areas to the satisfaction of the GDC and Sosian Geothermal Power Plants Ltd. • All solid waste generated during construction should be carefully monitored, collected, stored, and taken out of the crater for final disposal. • Develop and rehabilitate spoil areas by: Stripping and stockpiling of topsoil; Removal (to a nominal depth of 500mm) and stockpiling of subsoil; Placement of spoil material; Contouring of spoil site to approximate natural topography and drainage and/or reduce erosion impacts on the site; Placement of excavated subsoil and then topsoil over spoil material; Contouring and re-vegetation; The Contractor shall ensure that the placement of spoil is done in such a manner to minimise the spread of materials and the impact on surrounding vegetation and that no materials 'creep' into 'no-go' areas.	Construction site	Contractor Sosian Geothermal Power Plants Ltd	750,000
Increase in the amount and tonnage of traffic	• Upgrading of existing roads where necessary to take care of the new traffic; • Erection of proper signage along all roads exploited for the construction process especially on approaches to blind corners and in populated areas; • Construct speed bumps along Bahati entrance road and the roads within the caldera; • Sensitization and training of construction drivers; • Monitoring, enforcement and disciplinary action of offenders. • Use of escort and chase vehicles where necessary.	Construction site	Contractor Sosian Geothermal Power Plants Ltd	800,000

Environmental and Social Aspects	Recommended mitigation and/ or management measure	Location	Responsibility for implementation	Cost (KES)
Occupational and public health and safety	• Sosian should engage services of an Environment, Safety and Health personnel to oversee environmental and safety management throughout its operations; • Contractor must develop Construction Safety and Health Policy in compliance with OSHA, and international best practice e.g. IFCs Environmental, Health and Safety Guidelines; • Undertake comprehensive assessment for PPE requirements, provide and enforce use of all ranges of required PPEs; • Contractors to establish a comprehensive Health and Safety Policy which should be in compliance with GDC's Occupation Health and Safety Policy and be approved by Environment, Health and Occupation Manager from GDC; • Ensure compliance with all standards and legally required health and safety regulations in line with OSHA; • Include standard best practice health and safety provisions in the construction contract. The provisions should include insurance to enable the contractor to pay for any and all treatments required by his workers including those of all sub-contractors, together with any subsequent lifelong disability payments in line with WIBA; • Employ a full-time qualified Health and safety Officer; • Include a specific and independent task in the supervision contract concerning H&S supervision and compliance, together with the staff resources to carry this out; • Establish and enforce a strict code of conduct that focuses on safety, especially speed, and loading, especially banning all carriage of staff, workers and passengers except in seats for all project drivers including outside suppliers delivering materials.; • Implement the specified H&S programme throughout the construction period. This should incorporate but not limited to: An emergency response procedure and display on all work areas. This is likely to require one vehicle on site equipped as an ambulance and a paramedic on site at all times during construction activities; Provision of a standard first aid kit at the site office at all times; Provision of fire-fighting equipment available at the workers camp; Provision of medical facilities for staff; Installation of appropriate safety signage for all work sites; Registration of the work place; Maintain an accident register; Carry out accident and incidents investigations and implement corrective actions; Establishment of Occupational Health and Safety Committee; Staff and visitor induction; Toolbox and monthly safety meetings; Routine inspections.	Construction site Menengai Geothermal Field	Contractor Sosian Geothermal Power Plants Ltd	

Environmental and Social Aspects	Recommended mitigation and/ or management measure	Location	Responsibility for implementation	Cost (KES)
HIV/AIDs and STIs	• Education and sensitisation of workers and the local communities on HIV/AIDs and STIs in conjunction with Rongai and Nakuru North Sub-County Public Health Officers; • Provision of condoms to the construction workers, project team and the public. This should be kept in places that are not locked and are accessible to the above persons; • Where possible conduct regular sensitisation campaigns and monitoring and evaluation of the modes used during course of the project; • Formation of peer groups from among the project staff to ensure continuity in training and awareness raising; • The contractor has to institute HIV/AIDS awareness and prevention campaign amongst workers for the duration of the contract e.g. erect and maintain HIV/AIDS information posters at prominent locations as specified by the Resident Engineer in consultation with the GDC Community Liaison Office also if possible, outsource an HIV/AIDS trainer to train workers; • The contractor has to ensure that staff are made aware of the risks of contracting or spreading sexually transmitted diseases; and • The contractor should ensure that the project workers are sensitised on the local culture.	Construction site	Contractor Sosian Geothermal Power Plants Ltd PHO (Rongai and Nakuru North)	3,000,000
Contractor's camp	• Any contractor's camp should have a comprehensive waste management and sanitation plan and facilities commensurate with population of workers and activities in the camps; • Any storage tanks and equipment should have correct labels and Material Safety Data Sheets; Adequate Emergency Response Plan should be in place in the camps; • The contractor should employ best practice management "housekeeping" (site cleanliness, waste disposal etc.) at all times; and • The contractor's facilities should be completely removed from site after use and the land restored to its previous condition or better.	Contractor's camp	Contractor Sosian Geothermal Power Plants Ltd	
Risk of wild fires	• Include an adequate fire buffer zone around the proposed power plant construction site. This could be open bare ground/un-vegetated areas and planting fire resistant trees e.g. Mexican green ash (*Fraxinus sp*) around the plant that will be maintained throughout; and • Liaise with the Menengai KFS office to sensitize construction and operation staff on wildfires and train on emergency responses.	Construction site, Menengai Geothermal Field	Contractor, Sosian Geothermal Power Plants Ltd, GDC, KFS	

Environmental and Social Aspects	Recommended mitigation and/ or management measure	Location	Responsibility for implementation	Cost (KES)
Impact of fuel and chemical storage on site	• Ensure that the employees on site are aware of the company procedures for dealing with spills and leaks from oil storage tanks for the construction machinery though induction and safety training; • In case of spillage, isolate the source of oil spill and contain the spillage using sandbags, sawdust, absorbent material and/or other materials approved by NEMA; • ensure that there is always a supply of absorbent material such as saw dust on site during construction, readily available to absorb/breakdown spill from machinery or oil storage; • All vehicles and equipment should be kept in good working order, serviced regularly and stored in an area approved site by GDC and Sosian Geothermal Power Plants Ltd; • Ensure that filling areas, Oil storage drums / products storage areas have a smooth impermeable (concrete or thick plastic covered in gravel) floor. The floor should be bunded and sloped towards a sump to contain any spillages of substances in accordance with The Kenya Bureau of Standards (KEBS) KS 1969: 2006 The Petroleum Industry -The installation of underground storage tanks, pumps/dispensers and pipe work at service stations and consumer installations - Code of Practice.	Construction site	Contractor Sosian Geothermal Power Plants Ltd	
Chance encounter and interference with buried archaeological artefacts.	• Retain an archaeologist from NMK on site during earthworks; • Notify NMK if any artefacts or bones are uncovered in the course of excavations in accordance with the National Museums of Kenya Chance Finds Procedure (); and • Implement to the chance find procedure.	Construction site	Contractor, Sosian Geothermal Power Plants Ltd, NMK	
During Operational Phase				
Impact on flora	• Monitor invasive plant species at the project area and uproot unwanted germinating plants; • Plant soil-erosion preventing grass species such as *Cynodon dactylon*, *Digitaria abyssinica*, *Pennisetum clandestinum* and *Hyparrhenia sp* at bare sloppy grounds or loose soil dumps; • Rehabilitate disturbed areas along roads, pipelines and abandoned campsites etc by planting native plant species such as *Acacia mearnsii*, *Psidium guajava* and A. melanoxylon– this should be done as soon as practicable to avoid colonization by invasive/opportunistic pioneer species; • Create awareness among the local communities on the importance of vegetation cover and discourage them from engaging in charcoal burning.	Power Plant Site Menengai Geothermal Field	Sosian Geothermal Power Plants Ltd GDC KFS	

Environmental and Social Aspects	Recommended mitigation and/ or management measure	Location	Responsibility for implementation	Cost (KES)
	• Assess concentration geothermal gaseous effluents such as H2S, SO2, NH3 and CO2 (e.g. by use of automatic sensors) and continually test for any evidence of acid rain; • Steam pipe insulations should have a well camouflaged colours that are maintained so that animals don't perceive pipelines as barriers a green colour is recommended; • Brine flows and ponds should be located close to the source. Distant flow should be transmitted through closed pipes		GDC, Sosian Geothermal Power Plant Ltd.	
Impact on macro fauna	• Vehicular disturbances such as hooting should be discouraged accordingly; • Incident records (of poaching, accidents and other human wildlife conflicts etc) should be kept by monitoring and taking of corrective measures; • Brine ponds should be located close to the source and fenced. Distant flow should be piped to prevent animal or vegetation contact; • Erect speed bumps in wildlife crossing zones should these be established from monitoring activities.	Power Plant Site Menengai Geothermal Field	GDC Sosian Geothermal Power Plants Ltd	
	• Ensure enforcement of forest rules within the caldera; and	Menengai Geothermal Field	KFS	
	• Monitor wildlife abundance, distribution and movement in relation to this infrastructural development during construction and operation stages to aid in decision making;		GDC and KWS	
Impact on Avifauna	• High heat points and emission vents like NCGS stack should be sheltered or fitted with inhibitors to deter birds from perching or hovering around; • Develop and implement an avifauna monitoring scheme, assessing bird population trends and direct hazards relating to the project; and	Power Plant Site, Menengai Geothermal Field	GDC, Contractor, Sosian Geothermal Power Plants Ltd	
	• High voltage transmission lines should be fitted with wire markers and flappers to alert any birds on flight.	Menengai Geothermal Field	KETRACO	
Impact on Herpetofauna	• Where feasible, water and steam pipe lines should be laid across (perpendicular to) the valleys rather than running along them – as this will mean destroying large patch of this ecologically sensitive keystone habitat for many species; • re-vegetate disturbed areas along roads, pipelines and steam lines and other construction sites; and • Create awareness among the local communities and discourage them from engaging in charcoal burning which is evidently on the increase in this area.	Power Plant Site Menengai Geothermal Field	GDC, Contractor Sosian Geothermal Power Plants Ltd KFS	

Environmental and Social Aspects	Recommended mitigation and/ or management measure	Location	Responsibility for implementation	Cost (KES)
Operation solid wastes	• Use integrated solid waste management system i.e. source reduction; reuse; and recycling; • Donate any recyclable materials to local community groups, institutions and individuals; • Provide segregated waste respectable/bins within the plan premises and create awareness among staff on usage; • Dispose waste responsibly through a licensed waste handler for final disposal at designates sites; • Ensure compliance with waste management regulations; • Track waste handling from generation to final disposal in line with the waste management regulations.	Power Plant Site Menengai Geothermal Field	GDC Contractor Sosian Geothermal Power Plants Ltd	
Operation liquid wastes	• Domestic waste water and sewer from septic tanks should be disposed through NEMA- licensed exhaust service providers; • Obtain and maintain a valid effluent discharge licence in accordance with NEMA requirements; • Track waste handling from generation to final disposal in line with the EMCA waste management regulations; • Brine ponds should be sited close to the source and should be lined with durable impervious materials of suitable quality and protected from any form of vandalism; • Ensure brine re-injection through re-injection wells into underground reservoir; • Chemical composition and parameters of the brine should be regularly monitored; • Sensitize communities on hazards associated with vandalising brine pond installations.	Power Plant Site Menengai Geothermal Field	GDC Contractor Sosian Geothermal Power Plants Ltd Nakuru County Government	
Fire risk	• Implemental and maintain the proposed fire protection system of fire water tanks, fire extinguishers, fire hydrants, hose reels, fire alarms and sprinklers; • Formulate a fire emergency response plan; • Ensure no smoking signages are put up in the necessary areas; • Establish and maintain a fire break (against wild fires) along the plant boundary; • Train some staff to be fire marshals and ensure availability on site at any given time in line with OSHA requirements; • Carry out regular (at least once annually) fire drills; • Regularly inspect the installed firefighting equipment to ensure serviceability and maintain records; • Undertake regular fire and safety audits in line with the OSHA requirements	Power Plant Site	Sosian Geothermal Power Plants Ltd	

Environmental and Social Aspects	Recommended mitigation and/ or management measure	Location	Responsibility for implementation	Cost (KES)
Accidental Oil spill/Hazardous pollution	• Spill and drip trays used during servicing of machinery; • Use septic tanks while ensuring doesn't flow to the surface; • Response plans for accidental spills to be formulated and routinely tested; • Bunded storage areas and secondary containment for oil and chemicals; • Use of an oil interceptor in the plant; • Place hazardous materials up to 2 kilometres away from the public water supply reservoirs such as in Ol Banita groundwater reservoirs. Also avoid placing within flood levels; • Storage of fuel and other flammable materials shall comply with standard fire safety regulations; • A secured compound shall be provided for storage tanks for chemicals and fuel. All chemicals and fuels shall be stored with manufacturer's instructions in mind as per the MSDS; • Storage areas or secondary containment shall be constructed of waterproof reinforced concrete or approved equivalent, which is not adversely affected by contact with chemicals captured within them; • The minimum volume for secondary containment shall be 110% of the capacity of the largest tank system, plus 10% of the total capacity of all other separate tanks and containers within the bund wall with closed valves for controlled draining during rains; • Pipe-work carrying product from the tank to facilities outside the containment shall be provided with secondary containment; • Tank equipment such as dispensing hoses, valves, meters, pumps, and gauges shall be located within the containment or provided with own containment.	Power Plant Site	Contractor Sosian Geothermal Power Plants Ltd Nakuru County Government	

Environmental and Social Aspects	Recommended mitigation and/ or management measure	Location	Responsibility for implementation	Cost (KES)
Occupational safety and health	• Formulate a plant occupational safety and health management plan. The plan as a minimum MUST have and require; • Compliance with GDC Health, Safety and Environment policy; • Compliance with OSHA, 2007; • Continuous H2S monitoring within the plant premises; • Equipping employees with necessary Personal Protective Equipment (PPE) including personal H2S monitors for workers in exposed environments; • Regular and induction training, of members of the safety committee and new staff respectively on First Aid; • Ensure the plant and office blocks have adequate supply of First Aid Kits; • Location of appropriate safety and warring signs around the plant; • Inspections on conditions of machinery and equipment -Register the plant as a workplace with DOSH; • Medical examination of all employees before, during and after termination of employment; • Detailed emergency response plan; • Provision and display of relevant emergency contacts; and • Regular independent Occupational Health and Safety audits.	Power Plant Site	Contractor Sosian Geothermal Power Plants Ltd	
Potential thermal pollution of groundwater resources	• Obtain baseline ground water quality data inclusive of levels (depths), discharge rates and temperature. • Undertake joint studies to investigate possibility of thermal contamination of underground water aquifers within the area with geothermal steam production wells and institute appropriate mitigations where necessary; • Continually monitor water utilization in the plant's operation and enhance conservation efforts through water efficient fixtures; • Formulate efficient water use practices for both domestic and plant water requirements; and • Maintain and audit water use records	Plant site, Caldera and Ol Banita areas	GDC, NAWASCO and WRMA	
Air quality	• Adopt the cooling tower technology and incorporate H2S safety systems for the plant as well as for the occupational hazard detection system. • Installation of H2S monitors and ensure daily monitoring of H2S with alarm system within the Plant boundaries;	Power Plant site	Sosian Geothermal Power Plant; GDC	

Environmental and Social Aspects	Recommended mitigation and/ or management measure	Location	Responsibility for implementation	Cost (KES)

	• Ensure servicing and regular maintenance of site machines that use fuel to minimise the generation of CO2
	• Adopt collaborative (with GDC and other IPPs) air quality management plan incorporating:
	  ○ Installation of H2S monitors and regular monitoring of H2S within the caldera boundaries and at selected locations within the identified potential sensitive receptors;
	  ○ Liaison strategy for communication with communities who may be affected by odour nuisance. This should include disclosure of air quality monitoring results			

Noise impacts	• All diesel-powered equipment and plant vehicles must be kept at a high level of maintenance; • To minimise noise generation, vendors must be required to guarantee optimised equipment design noise levels; • Acoustic attenuation devices should be installed on all ventilation outlet and high-pressure gas or liquid should not be ventilated directly to the atmosphere, but through an attenuation chamber or device. • Ensure plant's vibrating equipment are on vibration isolation mountings; • The site layout should be designed in such a manner that the noisiest sections of the plant are at the centre of the site, using surrounding buildings as noise attenuation shields; • Areas within the plant with excessive noise should be clearly labelled and signages include requirements for appropriate PPE: • Ensure all exposed staff have and use noise protection equipment e.g. ear plugs; • Noise levels should be monitored, recorded and complaints responded to and mitigate impact; • Liaise with GDC to extend the regular monitoring of noise levels within the caldera to selected locations (identified potential Noise sensitive receptors) within the nearby settlements; • Develop a liaison strategy for communication with communities who may be affected by cumulative noise nuisance.	Power plant site	Sosian Geothermal Power Plant; GDC; and contractors	
During Decommissioning Phase				
Occupational safety and health	• Make the site safe by ensuring all electrical connections and supplies are disconnected and any dangerous chemical stores are identified and made safe	Power Plant Site	Sosian Geothermal Power Plants Ltd KETRACO and KPLC	

Environmental and Social Aspects	Recommended mitigation and/ or management measure	Location	Responsibility for implementation	Cost (KES)
	• Comply to the OSHA; • Provide for appropriate signage and warnings; • Any closed vessels, pipes and other areas which could have hazardous gases present would be vented in accordance with normal operating procedures. These would then be tested to ensure that they are safe for entry or removal; • Provide for First Aid facilities for staff as per the OSHA, 2007; • Monitor H2S levels during demolition works; • Maintain appropriate and serviceable firefighting equipment on site; • Designate an emergency assembly point within the plant and create general awareness on use for all staff; • Provide and clearly display emergency contacts; and • Develop a detailed and demolition-specific Emergency Response Plan		Sosian Geothermal Power Plants Ltd and Contractor	1,500,000
Redundant plant equipment and recyclable wastes	• Careful removal and sale/recycling of plant and materials including	Power Plant Site	Sosian Geothermal Power Plants Ltd	
Non-recyclable demolition waste	• Ensure demolition wastes are segregated on site; • Disposal of waste materials by appropriate methods in accordance with waste management regulations; • Procure services of licensed waste handlers for safe disposal of both hazardous and non-hazardous wastes; and • No burning of any wastes should be done on site.	Power Plant Site	Sosian Geothermal Power Plants Ltd	3,000,000
Re-instatement of biophysical environment	• Landscape of the power plant site with suitable mix of indigenous species. This should be done in liaison with the; and • Ensure landscaped species are established prior to final close out of the site	Power Plant Site	Sosian Geothermal Power Plants Ltd and KFS	2,500,000

Table 2: Environmental Monitoring Plan

Project Activity/Aspect	Parameter	Indicator	Institutional Responsibilities		Project Phase	Monitoring Cost Estimates (KES)
			Monitoring Responsibility	Frequency		
Impact on Flora (vegetation loss)	Visual inspection	• Monitoring records of cleared and rehabilitated areas • Soil cover; • Soil erosion features; • Abundance of species.	Contractor Sosian	Weekly	Construction	Included in Supervision scope and Costs
Impacts on fauna	Site inspection and reviews of records	• Incorporation of relevant measures in workers' code of conduct and induction/training materials; • Incorporation of KWS and KFS in the communication and site emergency response plans • Incident records (of encounters and actions taken)	Sosian and contractor	Continuous	Construction and operation	EPC contractor's cost
	Monitoring plan	• Abundance of species • Records of incidents involving wildlife	GDC and KWS	Quarterly	Operation	GDC cost
Air Emissions and Air Quality Dust	Document review Parameter measurements	• Air Quality management plan • H&S Plan in use; • Availability and use of appropriate PPE; • Record of Induction for Workers and relevant trainings • Active dust suppression measures • Air quality records (TSP, SO_2, CO, H_2S, CO_2, CH_4) • Received complaints • Volumes of fuel used (from receipts/invoices)	Contractor Sosian & GDC	Monthly Monthly	Construction Operation	Sosian to determine

Project Activity/Aspect	Parameter	Indicator	Institutional Responsibilities		Project Phase	Monitoring Cost Estimates (KES)
			Monitoring Responsibility	Frequency		
	Hydrogen sulphide (H_2S)	• H_2S instrumentation; and • Levels from Air quality monitoring records	Sosian	Twice a week for hand held monitors and continuously for automatic loggers	Operation	Hydrogen sulphide (H_2S)
Worker and Public Safety	Visual inspection Incident and accident records	• Health and safety management plan; • Induction training • Safe working procedures • Shoring & appropriate precautions in place	Contractor and Sub contractors Sosian and GDC	Daily	Construction	Included in Supervision scope and Costs
Public Safety	Dust and Noise	• Air quality & noise level monitoring records • Visual inspection; • Relevant traffic management plan • Sensitization records; • Relevant grievance management records • Measures under Air Quality management • Protected brine ponds	Contractor and Sub contractors Sosian and GDC	Twice during the dry season	Construction and Operation	Worker and Public Safety
Occupational Safety and Health	Health and Safety records Visual inspection	• OHS Management Plan • Relevant regulatory permits • Training and induction records • Active and passive monitoring records • Workplace safety culture • Accident/incident statistics • Independent OSHA audit reports	Contractor Sosian Energy's Senior Management Sosian Geothermal Power Plants Ltd Health Safety and Environment officer	Daily	Construction and Operation	Included in Supervision scope and Costs
	Inspection, maintenance and	• Quarterly record of reports by local fire appliances (fire		Quarterly	Operation	

Project Activity/Aspect	Parameter	Indicator	Institutional Responsibilities		Project Phase	Monitoring Cost Estimates (KES)
			Monitoring Responsibility	Frequency		
	servicing records of fire appliances	extinguishers and hose reel pipe and pump) dealers				
Conservation of Ground Water Resources		• Measures incorporated in the production wells design; • Re-injection of brine; • Installed meters and utility records/bills • Sensitization records/corporate strategies on utility conservation • Installed oil interceptors for plant's surface drainage • Quality monitoring records of water, brine/effluent	Sosian and GDC	Monthly apart from design that is reviewed once	Construction and Operation	Included in Supervision scope and Costs
Water Quality (both surface and underground)	pH, BOD, Temperature, COD, Turbidity, Conductivity, Dissolved Oxygen, Nitrates	• Monitoring records; • Water quality report.	GDC Sosian	Monthly	Operation	
	Brine discharge	• Monitoring report for Measurements of • pH @ 25°C, TDS and SiO_2; • Visual inspection of re-injection systems.	GDC	Monthly	Operation	GDC cost
Storage of hazardous materials and chemicals	Spillages Visual inspection	• MSDS for all stored Chemicals • Functioning storage containers and storage areas with secondary containments • Chemical usage records • Records on soil analysis following spill incidence, that is measured levels of Hg, Zn, As, Cd, Cr, B as well as measured levels of VOCs/TPH.	Contractor Sosian	Monthly Audit Review	Construction and Operation	Included in Supervision scope and Costs

Project Activity/Aspect	Parameter	Indicator	Institutional Responsibilities		Project Phase	Monitoring Cost Estimates (KES)
			Monitoring Responsibility	Frequency		
Traffic concerns	Visual inspection Records review	• Prepared and implemented Traffic Management Plan approved by GDC and plant manager • Traffic incidents/accident register • Community feedback/complaints • Barriers and signages as appropriate.	Contractor Sosian and GDC	Monthly	Construction and operation	Included in Supervision scope and Costs
Public Awareness and Community Perceptions	Records	• Agreed Stakeholders Engagement Plan (SEP) and periodic programs • Grievance redress mechanism and associated records • Consultation records	Sosian and GDC	Monthly	Construction and operation	Included in Supervision scope and Costs
Noise	Records and sample measurements	• Measure included in Design and Procurement plans • Health and safety plan; • Hearing Protection and PPE in use; • Record of Plant equipment Maintenance	Contractor Sosian	Monthly	Construction and operation	Included in Supervision scope and Costs
Soil Erosion	Visual inspection Record of periodic assessment	• Bare soil; • Soil pillars; • Cracks across the slope • Sediment management interventions • %Cover of revegetated sites	Contractor Sosian	Weekly	Construction	Included in Supervision scope and Costs
Solid waste management	Slag, domestic refuse, metallic scraps, sludge	• Comprehensive waste management plan; • Documented Approvals for placement of wastes; • Records on tracking the volume of solid waste generated.	Contractor Sosian	Monthly	Construction and operation	Included in Supervision scope and Costs

Project Activity/Aspect	Parameter	Indicator	Institutional Responsibilities		Project Phase	Monitoring Cost Estimates (KES)
			Monitoring Responsibility	Frequency		
Employment Opportunities	Labour Records	• HR policies for Sosian and contractors • Number of persons (by gender and region) employed directly by the project and levels of skills as captured in labor returns • Standard workers' agreements and codes of conduct • Relevant Insurance covers	Sosian and appointed contractors	Monthly	Construction and Operation	-
HIV/AIDS awareness and behaviour influence programs	Observation and records review	• Agreements with service providers • Sensitization records; • Campaign materials (posters, banners etc. on camp site and along project area)	Sosian and contractors	Monthly	Construction and operation	-
Power generation	Records	• Installed Plant Capacity • Annual Power generation trend • Electricity sold	Sosian	Annually	Operation	-

To ensure effective implementation, relevant ESMP sections for construction phase shall form part of the contractual requirements to be met by the appointed EPC contractor. In this regard, the cost of mitigation measures by the contractor shall be included in the contract as part of the project implementation cost.

In addition to appointing a qualified HSE manager, it is important that all other Sosian's and contractors' personnel responsible for the implementation of the various tasks and requirements contained in the ESMP are competent on the basis of education, training and experience. Thus, Project shall undertake an initial evaluation of training needs associated with this ESMP and, on this basis, develop and maintain an ESMP training matrix as follows:

- **ESMP Induction Training and Awareness**: this training should be for visitors or individuals who do not have direct roles or responsibilities for implementing the ESMP, and should cover basic Project environmental and social commitments.
- **ESMP Management Training and Awareness**: this training focuses attention on management, covering key aspects of the ESMP and providing an overview of the Project's environmental and social impact management expectations and the supporting processes and procedures prescribed in the ESMS to meet performance expectations.
- **ESMP Job-specific Training and Awareness**: job-specific training should be provided to all personnel who have direct roles and responsibilities for implementing or managing components of the ESMP. This training should also include all people whose specific work activities may have an environmental or social impact.

On site, these provisions and responsibilities should apply to all contractors and subcontractors. Those responsible for performing site inspections should receive training by drawing on external resources as necessary. Upon completion of training and once deemed competent by management, staff will be ready to train other people. The Project will require each contractor to institute training programmes for their personnel. All contractors and their subcontractors should be responsible for implementing relevant and adequate training programmes to maintain the required competency levels.

E6 Stakeholders' Consultation and Disclosure

Initial consultations on the development of all the three power plants were conducted in 2012 as part of the original ESIA study. In line with Kenyan laws, the findings were publicly disclosed through local dailies, the Kenya gazette and NEMA website. During the current ESIA update study, consultations were held through: (1) eight (8 No.) general public meetings at sub location levels within the project area (see table below); (2) key informant interviews with civil, government agencies and other institutions in the project area, from Nakuru North and Rongai sub counties, Nakuru County headquarters as well as government agencies based in Nakuru; and (3) household surveys.

Table 3: Schedule of public meetings conducted during the update

Rongai Sub County				
No.	**Sub Location**	**Date**	**Time**	**Venue**
1.	Kampi ya Moto	Thursday, 30th October, 2014	10.55 AM	GDC Kabarak Farm
Nakuru North Sub county				
2.	Kirima	Monday, 3rd November, 2014	11.30 AM	Full Gospel Church
3.	Ndunguri	Monday, 3rd November, 2014	12.15 PM	Ndunguri Cattle Dip
4.	Ol Banita	Monday, 3rd November, 2014	3.05 PM	Full Gospel Church
5.	Wanyororo	Wednesday,5th November, 2014	11.30 AM	Wanyororo Trading Centre
6.	Menengai	Thursday,6th November, 2014	11.40 AM	Menengai Trading Centre
7.	Mwaki Mugi	Friday,7th November, 2014	11.12 AM	Kabatini Chief's Office
8.	Mutukania/Landi Mawe/Karonga	Tuesday,11th November,2014	11.30 AM	Rehema Church Ahero

A summary of expected benefits and expressed concerns are given below.

i. The Expected benefits

- The project will attract more investment into Nakuru County;
- It will create more employment and investment opportunities for people in Nakuru County;
- The increased power generation is expected to reduce common incidences of power outages which currently affects production capacity of many establishments e.g. NAWSCO which runs numerous waters supply boreholes (constitute 90% production capacity) powered by electricity;
- Geothermal power plant's development will increase power available to the national grid and reduce cost of electricity;
- GDC has already experimental agricultural field for use of brine. These can be enhanced by participation of IPPs following the development of the power plants; and
- The project will lead to improved development of infrastructure which will improve marketing of agricultural produce.

ii. Expected negative impacts

- Local water service providers and water resources management authority have expressed concerns on increased borehole water temperatures with increased geothermal drilling activities in the project area;
- Potential destruction of scenic features characteristic of the Menengai landscape;
- Potential conflicts between locals and non-locals on employment;
- Environmental pollution from: dust, noise and odour;
- Interference with sacred caves at the rim of the caldera which are regularly patronized by various religious sect members;
- Increase pressure on waste management systems within the caldera which are already inadequate;
- Social problems including increased incidence of HIV/AIDS as experienced with Rongai flower farms in the area;
- Effects from Hydrogen sulphide (H_2S) gas to affect people, crops and may also cause acidic rain;
- The caldera area is naturally prone to wildfires (even in the absence of human interventions like charcoal burning); and
- Pollution from brine.

Most of the above concerns have been addressed in the proposed ESMP. In addition, given its continuous presence in the project area, GDC has been addressing and managing some of the identified concerns from the surrounding communities and other stakeholders as part of the broader initiatives of the Geothermal Development Programme within the Region.

GDC has developed a strong and well-resourced community relations department with community liaison officers acting as interface for information flow between the communities and GDC. Following implementation of its community relations strategy, the needs of the communities have been identified and access to water, education and health facilities are prioritised and reported to have already been provided. Lately, GDC has also constituted committees that shall be engaged from time to time to assist during the Menengai projects' activities. Thematic area committees have been proposed as follows: youth committees; Wanyororo B community project water committee; and St. John Dispensary/Bahati hospital committee.

Continuous Grievance Redress

GDC, through its Community liaison department, has developed a Grievance Redress Mechanism (GRM) that has been operation in the project area, addressing concerns from any affected communities from the ongoing geothermal development activities. This GRM has been very successful in addressing the concerns of the affected communities and/or interested parties

since commencement of the geothermal development activities in Menengai area. Various community representatives have also been enlisted through thematic committees, as identified above, which once formalized will further strengthen the GRM process. This GRM should be sustained and enhanced by Sosian through adoption of a project-specific stakeholder engagement plan inclusive of GRM as suggested in this report prior to commencement of construction works.

E7 Conclusion and Recommendations

This ESIA Study update has been prepared to provide sufficient and relevant information on the proposed 1x35 MW geothermal power plant in Menengai by Sosian Geothermal Power Plants Ltd. The report responds to the environmental assessment requirements by NEMA and IFC safeguards.

Most of the anticipated adverse impacts associated with the project can be readily managed to acceptable levels with implementation of the recommended mitigation measures and ESMP developed in this report such that the overall benefits from the project will greatly outweigh the adverse impacts. No land take for the power plant or resettlement of community for safety reasons is envisaged in the project implementation process. Further, the requisite conditions for most of the mitigations have been incorporated by Sosian Geothermal Power Plants Ltd on project design documents reviewed by the consultant.

The project construction and operation activities are not expected to strain existing water supplies by NAWASCO. However, consultations with the regional office of Water Resources Management Authority and NAWASCO pointed out that since geothermal wells in the Menengai caldera were commissioned, the water temperature from the Ol Banita boreholes near the caldera have been recording increased temperatures. This has impacted on operation and maintenance cost of the bulk water service providers and complaints from water consumers. It is notable that underground water is the main water supply to the locals and the nearby Nakuru town. This study recommends that GDC, NAWASCO and the water resources management authority should undertake joint studies to investigate possibility of thermal contamination of underground water aquifers within the area with geothermal steam production and institute appropriate mitigations where necessary.

Public consultations revealed that the local communities have high socioeconomic interests and a lot of expectations with the geothermal power development activities going on within the Menengai caldera. It is recommended that Sosian Geothermal Power Plants Ltd develop and implement a community liaison strategy with proper communication and feedback mechanism; and a clear and transparent employment policy for the local communities.

In general, the proposed project will result in appreciable benefits to the country power production and create opportunities for both social and economic development. The project is already licensed by NEMA and Plant site has received a no objection letter from the National Museums of Kenya (NMK).

It is recommended that the proposed project be implemented in compliance with all the relevant legislation and planning requirements of Kenya at all times. In line with this, the proponent Sosian Geothermal Power Plants Ltd and the contractor (s) must take the legislative framework reviewed in this report into consideration, during and after the implementation of the project, as will be appropriate.

Further, the following are recommended:

- Sosian Geothermal Power Plants Ltd management should enlist services of a duly qualified Health, Safety and Environment manager. The HSE manager will work in liaison with GDC, Sosian contractors and relevant government lead agencies to ensure sound environmental and social performance;
- Ensure implementation of NMK chance find procedure during construction phase;
- In liaison with GDC, ensure that community expectations are managed through well-structured community liaison plan and jointly agreed grievance redress mechanism;

- Ensure compliance with NEMA approval conditions throughout the project phases; and
- Ensure statutory annual environmental and occupational safety and health audits are carried out annually throughout the project implementation and operation periods.

1 INTRODUCTION

1.1 Background

This document is an updated Environmental and Social Impact Assessment Study Report for the proposed 1x35 MW Geothermal Power Plant in Menengai commissioned by Sosian Energy. The project is expected to generate an additional 35MW of electricity to be connected to the national grid. It involves finance, design, procurement, supply, installation/construction, testing, commissioning, operation and maintenance of 35MW Geothermal Modular Power Plant. The justification for the site is the availability of Steam from the Geothermal Wells; the primary fuel for the project.

Sosian Menengai Geothermal Power Ltd is one of the three Independent Power Producers (IPPs) each awarded a tender by Geothermal Development Corporation (GDC) through competitive bidding to install a 1x35MW Geothermal Modular Power Plant in Menengai Geothermal Field in Nakuru County for 25 years on a Build Own and Operate (BOO) basis. The purpose of the Power Plant Project is to increase the power generation capacity of Kenya to enhance socio- economic development and diversify sources of power supply by developing the country's huge geothermal potential. The three IPPs will cumulatively generate 105MW under the Phase I of geothermal development in the Menengai Geothermal field.

Sosian Menengai Geothermal Power Ltd (hereafter called Sosian) is a locally registered and incorporated company operating in Kenya as a developer, owner and operator of the Geothermal Power Plant. GDC is a wholly government owned limited liability company and is mandated to undertake integrated development of geothermal resources through initial exploration, drilling, resource assessment and promotion of direct utilization.

The power plant will be driven by steam owned by the GDC and supplied to the Power Plant under the terms in the Project Implementation and Steam Supply Agreement (PISSA) to generate a net electrical capacity of 35MW. Power generated will be supplied to Kenya Power Company (KPLC) under the terms in the Power Purchase Agreement (PPA) for commercial and industrial activities countrywide thus contributing job creation, increase productivity, electricity connection rates and improve the quality of life. Other direct project beneficiaries include people living around the project site who will benefit from employment during project implementation and operation, contractors and consultants will supply goods and services. The power will be generated at 11kV, stepped up to 132kV and evacuated to via a line constructed by the Kenya Transmission Company (KETRACO) who are responsible for high voltage transmission infrastructure in the country. KPLC will operate and maintain the transmission line.

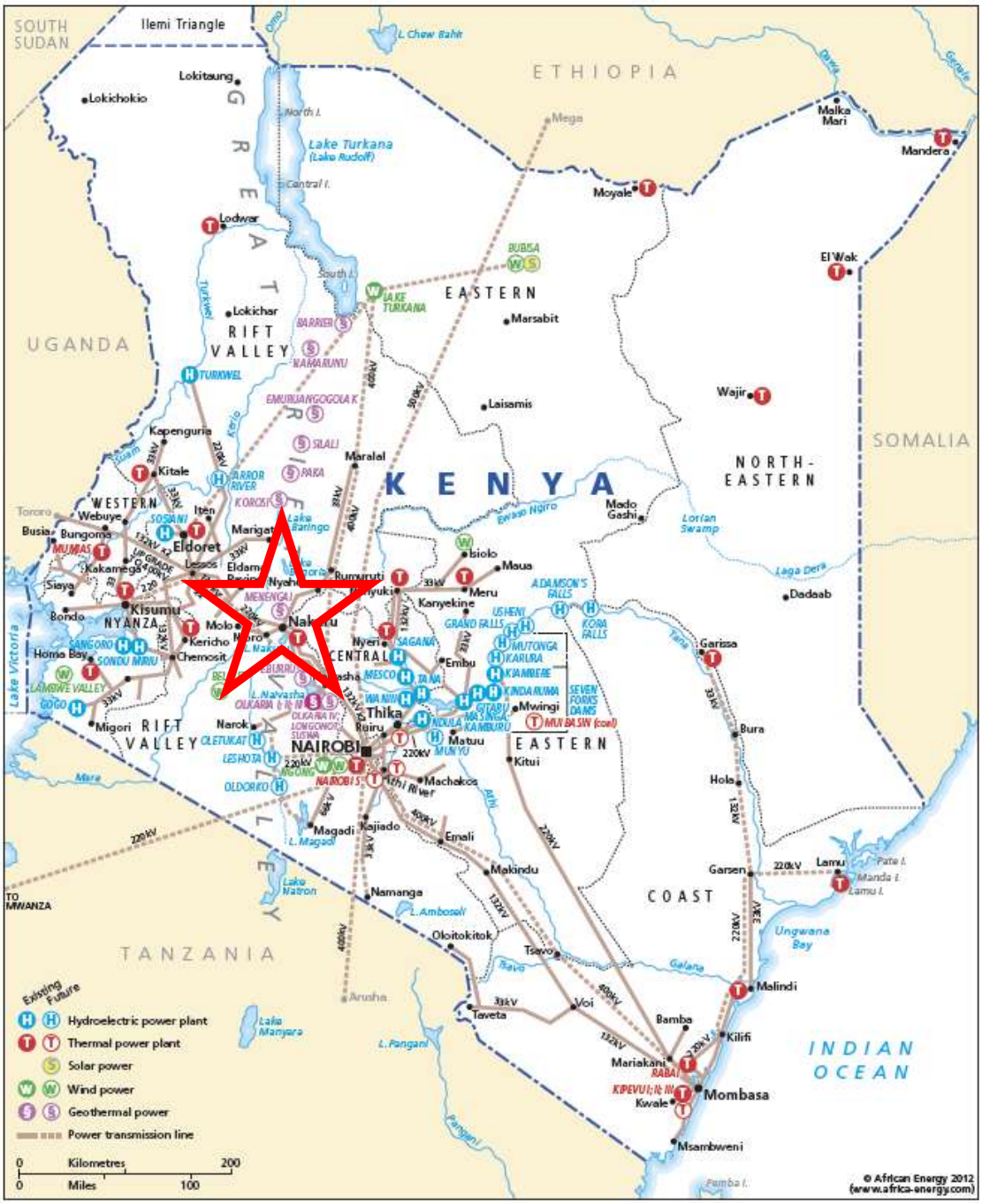
The additional power is intended for enhanced commercial and industrial activities countrywide thus contributing to job creation, increased productivity, electricity connection rates and improve the quality of life. Other direct project beneficiaries include people living around the project site who will benefit from employment during project implementation and operation, contractors and consultants will supply goods and services.

1.2 Project Location and Site

The Project is located in the Menengai Geothermal Field on the outskirts of the Nakuru town in Nakuru County, Kenya. The project site about 180 km North-west of Nairobi. Administratively, the project area lies within Nakuru North and Rongai sub counties of Nakuru County. It borders Subukia Sub County to the North, Bahati Sub County to the East and Nakuru West Sub County to the South. The caldera area falls in Mercy Njeri sub location of Rongai sun county. Access is through either Wanyororo route off the Nakuru – Bahati/Nyahururu road or the Kabarak/Mercy Njeri route off Nakuru-Marigat road.

The Project site is one of three 35 MW plants in the Menengai Geothermal field for which the GDC simultaneously granted identical build-own-operate geothermal concessions and allocated adjacent plant sites. The project area is bounded by 36˚01'E and 36˚07'E and 0˚09'S and 0˚15'S

Figure 1-1 and Figure 1-2 below illustrate the location of Menengai Geothermal Field in Kenya and project site respectively.


SOUTH SUDAN
Ilemi Triangle
ETHIOPIA
UGANDA
TANZANIA
SOMALIA
KENYA
GREAT RIFT VALLEY
EASTERN
NORTH-EASTERN
WESTERN
NYANZA
CENTRAL
RIFT VALLEY
EASTERN
COAST
NAIROBI
Lake Turkana
(Lake Rudolf)
Lake Victoria
INDIAN OCEAN
Lokitaung
Lokichokio
Lodwar
Lokichar
Kapenguria
Kitale
Eldoret
Webuye
Kakamega
Kisumu
Bondo
Homa Bay
Migori
Narok
Nakuru
Kericho
Chemosit
Molo
Marigat
Maralal
Laisamis
Marsabit
Moyale
Mandera
Malka Mari
El Wak
Wajir
Mado Gashi
Isiolo
Meru
Maua
Kanyekine
Embu
Mwingi
Kitui
Machakos
Thika
Matuu
Magadi
Kajiado
Emali
Namanga
Oloitokitok
Makindu
Taveta
Voi
Tsavo
Arusha
Lake Manyara
L. Pangani
Mariakani
Mombasa
Kwale
Kilifi
Malindi
Bamba
Garsen
Lamu
Hola
Bura
Garissa
Dadaab
Msambweni
Pemba I.
Ungwana Bay
Lorian Swamp
Laga Dera
Ewaso Ngiro
Tana
Athi
Galana
Turkwel
Kerio
Suam
Nzoia
Yala
Sio
Mara
Ewaso Nyiro
Lake Natron
L. Amboseli
L. Magadi
L. Baringo
L. Bogoria
L. Nakuru
L. Naivasha
Athi River
Nairobi S.
Olkaria I, II & III
Olkaria IV
Longonot
Susuma
Ngong
Oldoinyo Lengai
Menengai
Eburru
Lessos
Rumuruti
Nyahuru
Nyeri
Sagana
Kiambere
Kindaruma
Kamburu
Seven Forks Dams
Muyeye
Mesco
Tana
Waini
Ndula
Citarum
Masinga
Muhoroni
Chemosit
Sondu Miriu
Gogo
Lambwe Valley
Kipevu I, II & III
Rabai
Turkwel
Barrier
Kamaruinu
Emuruangogolak
Silali
Paka
Korosi
Arror River
Sosiani
Mumias
Yala
Grand Falls
Mutonga
Karura
Adamson's Falls
Kora Falls
Ushem
Bubisa
Lake Turkana
Olkaria
Leshota
Oletukat
Oldoinyo
Muhoroni
Chemosit
Sondu Miriu
Lessos
Lessos
Eldama Ravine
Nyahuru
Rumuruti
Lake Victoria
Siaya
Busia
Bungoma
Mumias
Homa Bay
Migori
Kisumu
Bondo
Molo
Kericho
Chemosit
Nakuru
Marigat
Kapenguria
Kitale
Webuye
Iten
Eldoret
Lodwar
Lokichar
Lokitaung
Lokichokio
Ilemi Triangle
Moyale
Mandera
Malka Mari
El Wak
Wajir
Mado Gashi
Isiolo
Maua
Meru

The power plant boundaries are defined by the following coordinates

Site boundary	Datum Arc1960 Zone 37S	
	Eastings (m)	Northings (m)
A	172305.69	9978784.10
B	172391.70	9978625.98
C	172514.68	9978692.97
D	172428.68	9978851.00

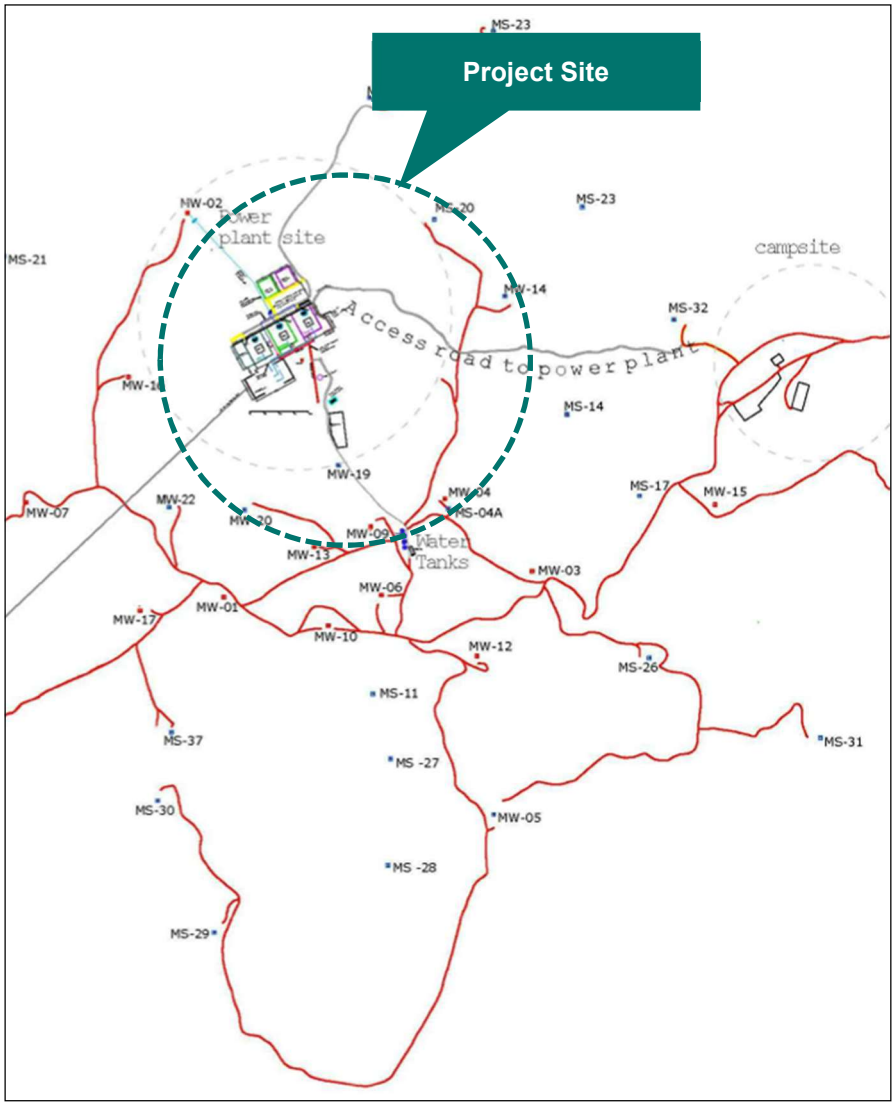


Figure 1-2: Project site in the Menengai Geothermal Field

1.2.1 Project area of influence

The proposed Project's Area of Influence is identified, according to the Integrated Safeguard System (ISS) criteria included in Operational Safeguard (OS) 1, which entails consideration of areas: likely to be directly affected by the project; related/associated facilities dependent on the project; and areas including communities within them, potentially affected by unplanned but technically predictable activities likely to be induced by the project. The project area of influence is summarised in Table 1-1.

Table 1-1: Summary of project area of influence

Area	Administrative units	Interaction with the project
Kenya	Republic of Kenya	Considered area of influence at macro-level as the power plant will feed into the national grid during operation
Menengai caldera,	Mercy Njeri Sub location,	Proposed Power Plant, lay down area, KETRACO substation, production wells, steam gathering system, re-injection wells, associated internal roads, water supply infrastructure and part of power evacuation line are all within the caldera. Key impact receptors in this zone for both the plant construction and operation include: • the terrestrial flora and fauna, including livestock which occasionally are grazed in the caldera; • Isolated settlements found within the caldera which are potential receptors of noise and air quality pollution; • some members of communities neighbouring the caldera, who access it for collection of fire wood and clandestine charcoal burning; • tourist visiting the crater view point and or using the nature trails. Other potential impacts associate with this area include surface drainage and soils, landscape features associated with installation of the various infrastructures.
Access road corridor Communities neighbouring Menengai Caldera	Kampi ya Moto and Mercy Njeri sub locations in Rongai sub county Kirima, Nduguri, Ol Banita, Wanyororo, Menengai, Mwaki Mugi and Mutukania/Karonga sub locations in Nakuru North sub county	Constitute area of influence associated with potential receptors of traffic noise, dust and potential traffic accident impacts as construction/operation vehicles enter or leave the caldera. As defined in the PISSA, construction vehicles are expected to use the Wanyororo access route (Nakuru North subcounty). However, some light vehicles may use the other caldera access road off the Nakuru – Kabarak/Eldama Ravine road. This passes through Mercy Njeri sublocation (Rongai sub county) Some communities/villages in these areas reside in close proximity to the caldera rim and are potential receptors due to: Benefits for casual labour employment opportunities; receptor of noise and air quality impacts; and users of some of the natural vegetation within the caldera.
Transmission line corridor outside the caldera	Milimani West and Viwandani locations	The line in this section stretches approximately 2.7km between the southern caldera rim and the existing Soilo sub-station. Main impact within this zone of influence is 30m wide way leave acquisition for the transmission line already installed. Affected land had some parcels under cultivation but no residential or commercial establishments at the time of way leave acquisition hence no physical displacement.
Construction materials sourcing areas	Not yet identified	Some active stone quarries exist nearby along the Nakuru – Nyahururu road. Haulage road is the existing public roads
Waste disposal	Nakuru county	Solid waste disposal site serving the Nakuru town is located south of the caldera
Water environment	Nakuru county	Domestic water supplied to the caldera/GDC by Nakuru water and sanitation company is partly sourced from Ol Banita aquifers. GDC exploits underground water within the caldera for drilling and other construction needs.

1.2.2 Site Land tenure

The site is within an area gazetted as public forest land and managed by the Kenya Forest Service (KFS). KFS leased the land to GDC who has then sub-leased the Land to Sosian Menengai Geothermal Power Ltd for 26 years and 7 months. GDC and KFS has memorandum of understanding for the management of activities in the forest (Appendix I).

Sosian's power plant and associated facilities shall occupy an area that measuring 180m by 140m with a 50m buffer zone between Sosian and QPEA.

While the area is designated as a public forest land, consultations held with the local forest manager indicated that the main interest of putting the area under forest management was its unique landscape features. Since 2011, GDC has undertaken numerous activities related to geothermal exploration and development within the caldera culminating in the current project which is meant to complete the development cycle. Geothermal production wells have been drilled at various locations within the caldera and connected through steam gathering system as well as associated access roads. Also, in place are power and water supply lines, substation and power evacuation line. Both Sosian's and the adjacent QPEA sites had been cleared and levelled in anticipation of power plant construction works. Similarly, the common access road to all the three IPP sites had been cleared of vegetation.

1.3 Electricity Supply Status in Kenya

Kenya's current effective installed (grid connected) electricity capacity is 2,651 MW, with peak demand of 1,802 MW, as at June 2018. At that time, demand was rising at a calculated rate of 3.6 percent annually, given the peak demand was 1,770 MW, at the beginning of 2018. Electricity supply is predominantly sourced from hydro and fossil fuel (thermal) sources.

Whilst about 30% is hydro power, about 47% is geothermal and emergency thermal power. Wind power play a minor role contributing less than 11.7%. 13% Fossil fuels. Bagasse Cogeneration 1.8%. and others such as solar 7.8%. Thermal energy sources have been used to make up for these shortfalls, geothermal sources contribute to the highest amount of electricity generated in the country.

Geothermal power plants, which convert steam generated from hot rocks deep underground into electricity, have a prominent place in Kenya's overarching development plans. These include the Vision 2030, the National Climate Change Action Plan (NCCAP) and the current '5000+ MW in 40 months initiative'. Geothermal power has the potential to provide reliable, cost-competitive, baseload power with a small carbon footprint, and reduces vulnerability to climate by diversifying power supply away from hydropower, which currently provides the majority of Kenya's electricity.

Kenya set out ambitious targets for geothermal energy. It aims to expand its geothermal power production capacity to 5,000 MW by 2030. Kenya has an installed geothermal capacity of approximately 340 MW. Although there is significant political will and ambition, reaching these ambitions is a major challenge. Kenya Electricity Generating Company (KenGen) and Geothermal Development Company aimed at raising the country's geothermal output from the 593MW, to 1 GW by the year 2018 and 5 GW to the grid by 2030.

1.4 Project Justification

Energy is considered an essential ingredient for economic growth and social development in Kenya and anywhere in the world. The growth of energy demand is often driven by several factors namely, population growth, economic growth, urbanization, rural energization programs, increasing penetration of energy intensive appliances and industrialization.

While Kenya is experiencing significant growth in energy demand, energy supply appears to have stagnated or dwindled. The security of energy supply especially electricity generation in Kenya seems to be threatened by climate change induced phenomenon, chief among them, drought. Inadequate electricity generation capacity and high-power bills have been perennial problems in Kenya prompting the Government to explore various ways of tackling the glitches. A shift to alternative sources of energy such as geothermal power which is environmentally friendly and more affordable to run compared to other sources of energy like fossil fuel will insulate the country against the effects of drought, which often interferes with hydroelectric power which historical has been the major source of installed power. The proposed geothermal power plants in Menengai will minimize climate drawbacks facing hydroelectric power generation and reducing the component of our energy mix that is dependent on the price of fossil fuels. It will create a reliable and stable renewable source of energy which will ensure sustainability of the Kenyan economy.

The Energy situation in Kenya dictates that there is need to develop the electricity generation capacity in the country for faster economic growth. According to Vision 2030, it is estimated that the national power requirements in the next 17 years will reach 15000MW, which is more than five times the current power generation capacity. Electricity demand is projected to grow to 2,600-3600 MW by 2020. This justifies the immediate need to more than double the power generation to 5000MW in the next 5 years to meet the rising demand and move in tandem with economic growth projections.

1.5 Need for update of ESIA prepared by GDC

ESIA Study was initially undertaken by the University of Eldoret on behalf of GDC for the proposed 3x35 MW Modular Geothermal Power Plants. The initial ESIA study was submitted to the National Environment Management Authority (NEMA), application reference no. EIA/872 and approved in 2012 vide NEMA license registration No. 0014205. A copy of the licence has been annexed in Appendix V. The licence originally issued to GDC was subsequently transferred to each of the three individual IPPs each responsible for development of a 35MW power plant

Sosian is applying for funding from the international lenders to finance the proposed development. One of the prerequisites to funding is compliance with specific lender's environmental and social safeguards. Preliminary review and gap analysis of the original ESIA study report, NEMA license and ESMP established the need for additional inputs in order for the report to comply with MDBs and IFC requirements. GIBB Africa Ltd as a Firm of Experts Registered by NEMA was commissioned by Sosian, to update an ESIA Study.

1.5.1 Objectives of the ESIA update

The overall objective of Environmental and Social Impact Assessment (ESIA) update is to ensure that the report fulfils the requirements of the international lenders by undertaking the following tasks:

- Task 1: Review of existing documentation;
- Task 2: Identify gaps that can hinder the international lenders approval of the reports in Task (1) above; and
- Task 3: Prepare a report based on Task 1 and 2 above.

The specific objectives of the study were to:

1. Verify the compliance of the existing project ESIA report and ESMP with the following policies and guidelines;
    - African Development Bank's environmental and social policies and guidelines;

- International Finance Corporation's Performance Standards including Environmental, Health, and Safety Guidelines for Geothermal Power Generation
- International Labour Organisation (ILO) Core Labour Conventions Terms and Conditions of Employment both as at 14th September, 2013

2. Re-organisation of the ESIA Report to meet the MDBs and IFIs reporting requirements;
3. Confirm the project description and the technologies to be used at the power stations;
4. Update the baseline socio-economic survey done within and outside the project boundaries;
5. Align the air quality modelling to the location of proposed power plants and preparation of a management plan;
6. Conduct socio-economic survey of the direct impact area of the power plant;
7. Identification of direct and indirect socio-economic impact zones;
8. Undertake public consultations and participation in the project area;
9. Update the environmental and social impacts of the associated with the construction, operation and decommissioning of the Project.
10. Re-evaluation of impacts and determination of mitigation measures; and
11. Update of the ESMP based on the study findings.

1.5.2 Target Group for the ESIA Report

This Environmental and Social Impact Assessment Study Report has been prepared for use by different stakeholders to be involved in the project. The report contains useful information on policies and procedures to be adhered to, implementation modalities, analysis of potential environmental and social impacts and suggested mitigation measures at various stages of the project activities. The information will be useful in planning, implementation, management and maintenance of the plant.

In this regard, the report will be useful to the following stakeholders:

- Multinational Development Banks;
- The Lead Agencies of the government;
- The NEMA monitoring and compliance section;
- Funding agencies and donors;
- Planners and engineers to be involved in preparation of designs and plans for project;
- Contractors engaged in the construction works for the project;
- The potential project affected persons (PAPS) living within the project area; and
- Beneficiaries of the project both at local and regional level.

1.6 Methodology

This ESIA Report has been prepared in accordance with the Environmental (Impact Assessment and Audit) Regulation, 2003 as amended in 2016. It is also guided by the IFC's EHS General Guidelines and IFC's EHS Guidelines for Geothermal Projects as well as African Development Bank (AfDB) Operational Safeguards.

The study methodology comprised the following activities:

- Preliminary meetings;
- Data collection and document review;
- Site inspection and discussions with site personnel;
- Air and Noise Dispersion Modelling;
- Ecological Assessment;
- Baseline Socio-Economic Studies;
- Community Resources Mapping;
- Meetings with stakeholders;
- Public Consultation;

- Data Analysis;
- Reporting.

The ESIA Report has confined itself to the construction of the 1x35MW modular geothermal power stations and associated infrastructure.

1.6.1 Preliminary meetings

An initial meeting was held with the Client representative at GIBB's offices on 21 October 2014 to brief him on the ESIA study work program and the various activities to be undertaken as part of the study as well as request for project information such as the project design. Another meeting was also held with GDC Environment and Community liaison department representatives on 22 October 2014 at the GDC Nakuru main office where the consultant briefed them on the work program and the various tasks to be undertaken by the ESIA team.

1.6.2 Desktop study

This entailed desktop review of project related literature in order to gain background information and the current status of the project. Some of the reports and documents reviewed include:

- ESIA Study Report prepared by the University of Eldoret;
- Water Quality Assessment Report;
- PISSA with GDC;
- GDC Environmental Monitoring Reports;
- Noise Assessment Reports;
- NEMA EIA License for the project;
- Project Design Report;
- Air Quality impact Assessment Report for the proposed Menengai Geothermal Power plant In Kenya;
- Noise impact Assessment Report for the proposed Menengai Geothermal Power plant In Kenya;
- National Census Report 2009; and
- Available reports on the project area on geology, soils, hydrology etc.

A detailed bibliography of the documents reviewed has been provided in section 10 of the report.

1.6.3 Field visit

A visit to the project area was undertaken from 20 October 2014 and 19 November 2014 to undertake a top-up exercise for the Environmental and Social Impact Assessment of 1x35 MW Geothermal Power Plant in Menengai. Specialized studies undertaken during this visit include: Baseline socio-economic survey and public and stakeholder consultations. No additional field work has been conducted in 2019. However, relevant desk review updates have been undertaken.

1.6.4 Methodology for specialised studies

(a) Air Quality Assessment

Airshed Planning Professionals (Pty) Ltd (Airshed) was appointed by Sosian to conduct the plant's operation air quality impact specialist study. The following tasks, typical of an air quality impact assessment, were included in the scope of work:

- A review of proposed project activities in order to identify sources of emission and associated emissions;
- A study of regulatory requirements and health thresholds for identified key pollutants against which compliance need to be assessed and health risks screened;
- A study of the receiving environment in the vicinity of the project; including: o

the identification of potential air quality sensitive receptors (AQSRs);

(i) Approach to assessment

The air quality impact assessment included a study of the receiving environment and the quantification and assessment of the impact of the proposed Menengai geothermal power plant on human health and the environment. The receiving environment was described in terms of local atmospheric dispersion potential, the location of potential Air Quality Sensitive Receptors (AQSRs) in relation to proposed activities as well as pre-development ambient pollutant levels. A comprehensive atmospheric emissions inventory was compiled for the operational phase of the project. Pollutant quantified included only hydrogen sulphide (H_2S).

(ii) Meteorological data

An understanding of the atmospheric dispersion potential of the area is essential to an air quality impact assessment. Physical environmental parameters that influence the dispersion of pollutants in the atmosphere include terrain and meteorology. Existing pre-development ambient air quality in the study area was also considered.

Readily available terrain data was obtained from the Atmospheric Studies Group (ASG) via the United States Geological Survey (USGS) web site at (ASG, 2011). In the absence of on-site meteorological data (that is required for atmospheric dispersion modelling), use was made of simulated data for a period between 2011 and 2013. The MM5 (short for Fifth-Generation Penn State/NCAR Mesoscale Model) is a regional mesoscale model used for creating weather forecasts and climate projections. It is a community model maintained by Penn State University and the National Centre for Atmospheric Research.

(iii) Dispersion modelling

Estimated emissions along with information on the receiving environment were used as input to an atmospheric dispersion model which simulated ground level pollutant concentrations. The assessment was done for the operational phase of the project only.

In the simulation of ambient air pollutant concentrations use was made of the Atmospheric Dispersion Modelling System Version 4.2 (ADMS 4) developed by the Cambridge Environmental Research Consultants (CERC). This model simulates a wide range of buoyant and passive releases to the atmosphere either individually or in combination. A summary of the model inputs is presented in Table 1-2 below.

Table 1-2: Model inputs summary for Air Quality Impact

Parameter	Comments
Dispersion Model Selection	Version 4.2 of ADMS
Meteorological Requirements	hourly MM5 surface and profile data for the period 2011 to 2013
Source Data Requirements	The ADMS model is able to model point, jet, area, line and volume sources. Stack and cooling tower fans were modelled as point sources.
Modelling Domain	The dispersion of pollutants expected to arise from proposed activities was modelled for an area covering 15 km (east-west) by 10 km (north-south). The area was divided into a grid matrix with a resolution of 200 m, with the geothermal power plants located centrally. The nearest town and farmsteads were included as AQSR. ADMS calculates ground-level (1.5 m above ground level) concentrations at each grid and discrete receptor point. Topography was included in dispersion simulations.
Results presentation	Dispersion modelling was undertaken to determine highest hourly, 8 hourly, highest daily and annual average ground level concentrations.

Parameter	Comments
	Averaging periods were selected to facilitate the comparison of simulated pollutant concentrations to relevant ambient air quality, inhalation health criteria and odour thresholds. Results are provided in tabular form as discrete values simulated at specific AQSR receptor locations. Selective use is also made of isopleths to present areas of exceedance of assessment criteria. It should be noted that ambient air quality criteria apply to areas where the Occupational Health and Safety regulations do not apply, thus outside the property or lease area. Ambient air quality criteria are therefore not occupational health indicators but applicable to areas where the general public has access i.e. off-site.

(iv) Determining risks of the project on the receiving environment

The simulated ground level pollutant concentrations were screened against both local and internationally accepted reference inhalation concentrations. In the evaluation air emissions and ambient air quality impacts reference was made to:

- Screening levels for non-criteria pollutants published by various internationally recognised organisations;
- Odour thresholds; and
- Occupational limits.

Health risk screening was done through the comparison of simulated criteria pollutant concentrations (H_2S) to inhalation screening levels. Potential for odour impacts was done through the comparison of simulated non-criteria pollutant concentrations (H_2S) to odour thresholds. Regulatory occupational limits were used to assess the occupational impact.

(v) Assumptions, Exclusions and Limitations

- The quantification of sources of emission was restricted to proposed operations at the geothermal power plants;
- Project information required to calculate emissions for proposed operations were provided by Sosian. Where necessary, assumptions were made based on the specialist's experience. Information was provided by the other two independent power producers (IPPs) located adjacent to the Sosian site (Quantum and OTTL);
- Routine emissions were estimated and simulated;
- In the absence of on-site surface meteorological data, use was made of modelled MM5 data for an on-site location;
- A minimum of 1 year, and typically 3 to 5 years of meteorological data are generally recommended for use in atmospheric dispersion modelling for air quality impact assessment purposes. Use was made of the meteorological data for the year 2017. Data for 2018 and 2019 were also available but found unsuitable for use in the modelling; and
- The impact assessment was limited to H_2S during the operational phase.

(b) Noise Modelling

For Noise modelling, Sosian commissioned Airshed Planning Professionals (Pty) Ltd (Airshed) to undertake an environmental noise impact assessment for the operational phase of the proposed Sosian Geothermal Power Plant in Kenya.

Noise impact assessment included a study of the legal requirements pertaining to noise impacts, a study of the physical environment of the area surrounding the project and the analyses of existing noise levels in the area. The impact assessment focused on the estimation of noise 'emissions' and noise impacts associated with the operational phase of the facility.

Baseline acoustic environment was described in terms of the location of Noise Sensitive Receptors (NSRs) in relation to the proposed power plant, the ability of the environment to attenuate noise over distances and existing or pre-development noise levels.

Sound power levels for main power plant equipment were determined from supplier specifications and theoretical calculations. The effective sound power level of the turbine hall was also estimated by taking into account the building size, sound absorption by cladding and floor as well as transmission losses through the galvanised steel sheet cladding.

The propagation of noise from proposed activities was calculated according *to 'The Calculation of Sound Propagation by the Concave method'* (SANS 10357, 2004). The Concave method makes use of the International Organisation for Standardization's (ISO) air absorption parameters and equations for noise attenuation as well as the factors for barriers and ground effects. In addition to the ISO method, the Concave method facilitates the calculation of sound propagation under a variety of meteorological conditions. Meteorological data obtained from the MM5 data set as used in the air quality impact assessment were applied.

The noise source inventory, local meteorological conditions and information on local land use were used to populate the noise propagation model (Concave). Noise levels were calculated over an area of 5 km east-west by 5 km north-south at intervals of 50m.

Noise impacts were calculated in terms of:

- Total day- and night time noise levels as a result of:
  - The proposed Sosian Power Plant in addition to the baseline; and
  - The, Sosian, QPEA, and OTTL geothermal power plants in addition to the baseline.
- The effective increase ambient day and night-time noise levels over the baseline as a result of:
  - The proposed Sosian Power plant; and
  - The QPEA, and OTTL geothermal power plants.

The impacts were assessed according to guidelines published by NEMA in the Environmental Management and Coordination (Noise and excessive vibration pollution control) regulations of 2009 and IFC. To assess annoyance at nearby places of residence, reference was made to guidelines published in SANS 10103 (2008).

Assumptions, Exclusions and Limitations on noise modelling

- The mitigating effect of infrastructure acting as acoustic barriers was not taken into account, providing a conservative assessment of the noise impacts off-site;
- The quantification of sources of noise was limited to the routine operational phase of the project. Construction and closure phase activities were assessed qualitatively;
- All activities were assumed to be 24 hours per day, 7 days per week; and
- The noise sources and sound power levels for the Sosian Geothermal Power Plant was provided by Sosian. It was assumed that this information was accurate and representative of routine operations at the facility.

(c) Ecological Survey

This top-up study has relied on baseline ecological survey data established from the initial study by the University of Eldoret in 2015. In addition, opportunistic observations were made by the ESIA Study Team during a site visit on 3 May 2019. No sampling protocol applied in this case. According to the University of Eldoret Ecological data was collected through the following approaches.

(i) Vegetation

Vegetation sampling was carried out on and around the six determined sites. Visual observation and recording of all spermatophytes encountered. Plant scientific names, family names, growth forms, natural habitat and their status whether indigenous or exotic were also noted and recorded. Selected plants images were also collected and the sites geo-referenced.

(ii) Avifauna

Birds investigation was based on line transect, which was designed at every site by use of binoculars. Bird species were identified and recorded. Also, bird calls or songs or any other songs were incorporated in bird identification exercise. During observations, only birds visible within a range radius of 25 m from transects were recorded.

(iii) Mammals

For Mammals, the survey used was standard line transect methods that are practiced widely in animal census (Burnharm *et al* 1980). Each site held one transect of 500 m in length and tracks, dung, footprint and other signs associated to certain species of mammals observed within the transect were recorded.

(iv) Herpertofauna

Field search were conducted in the study area where and at time when the reptiles were known to be active or detectable. The search for reptiles was centred on the ground and on trees. Active and barrowing reptiles encountered were recorded. Any other evidence or signs of presence of particular vertebrate were noted.

(d) Baseline Socio-Economic Studies

The following approaches were used

(i) Approach 1: Household Survey

The structured household interviews were carried out among the target population based on formatted questions. The survey grasped mainly quantitative information buy some open-ended questions (qualitative information) was useful for the study.

Study Design

A sampling frame and sample size was drawn from the households in the vicinity of the project site. The sample was based on stratified sample drawn from households neighbouring the project area. The sampling rate was between 10% and 25% of the households depending on the statistical significance within the area of the strata identified.

Recruitment of Enumerators

To ensure gender balance and reduce biasness on information gathering, female and male enumerators were recruited and trained to carry out the exercise. The objective of training the enumerators was to create awareness on the importance of the survey, provide training on interviewing techniques and build common understanding on the study tools as well as create team work.

The interviewer's guide and household questionnaires were discussed during the training and followed by pre-testing in the field.

Conducting the Survey

Door-to-door consultations were conducted by the enumerators with household heads or a responsible adult in the absence of the household head. Special considerations were given for child headed household holds if encountered. A supervisor was assigned the responsibility of quality assurance of the completed questionnaires on a daily basis. Quality assurance was undertaken to ensure compliance with the interview guidelines and completeness of the questionnaire.

Data Analysis and Presentations

The analysis of quantitative data was done using PASW (Predictive Analytics Software) formally known as Statistical Packages for Social Sciences (SPSS). Data is presented in form of prose, tables, matrices, pie charts and graphs.

(ii) Approach 2: Interview with Key Informants

Semi-structured interviews were conducted with local national and county government leaders and heads of line ministries in the project area of influence. Discussions focused on existing socio-economic situation in the project area. The meetings provided an opportunity to introduce the project to the community leaders and identify key informers.

(iii) Approach 3: Public Meetings

Public meetings were organized in the project area at the Sub location level with assistance from the local administration and conducted in compliance with MDBs and IFIs procedures. Qualitative data captured in the course of the discussions was used for triangulation of the output from other primary data sources throughout the study.

(e) Public Consultation and Disclosure

Public participation was done through one-on-one interviews and public meetings as detailed in Chapter 6 of the report. These were conducted in tandem with the baseline socio-economic studies.

1.7 ESIA Update study team

The ESIA team comprised the following:

Maurice Namiinda	Project Director;
George Owuor	Team leader/Lead EIA Expert;
Anastasia Ngatti	Sociologist/Public Consultation Expert;
Aggrey Kwadha	Lead EIA expert
Paul Mwangi	Occupational Health and Safety Expert; and
Alfrick Murunga	Assistant Environmentalist and
Rodrigues Nyandwaro	Assistant Environmentalist;

1.8 Structure of the report

This report has been prepared under the following chapters:

Executive summary: This chapter presents a summary of the significant findings and recommended actions, with an emphasis on expected impacts.

Chapter 1: **Introduction:** This chapter gives description of the project background,

location, purpose, objectives, reporting requirements, study methodology and the structure of the report.

Chapter 2: **Policy**, L**egal and regulatory framework**: This chapter outlines the overview of legislative framework, regulatory, international guidelines and conventions relevant to this project.

Chapter 3: **Description of the project environment:** This chapter gives description of the environmental setting of proposed project and surrounding areas, e.g., climate, soils, geology, vegetation, fauna, land use, human populations, socio-economics, cultural heritage.

Chapter 4: **Project description:** This chapter gives a description of the project details and design and implementation strategies.

Chapter 5: **Project alternatives:** This chapter gives an analysis of project alternatives including the no-project option.

Chapter 6: **Public and stakeholder consultation:***'* This chapter gives description of the objectives, methods used and summary of results of the public consultation activities undertaken during the project report stage.

Chapter 7: **Impacts assessment and mitigation measures:** This chapter presents the analysis of beneficial and adverse impacts of the project on the biophysical and human (social, cultural and economic) environments. The analysis covers anticipated impacts during the construction, operation phases and decommissioning phases and also describes the enhancement and mitigation measures proposed to enhance benefits or prevent, minimize, mitigate or compensate for adverse impacts as well as the estimated cost of mitigation.

Chapter 8**:** **Environmental and Social Management Plan:** This chapter gives in details summary of procedures and plans to ensure that the mitigation measures and monitoring requirements approved during the environmental compliance review will actually be carried out in subsequent stages of the project.

Chapter 9: **Conclusions and Recommendations:** This chapter summarises the consultant's conclusion and recommendations form the assessment.

2 POLICY LEGAL AND REGULATORY FRAMEWORK

2.1 Background

Regulation 18 (1) (b) of the Environmental (Impact Assessment and Audit) Regulations 2003 require that the proponent/Sosian provides an environmental assessment study report prior to the commencement of a project, this report should have among others; a concise description of national environmental legislative and regulatory framework. This chapter presents a review of the current local policy, legal and regulatory framework as well as MDBs and IFC safeguards triggered and of relevance to environmental management of the proposed project. Between the local and international guidelines, the ones with the stringiest requirements are preferred.

2.2 Policy Framework

2.2.1 National Environmental Policy, 2014

The National Environmental Policy gives the framework to guide the country's efforts in addressing the ever-growing environmental issues and challenges such as:

- Environmental governance;
- Loss of biodiversity;
- Valuation of environmental and natural resources;
- Rehabilitation and restoration of environmentally degraded areas;
- Urbanisation, waste management and pollution;
- Climate change, energy, security and disaster management;
- Public participation, environmental education and awareness;
- Data and information;
- Poverty;
- Chemicals Management.

The objectives of this Policy are to:

- Provide a framework for an integrated approach to planning and sustainable management of Kenya's environment and natural resources;
- Strengthen the legal and institutional framework for good governance, effective coordination and management of the environment and natural resources;
- Ensure sustainable management of the environment and natural resources, such as unique terrestrial and aquatic ecosystems, for national economic growth and improved livelihoods;
- Promote and support research and capacity development as well as use of innovative environmental management tools such as incentives, disincentives, total economic valuation, indicators of sustainable development, Strategic Environmental Assessments (SEAs), Environmental Impact Assessments (EIAs), Environmental Audits (EA) and Payment for Environmental Services (PES);
- Promote and enhance cooperation, collaboration, synergy, partnerships and participation in the protection, conservation, sustainable management of the environment and natural resources;
- Ensure inclusion of cross-cutting and emerging issues such as poverty reduction, gender, disability, HIV&AIDS and other diseases in the management of the environment and natural resources;
- Promote domestication, coordination and maximisation of benefit from Strategic Multilateral Environmental Agreements (MEAs).

The Policy discusses in depth the following key environmental topics:

- Management of ecosystems and sustainable use of natural resources;
- Environmental stewardship;
- Environmental quality and health;
- Research, education and monitoring;
- Environmental governance.

Relevance

ESIA is one of the environmental management tools identified and supported by the policy; Chapter nine of the policy regarding the "Implementation Strategies and Actions" requires that all significant development projects are subjected to EIA and regular environmental audits conducted.

2.2.2 Environmental, Health & Safety (EHS) Policy Framework for the Electric Power Sub-Sector, September 2005

The policy is aimed at strengthening the enforcement of environmental, health and safety regulations in the electric power sub-sector as provided for in the Act. The Policy recognizes the role of lead agencies in the power sector and the need for aligning with EMCA requirements in the ESIA process of approving EIA Reports for new power plants, transmission and distribution lines. It describes best practice on EHS principles for generation and demand sides of the energy subsectors. It also recognizes Energy and Petroleum Regulatory Authority (formerly Electricity Regulatory Board (ERB) in respect of the electric power sub-sector. It further affirms the strategic contribution of energy services in achieving sustainable social and economic development as an integral part of environmental ad ecological sustainability.

The policy sets out performance monitoring & compliance protocols including monitoring measures as well as monitoring and reporting procedures for key environmental, health and safety aspects of the operations in the power sub-sector (geothermal power plants, hydro-power plants, thermal power plants, transmission & distribution networks). Further, the policy provides an eco-efficiency indicator formula for EPRA to keep track of ecological efficiency performance of licensed power producers. This introduces a check to ensure that business (in the energy sub sector) does not only make profit but also in an environmentally responsible manner.

Relevance

Sosian as a geothermal power generator should recognize the mandates of EPRA as a lead agency in EHS management, especially in Licensing and oversight EHS monitoring in the power sub-sector. Sosian should integrate into its EHS monitoring protocols; the parameters, procedures and reporting schedules recommended by EPRA in S8.1 (Monitoring Protocols for Geothermal Power Plants) of the Policy.

2.2.3 Policy statement on Public Private Partnerships Act, 2011

The purpose of this policy is to articulate the Government commitment to Public Private Partnerships (PPP) and to provide a basis for the enactment of a PPP Law to strengthen the existing legal and regulatory framework. The policy is also expected to provide a foundation for the establishment of institutions to champion the PPP agenda, facilitate mobilization of domestic and international private sector investments, and to provide for Government support for PPP projects, as well as providing a clear and a transparent process for project development.
The key elements of the policy are:

- Establishment of central institutions to champion the PPP agenda, with
  - the PPP Steering Committee, consisting of senior officials to guide policy and promote awareness and
  - the PPP Secretariat, housed within the Ministry of Finance, as a resource centre of expertise and best practice;
- Mobilization of domestic and international private sector investment - creating a level playing field and clear rules of the game, by
  - establishing a clear process for project selection, preparation, procurement and

implementation with project evaluation at each stage with clear objectives and triter a for selection and evaluation;
  - strengthening of the existing legal and regulatory framework established under sector laws and policies as well as the PPP Implementing Regulations; and
  - implementing a clear, transparent process for allocating Government support, including guarantees
- Support for MDAs to encourage the development of PPP projects that provide value for money for Kenya, through
  - project preparation funding,
  - viability gap grants,
  - easier access to Government support, and
  - technical assistance from the PPP Secretariat to assist Ministry Department Agencies (MDAs) in selection, development, procurement and implementation of PPPs.

This project is geared towards achieving the goals and benefits in section 2.4 of this policy statement.

2.2.4 Draft National Energy and Petroleum Policy 2015

Chapter 3 of the Energy Policy discusses renewable energy sources available in Kenya such as geothermal, hydro, biomass, bio fuels, biogas, solar, wind, municipal waste and biomass co-generation. On geothermal energy, the policy outlines the guidelines and strategies to be implemented by the government under different implementation plans. It also highlights the challenges experienced by the sector:

- Relatively long lead time of between 5-7 years from conception to production of electricity;
- Geothermal projects typically progress through stages of reconnaissance, surface exploration, feasibility study, exploratory drilling, appraisal drilling, production drilling, steam field development and power plant construction stages which normally involve high upfront investment costs;
- High resource development risks;
- Inadequate geothermal expertise and expensive external technology;
- Remote location, siting restrictions and long distances to existing load centres necessitating heavy investment in transmission and other support infrastructure;
- Competing and conflicting interests in use of land and natural energy resources by various sectors of the economy; and
- Relocation and resettlement of affected persons during geothermal development.

Chapter 6 on Land, Environment, Health and Safety, the policy discusses policies and strategies and implementation Plan for the following issues related to the energy sector in Kenya:

1 Land and Socio-Economic Issues;
2 Environment, Health and Safety;
3 Climate Change Mitigation;
4 Renewable Energy EHS Concerns
5 Conservation of Catchment Areas;
6 Disaster Prevention and Management.

Relevance

This ESIA study addresses some of the concerns on geothermal energy as underscored in the policy including the management of associated gases and liquids which may contribute to global warming, acid rain, noxious smells and ground water pollution if released on the surface.

2.2.5 Kenya Vision 2030

Vision 2030 aspires to transform Kenya into a newly industrialized middle-income country by 2030. It identifies energy and electricity as a key element of Kenya's sustained economic growth

and transformation. According to the vision, the country aims at enhancing and diversifying national power generation and supply by identifying new generation and supply sources through exploitation of geothermal power, coal, renewable energy sources, and connecting Kenya to energy-surplus countries in the region. It encourages more private generators of power, and separating generation from distribution.

The vision for the environmental sector is “people living in a clean, secure and sustainable environment”. The vision is inspired by the principle of sustainable development and by the need for equity in access to the benefits of a clean environment. The vision focuses on four strategic thrust:

- Conservation;
- Pollution and waste management;
- ASALs and high-risk disaster zones; and
- Environmental planning and governance.

Relevance

Geothermal energy has been identified as one of the sources of energy that would substantially address the prevailing energy deficit. The proposed development is thus in line with sector specific objectives in vision 2030. This ESIA study report is one of the tools geared toward ensuring the project is undertaken in a sustainable manner with proper management of any resultant wastes.

2.2.6 The Kenya National Climate Change Policy (2016)

The vision of the Strategy/Policy is for a prosperous and climate change resilient Kenya. The mission is to strengthen and focus nationwide actions towards climate change adaptation and GHG emission mitigation.

In order to cushion key sectors against the impacts of climate change, the Strategy has identified sectoral adaptation and mitigation needs. To counter potential threats to the energy sector Kenya needs to, and should implement the following measures:

- Accelerate the development of geothermal energy;
- Accelerate the development of green energy including wind, solar and renewable biomass; and
- Energy Efficiency.

2.2.7 National Land Policy, 2009

The National Land Policy in Chapter 3 under section 3.4, Environmental Management Principles, provides for the policy actions for addressing the environmental problems such as the degradation of natural resources, soil erosion, and pollution of air, water and land.

The policy advocates for environmental assessment and audit as a land management tool to ensure environmental impact assessments and audits are carried out on all land developments that may degrade the environment and take appropriate actions to correct the situation. Public participation has also been indicated as key in the monitoring and protection of the environment.

Section 3.4.3.3 advocates for the Implementation of the polluter pays principle which ensures that polluters meet the cost of cleaning up the pollution they cause, and encourage use of cleaner production technologies.

In section 131 (d) the government undertakes to provide mechanisms for resolving grievances arising from human/wildlife conflicts for sustainable management of land based natural resources.

Relevance

The proposed works shall implement the ESMP from this environmental assessment to ensure that all the rivers and streams within the project area are not polluted by the subsequent activities during construction and operational phases.

2.2.8 GDC Health, Safety and Environment Policy, 2011

GDC has developed an elaborate Health, Safety and Environment policy geared towards ensuring safety and environmental protection in its entire working environment. In its health and safety policy statement, GDC undertakes as follows:

"GDC shall conduct all its activities taking foremost account of health and safety of its employees, contractor and local community while paying proper regard to the environment".

The policy in clause 2 stipulates responsibilities of various players involved in GDC activities including GDC itself, GDC employees; and any procured contractors.

Of relevance to Sosian Geothermal Power Plants Ltd is clause 2.1 which requires all contractors engaged by GDC to:

- Abide by its policy and be responsible for management of their employees through training, mentoring etc.;
- Perform all work in a manner to prevent HSE incidents;
- Ensure training and proper tools/equipment;
- Notify GDC immediately of any Health, Safety or Environmental (HSE) incidents, even if no injury occurs;
- Provide GDC with a written report on incidents within 24 hours;
- Undertake Proactive HSE efforts;
- Contractor shall hold a pre-job or pre-task HSE meeting on-site in which the specific hazards pertaining to the job are discussed prior to beginning all work; and
- Contractor shall have their own written drug, alcohol and firearms policy in effect.

Sosian Geothermal Power Plants Ltd shall review the current GDC policy and ensure full compliance in the power plant construction and operation activities undertaken by itself and on its behalf by any sub-contractors.

2.2.9 GDC Environment Policy, 2012

GDC also has an Environment policy in place whose goal is to provide a framework for addressing environmental issues and ensuring that all GDC's project are implemented in line with relevant laws, regulations and conventions so as to realize sustainable development.

The policy scope covers all GDC projects and programs in its operation areas. The policy commits GDC to internationally acceptable business standards that are ethical, healthy and environmentally acceptable/friendly and in conformity with all relevant laws, regulations and convention that are in force.

One of the main objectives of the policy is to mainstream environmental management in GDC strategic plan, performance contracts and annual activity plans. The key institutions responsible for the policy implementation include:

- The GDC Board of directors;
- CEO and Managing director and the management;
- The environmental department; and
- All GDC company employees to be responsible.

The policy among others provides for specific environmental management requirements including:

- Air quality monitoring and meteorology;
- Waste management;

- Water, effluent, soils and flora quality;
- Regulatory compliance/permits; and
- Environmental awareness.

Sosian Geothermal Power Plants Ltd shall review the current GDC Environmental Policy and in liaison with the established departments, ensure full compliance in the power plant construction and operation activities undertaken by itself and on its behalf by any sub-contractors.

2.2.10 Sustainable Development Goals (SDGs) 2016

The Sustainable Development Goals (SDGs) replaced the Millennium Development Goals (MDGs) in 2015. The SDGs are a collection of 17 global goals set by the United Nations General Assembly in 2015 for the year 2030. The SDGs are part of Resolution 70/1 of the United Nations General Assembly, the 2030 Agenda. The Sustainable Development Goals are:

- No Poverty,
- Zero Hunger,
- Good Health and Well-being,
- Quality Education,
- Gender Equality,
- Clean Water and Sanitation,
- Affordable and Clean Energy,
- Decent Work and Economic Growth,
- Industry, Innovation, and Infrastructure,
- Reducing Inequality,
- Sustainable Cities and Communities,
- Responsible Consumption and Production,
- Climate Action,
- Life Below Water,
- Life on Land,
- Peace, Justice, and Strong Institutions,
- Partnerships for the Goals.

The goals are broad based and interdependent. The 17 Sustainable Development Goal's each have a list of targets that are measured with indicators.

Goal no.7 recognises that Energy is central to nearly every major challenge and opportunity the world faces today. Be it for jobs, security, climate change, food production or increasing incomes, access to energy for all is essential. Working towards this goal is especially important as it interlinks with other Sustainable Development Goals. Focusing on universal access to energy, increased energy efficiency and the increased use of renewable energy through new economic and job opportunities is crucial to creating more sustainable and inclusive communities and resilience to environmental issues like climate change.

Relevance

The proposed power project will merely contribute to affordable and clean energy and in the process contribute to other SDGs which include but not limited to; Gender equity, decent work and economic growth etc. This ESIA study has been done to ensure that Environmental Sustainability is reflected by the proposed project especially during the time of construction and implementation.

2.3 Legal Framework

2.3.1 The Constitution of Kenya, 2010

The role of the environment in sustaining our heritage is recognized in the Constitution of Kenya, 2010 as a heritage of intergenerational benefit. Chapter 5 on Land and Environment is more particular on this. Part 1 of the chapter clarifies that the state may regulate the use of any land, or any interest in or right over any land, in the interest of defence, public safety, public order, public morality, public health, or land use planning. Part 2 of the chapter defines environment and natural resources, obligations in respect of the environment, enforcement of environmental rights, agreements relating to natural resources and legislation relating to the environment.

Section 69 explains each and every citizen's obligations in respect of the environment in subsection (1). it states the following:

The State shall:

- Ensure sustainable exploitation, utilisation, management and conservation of the environment and natural resources, and ensure the equitable sharing of the accruing benefits;
- Work to achieve and maintain a tree cover of at least ten per cent of the land area of Kenya;
- Protect and enhance intellectual property in, and indigenous knowledge of, biodiversity and the genetic resources of the communities;
- Encourage public participation in the management, protection and conservation of the environment;
- Protect genetic resources and biological diversity;
- Establish systems of environmental impact assessment, environmental audit and monitoring of the environment;
- Eliminate processes and activities that are likely to endanger the environment; and
- Utilise the environment and natural resources for the benefit of the people of Kenya.

Subsection (2) states:

Every person has a duty to cooperate with State organs and other persons to protect and conserve the environment and ensure ecologically sustainable development and use of natural resources.

Relevance

The constitution of Kenya provides for sound environmental management and sustainability and therefore this study provides one of the tools through which this can be achieved within the development.

2.3.2 Environment Management and Coordination Act (No. 8 of 1999) and Amendment Act, 2015

The major role of the act is to provide for the establishment of an appropriate legal and institutional framework for the management of the environment and for matters connected therewith and incidental thereto.

Part II of the Act vests on every person a right to a healthy environment and a responsibility to safeguard it. The Act therefore makes it mandatory for Sosian Geothermal Power Plants Ltd to work in a clean environment and protect people living close to the project.

Part V Section 44 includes protection of hill tops, hill sides, mountain areas and forests; Menengai area basically lies in a caldera. Sosian Geothermal Power Plants Ltd will be required to institute measures for the sustainable use of caldera so as to prevent environmental degradation as required by the Act.

Section 51 and 54 deals with conservation of biological resources and protection of the environmental significant areas, the proposed development lies in a caldera ecosystem, which needs to be protected.

Section 56 deals with the protection of ozone layer and emissions of dangerous gases to the atmosphere, the geothermal processes will lead to emission of CO_2. CO and CH4 which are ozone layer depleting substances. Sosian Geothermal Power Plants Ltd will be required to abide by the allowable discharge limits to the atmosphere.

All the chapters 1 to 13 apply to the new project at one stage or the other and therefore Sosian Geothermal Power Plants Ltd is required to understand and use the Act in total.

Relevance

In accordance with the second schedule of EMCA, geothermal development projects exceeding 10MW are classified under High Risk. The proposed 1X35 MW Geothermal Power Plant Project in Menengai falls under the prescribed list of projects for which environmental impact assessment is mandatory, prior to implementation. The basis is that the proposed project constitutes several components of activities, which would result in considerable changes and significant effects to the environment including on land, water, atmospheric resources and biological diversity.

EMCA has provided for the development of several subsidiary legislations and guidelines that govern environmental management which are relevant to the proposed project as reviewed below.

(a) Environmental (Impact Assessment and Audit) Regulations 2003 (Amendment 2016)

The Environmental Impact Assessment and Audit Regulations state in Regulation 3 that *"the Regulations should apply to all policies, plans, programmes, projects and activities specified in Part III and V of the Regulations"* basically lists the guidelines of undertaking, submission and approval of the ESIA Report.

Regulation 26 (1) provides that a holder of an environmental impact assessment licence may, on payment of the prescribed fee, transfer the licence to another person only in respect of the project to which such licence was issued.

Relevance

The project has already been licensed by NEMA in accordance with these regulations. Sosian Geothermal Power Plants Ltd should thus arrange with GDC to have the existing licence transferred to Sosian Geothermal Power Plants Ltd as provided in these regulations.

(b) Environmental Management and Coordination (Waste Management) Regulations 2006

These Regulations apply to all categories of waste as provided in the Regulations. These include:

- Industrial wastes;
- Hazardous and toxic wastes;
- Pesticides and toxic substances;
- Biomedical wastes;

- Radio-active substances.

These Regulations outline requirements for handling, storing, transporting, and treatment / disposal of all waste categories as provided therein. Wastes contaminated with petroleum product are considered to be hazardous. Sosian Geothermal Power Plants Ltd will have to abide by these regulations in dealing with waste management especially the provisions of industrial, hazardous and toxic wastes which may be generated during their operations.

Relevance

The proposed geothermal power plant project, during construction and operation, will generate various types of wastes which will need to be disposed as per the guidelines in the regulations.

(c) Environmental Management and Coordination (Water Quality) Regulations 2006

These Regulations protect the quality of drinking water, water used for agricultural purposes, water used for recreational purposes, water used for fisheries and wildlife and water used for any other purposes.

These Regulations outline:

- Quality standards for sources of domestic water;
- Quality monitoring for sources of domestic water;
- Standards for effluent discharge into the environment;
- Monitoring guide for discharge into the environment;
- Standards for effluent discharge into public sewers;
- Monitoring for discharge of treated effluent into the environment.

In fulfilling the requirements of the regulations Sosian Geothermal Power Plants Ltd will undertake monitoring of both domestic water and wastewater and ensure compliance with the acceptable discharge standards.

Relevance

During the construction and operation phases, the proposed project's water supplies will require compliance with the standards established under these regulations.

(d) Environmental Management and Coordination (Conservation of Biological Diversity) (BD) Regulations 2006

These Regulations apply to conservation of biodiversity which includes Conservation of threatened species, Inventory and monitoring of Biological Diversity and protection of environmentally significant areas, access to genetic resources, benefit sharing and offences and penalties. The Regulations mainly applies due to the location of the proposed project site with the Menengai caldera. Proper environmental management will be required to conserve the biological diversity within the area.

Relevance

A detailed assessment of the likely impacts of the power plants on biodiversity in the area has been conducted to ensure their sustainability.

(e) Environmental Management and Coordination (Air Quality) Regulations 2014

These Regulations cover air quality standards that are requisite to protect human health and allow an adequate margin of safety. These Regulations specify priority air pollutants, mobile and stationary sources as well as stipulates emission standards.

The emissions generated from construction activities (such as running vehicle and equipment engines) have the potential of polluting the immediate atmospheric environment. Vegetation clearing, earthworks and bulk delivery of construction material, if unmanaged may result in generation of dust. In addition, H_2S will be the main emission of concern during operation. Thus, need for strict adherence to these Regulations and standards therein in preventing possible pollutants and managing sources.

Hydrogen sulphide is listed as one of the priority air pollutants to be monitored with a stipulated threshold of 150µg/m^3.

These Regulations apply to all internal combustion engine emission standards, emission inspections, the power of emission inspectors, fuel catalysts, licensing to treat fuel, cost of clearing pollution and partnerships to control fossil fuel emissions used by Sosian Geothermal Power Plants Ltd. The fossil fuels considered are petrol, diesel, fuel oils and kerosene.

Relevance

These regulations will be applicable to equipment and machinery used by the contractor during plant construction and periodic maintenance and during the operation period.

(f) Environmental Management and Coordination (Controlled Substances) Regulations 2007

The Government of Kenya banned the importation of Chlorofluorocarbons (CFCs) with effect from 1 January 2009, to ensure that Kenya is compliant with the provisions of the Montreal Protocol on Substances that Deplete the Ozone Layer.

This regulation makes it mandatory for industries, and other stake holders in ODS trade, to obtain a license to import these substances. The ozone-friendly refrigerants, oil lubricants, and other ozone-friendly alternative chemicals to CFCs shall be the only ones that shall be licensed for importation for use in equipment. No license shall be issued to any person to import CFCs.

Relevance

The project is likely to involve use of coolants/refrigerants in the processes during operation. Therefore, it is imperative that appropriate ones are adopted in compliance with this regulation.

(g) Environmental Management and Coordination, (Wetlands, Riverbanks, Lake Shores and Sea Shore Management) Regulations 2009

These regulations include management of wetlands, wetland resources, riverbanks, lakeshores, and seashores. The regulations empower the District Environment Committee to co-ordinate, monitor, and advice on all aspects of wetland and water resource management within the district.

(h) Environmental Management and Coordination (Noise & Excessive Vibration Pollution) Control Régulations, 2009

These regulations stipulate the maximum permissible noise levels for various land use zones including construction sites. It prohibits Sosian from making or causing any loud, unreasonable, unnecessary or unusual noise which annoys, disturbs, injures or endangers the comfort, repose, health or safety of others and the environment. It also prohibits Sosian from excessive vibrations, which annoy, disturb, injure or endanger the comfort, repose, health or safety of others and the environment or excessive vibrations, which exceed 0.5 centimetres per second beyond any source property boundary or 30 metres from any moving source.

The noise limits stipulated by the (Noise and Excessive Vibration Pollution) (Control) Regulations, 2009 for various land use zones and construction sites are presented in tables 2-1 and 2-2 respectively.

Table 2-1: Maximum Permissible Noise Levels

Zone		Maximum Permissible Noise Level (dB(A))			
		Sound Level Limits dB(A) (Leq,14 h)		Noise Rating Level (NR) (Leq,14 h)	
		Day (6:01-20:00) (Leq, 14 h)	Night (20:00-06:01) (Leq, 10h)	Day (6:01-20:00) (Leq, 14 h)	Night (20:00-06:01) (Leq, 10h)
Silent Zone		40	35	30	25
Places of Worship				30	
Residential	Indoor	45		35	
	Outdoor	50		40	
Mixed residential area (with some commercial and entertainment facilities)		55		50	
Commercial Area		60		55	

Table 2-2: Maximum Permissible Noise Levels for Construction Sites

Facility	Maximum Permissible Noise Level (Leq) in (dB(A))	
	Day (6:01-20:00)	Night (20:00-06:01)
Health facilities, educational institutions and homes for the disabled	60	35
Residential		
Areas other than above categories	75	65

Relevance

The above threshold shall guide noise management at the proposed site during both construction and operation phases.

Under the regulations, Sosian will be required to undertake regular monitoring of the noise levels within the proposed geothermal power plant to check for compliance and any required corrective actions.

2.3.3 Public Private and Partnerships Act, 2013

The role of this act is to provide for the participation of the private sector in the financing, construction, development, operation, or maintenance of infrastructure or development projects of the Government through concession or other contractual arrangements; the establishment of the institutions to regulate, monitor and supervise the implementation of project agreements on infrastructure or development projects and for connected purposes.

The second schedule (public private partnership arrangements) and the third schedule (minimum contractual obligations required to be specified in a project agreement) clearly defines the roles of the contracting authority (GDC) and the private party (Sosian).

Relevance

Both GDC and Sosian shall follow procedures and perform their duties as required by this act during construction and during the operation period of the project.

2.3.4 The Public Private Partnerships Regulations, 2014

These Regulations apply to every contract for the design, financing, construction, operation, equipping or maintenance of a project for the provision of public services undertaken under the Act PPP Act 2013

For the purposes of section 71(I)(c) of the Act, these Regulations shall not apply to a project if that project:

- is a national project that has a capital expenditure component with a contract value of more than eighty-five million shillings;
- is a county government project that has a capital expenditure component with a Contract value of more than five million shillings; or
- is either a national government project or a county government project that does not have a capital expenditure component but a contract value of more than five million shillings being life cycle costs.

The requirements shall not apply:

- if there is a material public interest;
- if the Unit has recommended it; and
- if the Committee has adopted objective parameters to guide it in determining whether or not to exempt the project.

Relevance

This project does not fall short of the above-mentioned reasons not to apply the regulations and therefore, they are viable to it.

2.3.5 The Public Private Partnerships (Project Facilitation Fund) Regulations, 2017

In general, these regulations explain how Public Private Partnerships Project Facilitation Fund established under section 68 of the Act shall be used, these is explained in three sections of the regulations namely;

- Part ii - management of the fund
- Part iii - financial provisions
- Part iv - miscellaneous and transitional provisions

2.3.6 Energy Act, 2019

The Energy Act makes provisions that shall apply to every person or body of persons importing, exporting, generating, transmitting, distributing, supplying, using electrical energy, importing, exporting, transporting refining, storing and selling petroleum or petroleum products, producing, transporting, distributing and supplying of other forms of energy, and to all works or apparatus for any or all of these purposes.

It consolidates regulations relating to energy in Kenya. Part IV of the Act specifically makes provisions on renewable forms of energy including geothermal energy. The Minister is obligated to promote the use of renewable energy in Kenya. The Minister is charged with formulating a national strategy for coordinating research in renewable energy. The Act expressly identifies geothermal energy as a form of renewable energy whose production should be fostered in the Country.

This Act creates the Energy and Petroleum Regulatory Authority (EPRA), replacing Energy Regulatory Commission (ERC), whose functions and powers include issuance of licences, permits and exemptions for electric power and petroleum undertakings, review and approval of the electric power tariffs, imposition and collection of penalties and fines for non- compliance in the energy sector, investigation and resolution of conflicts, formulation of regulations and enforcement of standards in the energy sector, formulation and co- ordination of a disaster

preparedness plan for the energy sector, ensuring fair play and competition within the Energy sector.

EPRA must take into account, amongst other factors, the impact of an undertaking on the environment, social, cultural or recreational life of the community when determining license/permit applications under Section 121 of the Act. Under this Act, the Ministry of Energy and Petroleum released The Energy (Electricity Licensing) Regulations, 2010 which describe the manner and form for applying for generation and transmission licences.

The Act establishes a series of steps which the geothermal developer must follow. The Minister (hereinafter the Cabinet Secretary) for Energy must first Authorize all resource exploitation; a "geothermal resources license" must be obtained from the Cabinet Secretary to enable the developer to drill, extract, and utilize the resources, and if electricity is to be produced the developer must obtain a license under the Electric Power Act, or if commercial by-products are reclaimed; the geothermal resources license must include a lease consistent with the Mining Act.

(a) Provisions for Geothermal Resources in the Energy Act

(i) Authority for Geothermal Resources

Ownership of all geothermal resources under any land is vested with the Government. The Cabinet Secretary for Energy is responsible for declaring any area a geothermal resources area. The Act prohibits any unauthorized use of the geothermal resources. In order to extract and use geothermal resources one has to be granted authority or license. Authority to search for geothermal resources is also granted by the Cabinet Secretary for Energy. The Cabinet Secretary may authorize any person (including a public officer) to make surveys, investigations, tests and measurements in search of geothermal resources. The written authority empowers a person to enter any land specified by the authority, drill any bore, make geological and geophysical surveys and generally do all things necessary in connection with the search for geothermal resources. When practicable, reasonable notice of intention to enter upon any land shall be to the owner of the land. Also, the authorized person should be ready to produce his notice of authority when required to do so by the owner or occupier of the land on which he intends to enter or has entered. The authority granted is subject to the condition that every bore drilled shall be kept under close supervision, maintained in safe condition and finally left in a condition of lasting safety.

The authority granted is not transferable and is valid for one year but it may be renewed on a yearly basis after expiration. The authority may be revoked if the person to whom it was granted has not complied with any requirement or condition of his authority or if the operations being carried out are detrimentally affecting other specified bores. It may also be revoked if it is in the public interest that the operations being carried out should cease.

(ii) Geothermal Resources License

The Geothermal Resources License may be granted over part or the whole of a geothermal resources area. The license application must be on the approved form and should be accompanied by the prescribed fees. The license granted will be for a term not exceeding thirty years or as the Cabinet Secretary for Energy may determine.

The license shall confer upon the licensee the right to enter upon the land being the subject of the license to drill and to extract geothermal resources and to do all such things as are necessary for the conduct of those operations. This means the right to drill and construct all necessary boreholes, erect the necessary infrastructure for operations, utilize the geothermal resources and subject to the Water Act, reclaim and utilize any water. The licensee also has the right to take and use or apply the geothermal resources for any purpose specified in the license.

Where any by-product obtained in the production of geothermal resources may be

reclaimed for further use or sale and is a mineral within the meaning of the Mining Act, the license may be modified so as to allow for the inclusion of a mining lease to enable recovery of that by-product.

The license is renewed for a term not exceeding five years subject to such terms and conditions as the Cabinet Secretary for Energy may think fit. The licensee shall not transfer or assign his license or any part thereof the consent in writing of the Cabinet Secretary for Energy. The license may be declared forfeited if the licensee wholly ceases to work in the area of the license during a continuous six months period without the written consent of the Minister for Energy, or if he a breach or is in default of any provision of the Geothermal Resources Act. The forfeiture of a license shall not affect any liability already by the licensee.

(iii) Power of licensee in respect of generation of electricity

The holder of a licence under the Electric Power Act (Cap. 314) may for the purposes of generating, transmitting or supplying electrical power:

- Extract, take, use and apply geothermal resources on or under any land which is the subject of licence;
- Erect, construct, provide and use such works and appliances as may be necessary for the purpose of generating electricity, and in connection with the transmission, use, supply and sale of electricity.

(iv) Safety of persons

The Energy Act, in Section 87, places responsibility and liability to the licensee for for any loss, damage or injury to any person or property resulting from his works or operations, whether as a result of negligence or otherwise.

2.3.7 Geothermal Resources Regulations, 1990 (314A)

Regulation 6 prohibits the use of a geothermal resource license to give rights over or enter upon a burial ground, church, public roads, national park or reserve. Regulation 9 directs that licensee shall give the Cabinet Secretary thirty days' notice of any proposed geophysical survey and drilling. Regulation 10 directs for the supervision of a competent representative of the licensee during the drilling of all bore holes who shall also maintain a driller 's log for each bore hole.

Regulation 13 provides that all geothermal operation must be conducted in a workman-like manner and must prevent the unnecessary waste of or damage to geothermal resources, protect the quality of surface waters, air, and other natural resources including wildlife, protect the quality of cultural resources among other provisions. Any information given by the licensee to the Cabinet Secretary will be treated as confidential as per regulation 14.

2.3.8 Occupational Health and Safety Act, 2007

This is an Act of Parliament which provides for the safety, health and welfare of all workers and all persons lawfully present at workplaces and it also provides for the establishment of the National Council for Occupational Safety and Health and for connected purposes.

It applies to all workplaces where any person is at work, whether temporarily or permanently and therefore will apply to the project both during construction and operation phases.

The purpose of this Act is to:

- Secure the safety, health and welfare of persons at work; and
- Protect persons other than persons at work against safety and health arising out of, or in connection with the activities of persons at work.

The Occupational Health and Safety Act (OSHA) 2007 repealed the Factories and Other Places

of Work Act. Anything done under the provisions of the Factories and Other Places of Work Act including subsidiary legislation issued before the commencement of the OSHA 2007 shall be deemed to have been done under the provisions of this Act.

The Factories and Other Places of Work Act had over the years passed several subsidiary rules and regulations for effective implementation of the Act. All shall, as long as it is not inconsistent with OSHA 2007 remain in force until repealed or revoked by subsidiary legislation under the provisions of OSHA 2007 and shall for all purposes be deemed to have been made under this Act.

These regulations include:

- The Factories (Cellulose Solutions) Rules 1957;
- The Factories (Wood Working Machinery) Rules 1959;
- The Factories (Dock) Rules 1962;
- The Factories (Eye Protection) Rules 1978;
- The Factories (Electric Power) (Special) Rules 1978;
- The Factories (Building Operations and Works of Engineering Construction) Rules 1984;
- The Factories and Other Places of Work (Health & Safety Committees) Rules 2004;
- The Factories and Other Places of Work (Medical Examination) Rules 2005;
- The Factories and Other Places of Work (Noise Prevention and Control) Rules 2005;
- The Factories and Other Places of Work (Fire Risk Reduction) Rules 2007;
- The Factories and Other Places of Work (Hazardous Substances) Rules 2007.

The scope of OSHA 2007 has been expanded to cover all workplaces including offices, schools, academic institutions and plantations. It establishes codes of practices to be approved and issued by the Director, Directorate of Occupational Health and Safety (DOHS) for practical guidance of the various provisions of the Act.

Other parameters within the Act relevant to the project include:

- Duties of employers, owners or occupiers of workplace;
- Establishment of safety and health committees;
- Annual safety and health audit of workplaces;
- Safety and Health obligations for persons who may come to premises for work and are not employees of that particular workplace;
- Reporting of any accident, dangerous occurrence or occupational poisoning caused in the workplace to the area Occupational Health and Safety Office. These incidents should be entered in the General Register. In case of a fatal accident information to the area Safety and Health Office should be within 24 hrs and a written notice to the same within 7 days;
- The duties of manufactures, designers, importers and suppliers to ensure that all articles and substances for use at workplace are safe and will not cause injury to health and the environment;
- Duties of self-employed persons;
- Duties of employed persons;
- Prohibition of interference or misuse of any appliance, convenience or any other facility provided to secure Safety, Health and Welfare at work by any person (occupier, self-employed person or employed);
- The administration of the Act is the responsibility of a Director and other appointed and gazetted officials (Occupational Health and Safety Officers);
- The registration of all workplaces by the Director DOHS forming the basis of his work statistics;
- Machinery safety to include:

    - Safe use of machinery, plant and equipment;
    - Prime makers and transmission machines;
    - The maintenance, construction of fencing safeguards;

- The statutory requirements of various machines, plants and equipment (hoists and lifts, chains and ropes, cranes, steam receivers and containers, air receivers, cylinders for compressed liquefied and dissolved gases and refrigeration plants).

- Chemical safety including:
  - Handling, transportation and disposal of chemicals and other hazardous substances;
  - Importance of Materials Safety Data Sheets (MSDS);
  - Labelling and marking of chemical substances;
  - Classification of hazardous chemicals and substances;
  - Establishment and adoption of exposure limits on hazardous substances in a workplace;
  - Control of air pollution, noise and vibrations;
  - Redeployment on medical advice.

- Health, safety and welfare special provision including:

  - Permit to Work systems;
  - Work processes that are likely to harm persons below eighteen (18) years;
  - Supervision of apprentices and indentured learners;
  - Training and supervision of inexperienced workers;
  - Medical surveillance.

- Penalties, offences and legal proceedings including:

  - The upward adjustments of all fines imposed in the event of failure to comply with provisions of the Act;
  - The need to investigate and prosecute the real offender otherwise all those who fail to comply with any provisions of this Act that have been legally imposed on him/her shall be prosecuted;

- The establishment of the safety and Health fund and Safety and Health regulations and procedures thereof.

Relevant Occupational exposure threshold levels

Through the Factories and Other -Places of Work (Noise prevention and control) Rules,2005, the Act stipulates that no worker should be exposed to a noise level exceeding 90 decibels in eight hours within twenty-four hours duration and 140 dB(A) peak sound level at any given time. Similarly, it stipulates that It shall be the duty of the occupier to ensure that noise that gets transmitted outside the workplace shall not exceed fifty-five dB (A) during the day and forty-five dB (A) during the night.

The main hazardous chemical workers at the plant will be exposed to is hydrogen sulphide (H_2S). Under OSHA, the Factories and Other Places Of work (Hazardous Substances) Rules, 2007 provide the following limits.

Time Weighted Average (TWA) Occupational Exposure Limit (OEL)- Control Limit (CL)	10ppm	14mg/m^3
Short term exposure	15ppm	4mg/m^3

Relevance

It is important that Sosian and any appointed contractors adhere to the relevant requirements of the OSHA during construction and operation phases to avoid penalties.

2.3.9 Work Injury Benefits Act (WIBA), 2007

It is an act of Parliament (No. 13 of 2007) to provide for compensation to workers for injuries suffered in the course of their employment.

It outlines the following:

- Employer's liability for compensation for death or incapacity resulting from accident;
- Compensation in fatal cases;
- Compensation in case of permanent partial incapacity;
- Compensation in case of temporary incapacity;
- Persons entitled to compensation and methods of calculating the earnings;
- No compensation shall be payable under this Act in respect of any incapacity or death resulting from a deliberate self-injury; and
- Notice of an accident, causing injury to a workman, of such a nature as would entitle him for compensation shall be given in the prescribed form to the director.

Relevance

During power plant construction and operation period, both the proponent and any appointed contractors will need to abide by all the provisions of WIBA.

2.3.10 Employment Act, 2007

This is an Act of parliament that applies to all employees employed by any employer under a contract of service and covers the following elements:

- Protection of wages;
- Rights and duties in employment;
- Termination and dismissal;
- Protection of children;
- Insolvency of the employer;
- Employment records;
- Employment management;
- Foreign Contracts of Service;
- Dispute settlement procedures (between employer and employees);

In its general principles, the Act provides for prohibition against forced labour, discrimination in employment and sexual harassment.

Specifically, on employment and protection of children, the Act states the following:

53. (1) notwithstanding any provision of any written law, no person shall employ a child in any activity which constitutes worst form of child labour.

56. (1) No person shall employ a child who has not attained the age of thirteen years whether gainfully or otherwise in any undertaking.

(2) A child of between thirteen years of age and sixteen years of age may be employed to perform light work which is

(a) Not likely to be harmful to the child's health or development; and

(b) Not such as to prejudice the child's attendance at school, his participation in vocational orientation or training programmes approved by Minister for labour or his capacity to benefit from the instructions received.

Relevance

Sosian and the procured Contractors will need to understand all the requirements of the Act during employment such as ensuring that employees are of the right age, they have entitlement to leave, protection from discrimination and sexual harassment among others.

2.3.11 The Labour Institutions Act, 2007

The Act provides for establishment of labour institutions in Kenya such as the National Labour Board, Labour Committees (e.g. the Work Permits Committee, Trade Disputes Committee etc.), The Industrial Court and the Wages Council.

The applicable minimum wage requirements in Kenya classified by urban, peri-urban and rural areas are usually gazetted every year or every other year as regulations under this Act may provide.

2.3.12 The Labour Relations Act, 2007

This is an Act of Parliament to consolidate the law relating to trade unions and trade disputes, to provide for the registration, regulation, management and democratisation of trade unions and employers organisations or federations, to promote sound labour relations through the protection and promotion of freedom of association, the encouragement of effective collective bargaining and promotion of orderly and expeditious dispute settlement, conducive to social justice and economic development and for connected purposes.

Workers freedom of association, procedures for establishment and registration of trade unions and employers' organisations and related mechanisms are provided in this Act.

Sosian, its contractors and sub-contractors will be expected to comply with the provisions of this act when their employees exercise these rights.

2.3.13 The Public Health Act (Cap. 242)

This is an Act of Parliament to make provision for securing and maintaining health. Section 115 of this act prohibits causing nuisance or other conditions liable to be injurious or dangerous to health. Section 118 provides a list of nuisances that includes any noxious matter, or wastewater, flowing or discharged from any premises, wherever situated, into any public street, or into the gutter or side channel of any watercourse, irrigation channel or bed thereof not approved for the reception of such discharge.

(a) The Public Health (Drainage and Latrine) Rules

Rule 85 provides that every owner or occupier of every workshop, workplace or other 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 workers for the demolition, construction, reconstruction, or alteration of any building or other work in any way connected with building to provide in an approved position sufficient and convenient temporary latrine for use by such workers. 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 that is at a suitable level, and where there is sufficient water supply.

Relevance

The project construction and operation activities are bound to expose both workers and members of the general public to situations injurious to health. All activities of the project are thus expected to abide by this act to ensure a healthy environment.

2.3.14 Water Act 2016

Water in Kenya is a national resource, subject to any right of the user, legally acquired. The control and right to use water are exercised by the Minister administering the Act, and such use can only be acquired under the provisions of the Act. The Cabinet Secretary is also vested with the duty to promote investigations, conserve and properly use water throughout Kenya. Water permits may be acquired for a range of purposes, including the provision and employment of water for the development of power and other uses. The following are the regulations developed under Water Act 2016 relevant to the project:

(a) The Water Resources Management Rules (2007)

These Rules are described in Legal Notice Number 171 of the *Kenya Gazette Supplementary Number 52 of 2007*. They apply to all water resources and water bodies in Kenya, including all lakes, watercourses, streams and rivers, whether perennial or seasonal, aquifers, and shall include coastal channels leading to territorial waters.

The Water Resources Management Rules empower Water Resources Management Authority (WRMA) to impose management controls on land use falling under riparian land.

It also enables any person with a complaint related to any matter covered by these rules to the appropriate office in WRMA as per the Tenth Schedule which provides a format for report on complaints. WRMA is to reply to the complainant with "*copies to all other relevant parties within twenty-one days of receiving the complaint, starting with what action is being taken, the position of the Authority on the matter and any recommendation to the complainant."*

The rules also elaborate on the following:

- Mechanisms for appeal;
- Public notification;
- Public consultation;
- Orders on compliance;
- Protection of the integrity of the water resources monitoring network;
- Water Resource User Associations;
- Water Resource Database;
- Approval of activities listed in the fifth schedule of Water Act 2002;
- Authorisation and permitting;
- Prior right to water for storage;
- Groundwater development and its regulation;
- Control of water pollution and effluent discharge;
- Water works;
- Water use charges on permitted water use;
- Conservation of riparian land and catchment areas;
- Catchment management strategies;
- Protected areas and ground water conservation areas;
- Establishment and protection of reserve water;
- Miscellaneous provisions which include provisions on:
    - Qualifications to practise as a water resource professional;
    - Qualifications for a registered contractor;
    - Recognised water quality laboratories;
    - Emergency orders;
    - Penalties for offences;
    - Revocation of rules under Cap 372.

Part IV: *Ground Water* of the Rules, Section 72 (4) state "*Where any borehole or well is intended to be equipped with a motorised pump, the application shall be accompanied by a hydrogeological assessment report in the prescribed form set out in the second*

schedule".

Part IV, Section 73 states as follows:

"……

(1) For the regulation of ground water development, the authority will determine the allocation plan for a given aquifer or part thereof, the spacing of boreholes, or wells to be equipped with a motorised plant and will be guided by:

- *Existing borehole or well spacing;*
- *Individual aquifer characteristics, including water quality;*
- *Existing aquifer use;*
- *Existing bodies of surface water.*

(2) The allocation plan shall be available and accessible to the public during normal working hours from any of the Authority Offices.

……."

Part IV, Section 74 states as follows:

"…….

(1) All new boreholes and wells to be equipped with motorised pumps shall be subject to test pumping.

(2) Continuous constant rate pumping test of not less than twenty-four hours duration and recovery duration of not less than twenty hours or as otherwise stipulated by the Authority.

GDC has an abstraction permit for its developed ground water supply system which is used to supplement water supply from NAWASCO.

2.3.15 The Wildlife (Conservation and Management) Act, 2013

This Act has a purpose to consolidate and amend the law relating to the protection, conservation and management of wildlife in Kenya. The act in its sixth schedule list various animal and tree species that are nationally considered as critically endangered, vulnerable, nearly threatened and protected. It also lists in its seventh schedule, national invasive species for which control is required. Section 48 restricts activities involving the above listed species without a permit from KWS. KWS can make recommendations to the responsible cabinet secretary, to prohibit carrying out of any activity which: is of a nature that may negatively impact on the survival of species listed in sixth schedule; or is specified in the notice or prohibit the carrying out of such activity without a permit issued by KWS.

Relevance

Any critically endangered, vulnerable, nearly threatened or protected species found within the project area will have to be managed in line with this Act.

The project is not located in a wildlife sensitive area. However, in the whole lifecycle of the project actions the Proponent will ensure as much as possible not to jeopardize the wellbeing of wildlife in the caldera. Failure of which will attract the consequences enumerated in section 56 of the Act which include a fine not exceeding forty thousand shillings

2.3.16 Urban Areas and Cities Act No. 13 of 2011

This Act came into operation on the repeal of the Local Government Act (Cap. 265) as per section 1(2) *Subject to subsection (3), this Act became operational after the first elections held under the Constitution in 2014*.

According to section 27 and 28 of the Act, it empowers County Government to appoint a Manager to manage or prohibit all places of work that by reason of smoke, fumes, or chemical gases, dust smell, noise or vibration or other cause may be a source of danger, discomfort, or annoyance to the neighborhood, and to prescribe the conditions subject to which businesses, factories and workshops shall be carried on. The 1X35 MW Geothermal Power Station Project falls under the jurisdiction of County Government of Nakuru and is expected to abide by all the by-laws such as legislation governing control of pollutants and wastes, business permits and so forth.

2.3.17 The County Governments Act 2012

This statute vests the power of spatial and environmental planning on the County. Sections 114 specifically outline the procedures for planning nationally significant project such as the proposed project.

Relevance

The Proponent is required to involve the public (as undertaken in this study) and seek approval from the County assembly.

2.3.18 The Physical Planning Act Chapter 286

The Act *inter-alia*, governs the preparation and implementation of physical development plans in Kenya. Section 29 of the Act gives power to local authorities to determine development applications and grant all development permissions. The Nakuru County Government has to determine all physical development plans and the proponent will operate in full consultation with the respective council.

2.3.19 The Forest Conservation and Management Act, 2016

This Act provide for the establishment, development and sustainable management, including conservation and rational utilization of forest resources for the socio-economic development of the country.

The Act in Section 8 establishes the Kenya Forest Service with the following mandate:

- Conserve, protect and manage all public forests in accordance with the provisions of this Act;
- Prepare and implement management plans for all public forests and, where requested, assist in preparation of management plans for community forests or private forests in consultation with the relevant owners;
- Receive and consider applications for licenses or permits in relation to forest resources or management of forests or any other relevant matter in accordance with this Act;
- Establish and implement benefit sharing arrangements in accordance with the provisions of this Act;
- Assist county governments to build capacity in forestry and forest management in the counties;
- In consultation with relevant stakeholders, develop programmes for tourism and for recreational and ceremonial use of public forests;
- Promote forestry education and training;
- Register and maintain a register of all forest management plans prepared for public forests;
- Collaborate with relevant persons in identifying research needs and applying research findings in relation to forests and forestry;
- Manage water catchment areas in relation to soil and water conservation, carbon sequestration and other environmental services in collaboration with relevant stakeholders;
- Consider and recommend to the Cabinet Secretary the establishment of public forests on un-alienated public land or any other public land;

- Consider and recommend to the Cabinet Secretary the determination and alteration of boundaries of public forests;
- Establish forest conservancy areas for purposes of conservation and management;
- Approve the provision of credit facilities and technical training for community-based forest industries, and the provision of incentives to persons for the sustainable utilization of wood and non-wood forest products;
- Implement and enforce rules and regulations governing importation, exportation and trade in forest produce; and
- Develop, maintain and regularly update a geographic information system database of all forests in Kenya.

Section 21 of the Act mandates Each County Government to:

- Implement national policies on forest management and conservation;
- Manage all forests on public land defined under Article 62(2) of the Constitution;
- Prepare an annual report, with the approval of the County Assembly, for the Service on the activities of the county government in relation to this Act and any national policies on forest management and conservation;
- Promote afforestation activities in the county;
- Advice and assist communities and individuals in the management of community forests or private forests; and
- May enter into joint management agreements with communities or individuals for the management of community forests or private forests.

A county assembly may enact legislation for the better carrying into effect of the provisions of this section. The Service may if requested, collaborate, partner or offer assistance to the County Government for the better carry out the provisions of this Act.

The Act requires community participation in forest conservation and management done through a registered community forest association under the Societies Act. The association thereafter can be granted forest user right under the management agreement with the Director of KFS.

Relevance

The land on which the proposed project will be undertaken is gazetted as a public forest land and managed by Kenya Forest Services (KFS). KFS has plantation forestry within the project immediate neighbourhood and is also in the process of formulation a Community Forest Association (CFA) all which are managed in line with the forest Act.

2.3.20 Land Act, 2012

This is an Act of Parliament intended to give effect to Article 68 of the Constitution, to revise, consolidate and rationalize land laws; to provide for the sustainable administration and management of land and land-based resources, and for connected purposes. The Kenyan Constitution under the bill of rights provides protection of property rights under Article 40. It further provides for the acquisition of private property by government for public purposes or for public interest. Conditions and guidelines for acquiring are described in Part VIII of the Act. However, the land on which the proposed project will be undertaken is owned by a state agency, Kenya Forest Services (KFS). The Proponent has an agreement (Appendix I) with KFS allowing GDC to explore, exploit and generate electricity from geothermal resources.

2.3.21 Land and Environment Court Act, 2012

This is an Act of Parliament to give effect to Article 162(2) (b) of the Constitution; to establish a superior court to hear and determine disputes relating to the environment and the use and occupation of, and title to, land, and to make provision for its jurisdiction functions and powers, and for connected purposes. The principal objective of this Act is to enable the Court to facilitate the just, expeditious, proportionate and accessible resolution of disputes governed by this Act.

Section 13 (2) (b) of the Act outlines that in exercise of its jurisdiction under Article 162 (2) (b) of the Constitution, the Court shall have power to hear and determine disputes relating to environment and land, including disputes:

- Relating to environmental planning and protection, trade, climate issues, land use planning, title, tenure, boundaries, rates, rents, valuations, mining, minerals and other natural resources;
- Relating to compulsory acquisition of land;
- Relating to land administration and management;
- Relating to public, private and community land and contracts, chooses in action or other instruments granting any enforceable interests in land; and
- Any other dispute relating to environment and land.

Section 24 (2) also states that the Chief Justice shall make rules to regulate the practice and procedure, in tribunals and subordinate courts, for matters relating to land and environment.

Section 30 (1) states that all proceedings relating to the environment or to the use and occupation and title to land pending before any Court or local tribunal of competent jurisdiction shall continue to be heard and determined by the same court until the Environment and Land Court established under this Act comes into operation or as may be directed by the Chief Justice or the Chief Registrar.

Relevance

Any land or/and environmental cases arising from the project will be handled in accordance with the provisions of this act.

2.3.22 The Penal Code (Cap. 63)

Section 191 of the Penal Code makes it an offence for any person or institution that voluntarily corrupts, or foils water for public springs or reservoirs rendering it less fit for its ordinary use. Similarly, section 192 prohibits making the atmosphere in any place noxious to health of persons/institution in dwellings or business premises in the neighbourhood or those passing along a public way.

Relevance

The contractor and proponent will be required to ensure strict adherence to the Environmental Management Plan throughout the project cycle in order to mitigate any possible negative impact associated with dust, noise, and effluent discharge.

2.3.23 The National Museums and Heritage Act (Cap. 216)

The Act provides for the preservation and protection of historical monuments and objects of archaeological, paleontological, ethnographical and traditional interest. The Act prohibits any person from carrying out activities on or in relation to any object declared to be preserved or protected. The Act equally spells out the procedures and requirements to declare and inspect newly discovered sites that may have archaeological, paleontological, ethnographical, historical and traditional significance for purposes of protection

Whereas there were no sites of archaeological, paleontological, ethnographical, historical and traditional significance identified within the proposed project area, chance findings may be encountered. The project proponent, should exercise due diligence where historical property is encountered in any way during construction of the proposed project and other related activities.

Project planning should ensure that all reasonable measures are taken to protect any objects encountered during the implementation proposed power plant that may be of archaeological, paleontological, ethnographical, historical or traditional interest.

2.3.24 National Construction Authority Act, 2011

This Act establishes the National Construction Authority (NCA), meant to oversee the construction industry and coordinate its development. The authority is meant to promote quality assurance of the construction industry; accredit and register contractors as well as accredit and certify skilled construction workers and construction site supervisors.

During project implementation, the appointed contractor and conduct of construction works will be required to meet registration and approval requirements with NCA.

2.3.25 HIV/AIDS Prevention and Control Act, 2006

This law requires HIVAIDS awareness campaigns to be conducted in the work place. Long term construction project works by their nature increase risks of HIV/AIDS spread between workers and host communities and even among workers themselves in camps.

The project appointed contractor is expected to institute HIV/AIDS awareness and prevention plan among his staff and the host communities through service providers approved by the local public health departments. This requirement shall be incorporated in the tender documents to ensure compliance is achieved by bidders.

2.4 Administrative Framework

2.4.1 The National Environment Council

The National Environmental Council (the Council) is responsible for policy formulation and directions for the purposes of the Act. The Council also sets national goals and objectives, and determines policies and priorities for the protection of the environment.

2.4.2 The National Environment Tribunal

The Tribunal performs the following functions:

- To hear and determine appeals from NEMA's decisions and other actions relating to issuance, revocation or denial of Environmental Impact Assessment (EIA) licences or amount of money to be paid under the Act and imposition of restoration orders;
- To give direction to NEMA on any matter of complex nature referred to it by the Director General; and
- In accordance with the Forest Act No. 7 of 2005, NET is mandated to review decisions of the board under sections 33 and 63.

2.4.3 The National Environment Management Authority

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

In addition to NEMA, the Act provides for the establishment and enforcement of environmental quality standards to be set by a technical committee of NEMA known as the Standards and Enforcement Review Committee (SERC) which will govern the discharge limits to the environment by the proposed project.

(a) County Environmental Offices

NEMA has offices at county levels contributing to decentralised environmental management.

Relevance

The project is licensed by NEMA as required and the NEMA county officers will have overall supervision of environmental matters during both construction and operation.

2.4.4 National Environment Complaints Committee

The Act EMCA, 1999 as amended in 2015 established a National Environment Complaints Committee, which provides the administrative mechanism for addressing environmental harm. The Committee has the mandate to investigate complaints relating to environmental damage and degradation. Its members include representatives from the Law Society of Kenya, NGOs and the business community.

2.4.5 Ministry of Energy and Petroleum (MoEP)

It is responsible for formulation and articulation of energy policies through which it provides an enabling environment for all stakeholders. Its tasks include national energy planning, training of manpower and mobilisation of financial resources.

2.4.6 Energy and Petroleum Regulatory Authority (EPRA)

EPRA is the successor of ERC as noted in the Fourth Schedule of the Energy Act, 2019. It was established as an energy sector regulator under the Energy Act, 2006 which has been replaced by the Energy Act, 2019, with responsibility for economic and technical regulation of electric power, renewable energy, and downstream petroleum sub-sectors. Its functions also include tariff setting, review, licensing, enforcement, dispute settlement and approval of power purchase and network service contracts.

2.4.7 The Energy and Petroleum Tribunal

The Energy and Petroleum Tribunal is a successor of the Energy Tribunal as noted in the Fourth Schedule of the Energy Act, 2019. This quasi-judicial body was established under section 108 of the Energy Act, 2006 which has been replaced by Energy Act, 2019. It came into operation in July 2007 to primarily hear appeals against the decisions of ERC now known as EPRA. It also has jurisdiction to hear and determine all matters referred to it relating to the energy sector.

2.4.8 Geothermal Development Company (GDC)

This is a 100% state-owned company established by the Government of Kenya as a Special Purpose Vehicle for the development of geothermal resources in Kenya.

GDC will supply/deliver steam to the plant based on parameters in the PISSA. GDC will also develop the Steam gathering facilities and condensate re-injection systems before the testing and commissioning of the plant.

As the owner of the head lease, GDC will also play crucial role in ensuring that all environmental and safety measures within the geothermal field in general and those pertaining to the steam gathering and re-injection systems in particular are assured. This will require continuous coordination with both Sosian and the other two IPPs as necessary.

2.4.9 Kenya Electricity Transmission Company (KETRACO)

This is a Government of Kenya wholly owned company established to be responsible for the development, maintenance and operation of the national transmission grid network. It is also responsible for facilitating regional power trade through its transmission network.

KETRACO was responsible for development of power evacuation transmission line for the power generated from the plant and its connection to the existing national grid. In this respect, KETRACO was responsible for a separate ESIA and RAP studies for the transmission line. The line was implemented following approval by NEMA and implementation of the ARAP.

2.4.10 Independent Power Producers (IPPs)

IPPs are private companies which will be responsible for the construction and operation phases of the power plants and selling the generated electricity in bulk to KPLC.

Sosian will liaise with the other two IPPs i.e. Quantum and OTTL as well as GDC in managing environmental and social issues relating to their power plants' construction and operation within the Menengai caldera.

2.4.11 Kenya Forest Service

Kenya Forest Service (KFS) is mandated to manage protected forests within the country and is also the owner of the land in which the project is located. Protection of the Menengai forest cover and general management of the area will require close collaboration between the proponents and KFS. GDC has a memorandum of understanding with KFS in which they have agreed in the development of geothermal resources, management and conservation of forest resources.

2.4.12 Kenya Wildlife Service

Kenya Wildlife Service (KWS) is principal institution responsible for implementation of the Wildlife Management Act, 2013. KWS is responsible for protection of all wildlife within the Menengai forest and thus works jointly with KFS in the forest conservation management program.

2.4.13 Directorate of Occupational Safety and Health Services

Directorate of Occupational Safety and Health Services (DOSHS) is a government agency responsible for enforcement of Occupational Safety and Health throughout the country for the protection of workers and the general public at all work places in line with OSHA, 2007.

The proponent must have its power plants registered as a work place with the Nakuru county office and also submit regular audit and any incidence reports report to the agency.

2.4.14 County Government of Nakuru

Nakuru County as the project host county will have various inputs in the project implementation in line with constitutional functions of county governments. The functions of the county government relevant to the proposed project, as outlined in the Fourth Schedule, Constitution of Kenya 2010 are as follows:

- Agriculture and husbandry;
- Provision of essential services such health services, county transport, education;
- Control pollution and disasters management;
- Monitor cultural activities, public entertainment and public amenities;
- County planning and development;
- County public works and services;
- Implementation of specific national government policies on natural resources and environmental conservation; and
- Encourage public participation in county governance and development

The county government of Nakuru is thus expected to actively be engaged in coordinating various project related activities as far as general environmental conservation and public participation are concerned. This will be better achieved through the county directorate of environment under Ministry of Environment, Natural Resources, Energy and Water.

2.4.15 Water Resources Authority (WRA)

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

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

2.4.16 Land and Environment Court

The court is mandated to hear and determine disputes relating to the environment and the use and occupation of, and title to land.

2.4.17 Summary Statutory Permits

Form the foregoing review, the Table 2-3 provides a summary of associated statutory approvals required of Sosian Geothermal Power Plant prior to implementation of the project and their current status.

Table 2-3: List of permits/authorisations already obtained by Sosian

License/permit/Authorization	Reference Legal requirement	Issuing authority	Permit status
EIA license	EMCA	NEMA	License validity extended for 24 Months effect from 30 May 2019.
GDC Geothermal License	The Geothermal Resource Act 1982	EPRA	Valid
Nakuru Planning Approval	Physical Planning Act 1996	Nakuru County Government.	Valid
Sosian Business permits (for Nairobi and Nakuru offices)	National Construction Authority Regulation	Nairobi County Government and Nakuru County Government	Valid.
Sosian Generation License	Energy Act	EPRA	Valid
DOSH Registration certificate	OSHA 2007	DOSH	Valid

2.5 International Guidelines

2.5.1 International Finance Corporation (IFC) Guidelines

(a) IFC Environmental, Health and Safety General Guidelines

The EHS general guidelines are technical reference documents with general and industry-specific examples of Good International Industry Practice. The guideline will be tailored for the project specific impacts on the environment and human health. The guidelines provide issues and recommendation in the following areas:

- Environmental;
- Occupational health and safety;
- Community health and safety;
- Construction and decommissioning.

(b) IFC Environmental, Health, and Safety Guidelines for Geothermal Power Generation

The EHS Guidelines for Geothermal Power Generation are applicable to geothermal power generation activities such as exploration and reservoir evaluation, production field development, and power plant construction.

The guidelines provide environmental, health and safety issues that may occur during geothermal generation project such as;

- Effluent.
- Air emission.
- Solid waste.
- Well blowouts and pipeline failure.
- Water consumption and extraction.
- Heat.
- Noise.
- Geothermal gases.
- Confined spaces.
- Infrastructure safety.

Environmental, health and safety performance and monitoring indicators are also provided to be used to measure performance and make correction where performance is not satisfactory. These guidelines have been consulted in completing this report.

(i) Effluent monitoring guidelines

The guidelines recognize that spent geothermal fluids are typically re-injected to the host rock formation, resulting in minor effluent volumes involving reject waters. However, if spent geothermal fluids are not re-injected, effluents should meet site-specific discharge levels for surface water as discussed in the General EHS Guidelines.

(ii) Emissions monitoring guidelines

Although geothermal energy projects do not normally generate significant point source emissions during construction and operations, hydrogen sulphide emissions, or other types of emissions, should not result in ambient concentrations above nationally established air quality standards or, in their absence, internationally recognized guidelines.

(iii) Occupational health and safety guidelines

These IFC guidelines require occupational health and safety performance of geothermal project to be evaluated against internationally published exposure guidelines. Examples of these include: the Threshold Limit Value (TLV) occupational exposure guidelines and Biological Exposure Indices (BEIs) published by American Conference of Governmental Industrial Hygienists (ACGIH), the Pocket Guide to Chemical Hazards published by the United States National Institute for Occupational Safety and Health (NIOSH), Permissible Exposure Limits (PELs) published by the Occupational Safety and Health Administration of the United States (OSHA), Indicative Occupational Exposure Limit Values, published by European Union member states, or other similar sources.

A review of the the various international guidelines for hydrogen sulphide (H_2S), for both general community health and occupational exposure relevant to the project is summarized in table Table 2-4.

Table 2-4: Summary of recommended limits by various international organizations

Effect	Concentration ($\mu g/m^3$)	Concentration (ppm)	Averaging period
Occupational	1500(ACGIH)	1	8 hour
Community Health	150(WHO)	0.1	24 hour
	50 (Iceland)	0.03	24 hour
	10 (OEHHA)	0.007	annual
Community odour	7 (WHO)	0.005	30 min
	70 (New Zealand)	0.05	1 hour

The WHO limits are recommended for the Menengai project's community heath and odour assessment while ACGIH guidelines are recommended as target for the occupational exposure.

(c) IFC Performance Standards on Environmental and Social Sustainability

The Performance Standards are relevant to the project, providing guidance on how to identify risks and impacts, and help avoid, mitigate, and manage risks and impacts as a way of ensuring project sustainability, including stakeholder engagement and disclosure obligations of the client in relation to project-level activities. In the case of its direct investments (including project and corporate finance provided through financial intermediaries), IFC requires project proponents to apply the Performance Standards to manage environmental and social risks and impacts so that development opportunities are enhanced.

Eight Performance Standards establish that the project proponent is to meet them throughout the life of an investment by IFC:

Performance Standard 1: Assessment and Management of Environmental and Social Risks and Impacts;
Performance Standard 2: Labor and Working Conditions;
Performance Standard 3: Resource Efficiency and Pollution Prevention;
Performance Standard 4: Community Health, Safety, and Security;
Performance Standard 5: Land Acquisition and Involuntary Resettlement;
Performance Standard 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources;

Performance Standard 7: Indigenous Peoples Cultural Heritage;
Performance Standard 8: Cultural Heritage.

A summary of the trigger status of the above standards is provided in Table 2-5.

Table 2-5: Summary on the expectation of each of the PSs

No.	PS	Expectation	Triggered	Comment
1	Assessment and Management of Environmental and Social Risks and Impacts	Development of an environmental and social management system (ESMS) that will help integrate plans and standards so that to anticipate environmental and social risks posed by the geothermal activities and avoid, minimize, and compensate for such impacts as necessary. A good management system provides for consultation with stakeholders and a means for complaints from workers and local communities to be addressed.	Yes	Both during construction and operation phase they shall be workers on site also they are surrounding communities within the site even if not near that shall be affected either by the movement of materials to site and even by Sosian staff interacting with the community.
2	Labour and Working Conditions	Fair treatment of workers, ensuring safe and healthy working conditions, avoidance of the use of child or forced labour, and identify associated risks in their primary project supply chain.	Yes	There will be need for Sosian to employ workers both during construction and during operation of the plant. requirements of this standards will therefore apply throughout the project cycle.
3	Resource Efficiency and Pollution Prevention	Integration of practices and technologies that promote energy efficiency, use resources—including energy and water—sustainably, and reduce greenhouse gas emissions.	Yes	During the construction and operation phases, water and energy shall be required for various uses, there shall be generators to provide power before electricity is generated. In addition, various chemicals including hazardous materials will be deployed during both construction and operation phases. Careful handling of these and other materials will be required to prevent associated potential pollution and ensure efficient use of resources. Geotherm works also involve elevated release of H_2S gas which is harmful to both human health and animal and therefore the need to either limit the amount of H_2S emitted into the atmosphere as much as possible or look for better management alternatives.
4	Community Health, Safety, and Security	Adoption of responsible practices to reduce risks including through emergency preparedness and response,	Yes	The project may expose local communities to increased risks and adverse impacts related to worksite and traffic accidents,

No.	PS	Expectation	Triggered	Comment
		security force management, and design safety measures.		hazardous materials including release of H_2S and excessive noise, spread of communicable diseases, or interactions with private security personnel. Accidents may occur be it onsite or on the access roads and mitigation measures are required to be put in place for such like reasons.
5	Land Acquisition and Involuntary Resettlement	Avoidance of involuntary resettlement wherever possible and to minimize its impact on those displaced through mitigation measures such as fair compensation and improvements to and living conditions. Active community engagement throughout the process is essential.	Yes	The power plant development site is government land under KFS. This site has been sub-leased to Sosian by GDC who holds the head lease from KFS. Project's associated facility, the Power evacuation line constructed by KETRACO, necessitated acquisition of some private land. An ARAP was prepared for the transmission line and has been implemented by KETRACO.
6	Biodiversity Conservation and Sustainable Management of Living Natural Resources	Protecting and conserving biodiversity, maintaining ecosystem services, and managing living natural resources adequately which are fundamental to sustainable development.	Yes	There shall be clearing of the land and access road reserve during the construction phase and therefore interacting with animal habitats and potentially some protected plant species.
7	Indigenous Peoples	Minimize negative impacts, foster respect for human rights, dignity and culture of indigenous populations, and promote development benefits in culturally appropriate ways. Informed consultation and participation with IPs throughout the project process are a core requirement and may include Free, Prior and Informed Consent under certain circumstances.	No	The project area is a cosmopolitan sub-urban area of Nakuru town with no indigenous communities.
8	Cultural Heritage	Protecting cultural heritage from adverse impacts of project activities and supporting its preservation. It also promotes the equitable sharing of benefits from the use of cultural heritage.	No	No archaeological sites have been recorded in the project area and no artefacts were seen on the proposed development site during a visit by archaeological specialist. However, since the project will entail excavation activities, a chance find procedure will be formulated for precautionary purposes. Few caves with religious attachments exist at the rim of the caldera near the power

No.	PS	Expectation	Triggered	Comment
				evacuation line. However, these are not affected by the line. As a precaution, a chance find procedure (see Appendix VI) is proposed for adoption during the construction phase.

(d) IFC Cumulative Impact Assessment and Management Guidance for the Private Sector in Emerging Markets

The Guidelines are based on IFC's experience in applying its Performance Standards and are to be used in conjunction with the Performance Standards, their Guidance Notes, and the World Bank Group Environmental, Health, and Safety Guidelines, which contain basic requirements and good international practices to be followed when designing, developing, and/or implementing projects. It provides a practical guidance to companies investing in emerging markets to improve their understanding, assessment, and management of cumulative environmental and social impacts associated with their developments.

For private sector management of cumulative impacts, IFC considers good practice to be two pronged:

- effective application of and adherence to the mitigation hierarchy in environmental and social management of the specific contributions by the project to the expected cumulative impacts; and
- best efforts to engage in, enhance, and/or contribute to a multi stakeholder, collaborative approach to implementing management actions that are beyond the capacity of an individual project proponent.

Cumulative Impact Assessment (CIA) should focus the assessment and management strategies on Valued Environmental and Social Components (VECs) such as

- physical features, habitats, wildlife populations (e.g., biodiversity);
- ecosystem services;
- natural processes (e.g., water and nutrient cycles, microclimate);
- social conditions (e.g., health, economics), or
- cultural aspects (e.g., traditional spiritual ceremonies).

It should employ information from a variety of instruments including, regional and local environmental, social and resource studies, programs and/or planning documents; strategic, sectoral, and regional assessments; project impact assessments, cumulative impact assessments, and targeted studies on specific issues.

Project initiated CIA have six objectives:

1. Assess the potential impacts and risks of a proposed development over time, in the context of potential effects from other developments and natural environmental and social external drivers on a chosen VEC;
2. Verify that the proposed development's cumulative social and environmental impacts and risks will not exceed a threshold that could compromise the sustainability or viability of selected VECs;
3. Confirm that the proposed development's value and feasibility are not limited by cumulative social and environmental effects;
4. Support the development of governance structures for making decisions and managing cumulative impacts at the appropriate geographic scale (e.g., airshed, river catchment, town, regional landscape);
5. Ensure that the concerns of affected communities about the cumulative impacts of a proposed development are identified, documented, and addressed;

6. Manage potential reputation risks.

2.5.2 African Development Bank Integrated Safeguard Systems, 2013

AfDB adopted Integrated Safeguard Systems (ISS) in 2013 which is the cornerstone of its strategy to promote growth that is socially inclusive and environmentally sustainable. The ISS promotes best practices and also encourages greater transparency and accountability. It provides a process for the people, especially the most vulnerable communities, to express their views by providing project-level grievance redress mechanisms.

The safeguards aim to:

- Avoid adverse impacts of projects on the environment and affected people, while maximizing potential development benefits to the extent possible;
- Minimize, mitigate, and/or compensate for adverse impacts on the environment and affected people when avoidance is not possible; and
- Help borrowers/clients to strengthen their safeguard systems and develop the capacity to manage environmental and social risks.

The Bank requires that borrowers/clients comply with these safeguards' requirements during project preparation and implementation. The Integrated Safeguards Policy Statement sets out the basic tenets that guide and underpin the Bank's approach to environmental safeguards. The bank has adopted five operational safeguards as follows:

- Operational Safeguard 1: Environmental and social assessment;
- Operational Safeguard 2: Involuntary resettlement land acquisition, population displacement and compensation;
- Operational Safeguard 3: Biodiversity, renewable resources and ecosystem services;
- Operational Safeguard 4: Pollution prevention and control, hazardous materials and resource efficiency; and
- Operational Safeguard 5: Labor conditions, health and safety.

Operational Safeguard (OS) 1: Environmental and social assessment is the overarching OS and governs the process of determining a project's environmental and social category and the resulting environmental and social assessment requirements.

At the project identification phase, the screening exercise focuses on the environmental and social dimensions of a project to categorise it in one of four categories listed in Table 2-6.

Table 2-6: AfDB categories for Environmental Assessments

Category	Requirement
Category 1	Projects those are likely to cause significant/irreversible environmental and social impacts and require a full ESIA.
Category 2	Projects likely to cause less adverse environmental and social impacts than category 1. Likely impacts are few in number, site-specific, largely reversible, and readily minimized by applying appropriate management and mitigation measures or incorporating internationally recognized design criteria and standards.
Category 3	Projects with negligible adverse environmental and social risks, projects do not directly or indirectly affect the environment adversely and are unlikely to induce adverse social impacts. They do not require an environmental and social assessment.
Category 4	Projects involve investment of Bank's funds through Financial Intermediaries (FIs) in subprojects that may result in adverse environmental or social impacts. Specific requirements for this type of project include an assessment of FI capacities to handle environmental and social considerations.

The geothermal power plant project covers a small area but within a legally protected public forest land. The impacts during operational phase have potential to be widespread and adverse on lives of the people, wildlife and plants within and in surrounding areas. This study is informed by the fact that geothermal power plants can have severe environmental and social impacts on major sensitive components of the environment, thus require full ESIA studies.

Under the ISS, the Borrower is responsible for integrating environmental and social considerations sponsored projects according to the Bank's requirements.

Table 2-7: Applicability of the other 4 Operational Safeguards

Operational Safeguard (OS)	Triggered	Comment
OS 1: Environmental and social assessment	Yes	Geothermal power projects with capacity exceeding 10MW are categorized as High Risk under Kenyan Environmental Management and Conservation Act (EMCA). The proposed Sosian power plant, with a capacity of 35MW, falls under this category and hence needs a full ESIA. An ESIA study was originally conducted for all the three plants by GDC and license issued in line with EMCA requirements. This report considered updates to align the original ESIA report with the lenders requirements and this OS provides the overarching standard for AfDB requirements.
OS 2: Involuntary resettlement land acquisition, population displacement and compensation;	Yes	For the power plant they will be no involuntary resettlement since the land was already leased to GDC by KFS which later sub leased it to Sosian. However, the transmission line necessitated way leave acquisition which was done by KETRACO.
OS 3: Biodiversity, renewable resources and ecosystem services;	Yes	The power plant is located in an area that is gazetted as public forest land. The project has necessary legal clearance to be implemented in the forest land. Chapter three of this report elaborates on the existing environment in terms of biodiversity and ecosystem services.
OS 4: Pollution prevention and control, hazardous materials and resource efficiency;	Yes	Waste is expected to be generated during both construction and operation phases hence the need to have a waste management system. During construction there will be delivery of materials to site by vehicles using the access road, this might lead to noise pollution and dust generation. During operation there will be release of H_2S and brine discharge. In addition, varying amounts of hydrocarbon will be handled on site during both construction and O&M phases.
OS 5: Labour conditions, health and safety;	Yes	The client and appointed contractors will have to employ people both during construction and operation phases and will be required to have a Human Resource, Health and Safety policies and management plans aligned to both Kenyan legal requirements and this OS.

2.6 International Conventions

2.6.1 Vienna Convention for the Protection of the Ozone Layer

Intergovernmental negotiations for an international agreement to phase out ozone depleting substances concluded in March 1985 with the adoption of the Vienna Convention for the Protection of the Ozone Layer. This Convention encourages intergovernmental cooperation on research, systematic observation of the ozone layer, monitoring of CFC production, and the exchange of information.

The Montreal Protocol on Substances that Deplete the Ozone Layer was adopted in September 1987, and was intended to allow the revision of phase out schedules on the basis of periodic scientific and technological assessments. The Protocol was adjusted to accelerate the phase out schedules. It has since been amended to introduce other kinds of control measures and to add new controlled substances to the list.

2.6.2 Convention on Biological Diversity

The purpose of this convention is to ensure the conservation and sustainable use of biodiversity. Kenya signed the convention on 5th June 1992 and ratified the same on 26th July 1992. The National Environment Management Authority (NEMA) is the national focal point to this Convention on Biological Diversity. The provisions of this Convention have been integrated in many laws of Kenya.

2.6.3 African Convention on the Conservation of Nature and Natural Resources

This convention reaffirms the importance of natural resources both renewable and non-renewable, particularly the soil, water, flora and fauna. The main objective is to facilitate sustainable use of the above resources. The convention was adopted in Algiers on 15th September, 1968 and came into force on 16th June 1969.

Relevance

Some indigenous trees exist within the project area whose conservation are important. The project shall encourage the planting of indigenous trees to try to restore a balance within the ecosystem.

2.6.4 The Ramsar Convention

Kenya ratified the convention in June 1990. The Ramsar Convention on Wetlands is primarily concerned with the conservation and Management of Wetlands. Parties to the convention are also required to promote wise use of wetlands in their territories and to take measures for the conservation by establishing nature reserves in wetlands, whether they are included in the Ramsar list or not.

The proposed project is expected to observe and adhere strictly to the Ramsar Convention's principles of wise use of wetlands in the project area. Wetlands are defined by the convention on Wetlands or the Ramsar Convention (1971) as: "Areas of marsh, fen, peat land or water, whether natural or artificial, permanent or temporary with water that is static or flowing, fresh, brackish or salty, including areas of marine water the depth of which at low tide does not exceed six meters"

In Kenya, as well as in east Africa, wetlands are defined as: "areas of land that are permanently, seasonal or occasionally water logged with fresh, saline, brackish or marine water, including both natural and manmade areas that support characteristic biota" the latter definition has the approval of the national wetland standing committee of Kenya's Inter ministerial Committee on Environment (IMCE). It is the refinement of Ramsar Convention's definition for the East Africa and does not exclude anything defined by the Ramsar Convention. This definition included

swamps, marshes, bogs, soaks, shallow lakes, ox-bow lakes, river meanders and flood plains, as well as riverbanks, lakeshores where wetland plants grow. It also includes marine and inter-tidal wetlands such as deltas, estuaries, mudflats, mangroves, salt marshes, sea grass beds, shallow coral reefs and creeks.

2.6.5 Sustainable Development Goals (SDGs)

The major focus of the Sustainable Development Goals is to achieve a better and more sustainable future for all. They address the global challenges we face, including those related to poverty, inequality, climate, environmental degradation, prosperity, and peace and justice. The Goals interconnect and in order to leave no one behind, it is important that we achieve each Goal and target by 2030.

2.6.6 The 1992 UNFCCC

The UNFCCC is a “Rio Convention”, one of three adopted at the “Rio Earth Summit” in 1992. Its sister Rio Conventions are the UN Convention on Biological Diversity and the Convention to Combat Desertification.

The primary purpose of the convention is to establish methods to minimize global warming and in particular the emission of the greenhouse gases. The UNFCCC was adopted on 9th May 1992 and came into force on 21st March 1994. The Convention has been ratified by 189 states. Kenya ratified the Convention on 30th August 1994. NEMA is the focal point for the Convention.

2.6.7 Convention on International Trade in Endangered Species

This Convention was adopted on 3rd March 1973 and came into force on 1st July 1975. The purpose of the Convention is to regulate the international trade in wild plants and animals that are at risk of extinction as a result of trade. The Convention seeks to control trade not only in live species but also in dead specimen and their derivatives. The Kenya Government ratified CITES on 13th December 1978. The lead agency for the CITES in Kenya is the Kenya Wildlife Service (KWS).

2.6.8 Kyoto Protocol to the UNFCCC

The Kyoto Protocol requires signatories to the United Nations Framework Convention on Climate Change to reduce their greenhouse emissions levels to 5% below 1990 levels by the year 2012. The Protocol came into force on 16th February 2005, after it received the pre-requisite signatures. However, major countries like United States, China, India, and Australia are not signatories to the Protocol. NEMA is the national focal point for this Protocol.

2.6.9 Convention on the Rights of the Child

The Convention on the Rights of the Child (CRC), 1989 is the most comprehensive compilation of international legal standards for the protection of the human rights of children. The CRC is also the most widely ratified international human rights treaty, ratified by all countries in the world, with the exception of two. The Convention acknowledges children as individuals with rights and responsibilities according to their age and development (rather than the property of their parents or as victims), as well as members of a family and community. Underlying the Convention are four main principles: non-discrimination, the best interests of the child, the right to life, survival and development and the right to participation.

The CRC reaffirms children’s basic human rights to health, shelter and education. Special emphasis is placed on safeguarding family unity and the reunification of families (Articles 8, 10, 20). Another fundamental right enumerated in the Convention is the child’s right to education and the obligation of states to make primary education free and compulsory for all children (Articles 28, 29). Education has also been identified as an effective and essential form of protection for displaced children. For example, displaced children in school may be more protected from the risks of military recruitment, exploitation and abuse. Educational and

recreational activities, like sports, can also help children recover from the trauma of conflict and displacement *(Internal Displacement Monitoring Centre, 2004).*

2.6.10 Convention on the Elimination of all forms of Discrimination against Women

The Convention on the Elimination of all forms of Discrimination against Women (CEDAW) places explicit obligations on states to protect women and girls from sexual exploitation and abuse.

Universal Declaration of Human Rights (Article 7), the UN Charter (Articles 1, 13, 55, and 76) and the International Covenant on Civil and Political Rights (Article 24) reaffirm the freedoms and rights of all children, including internally displaced children.

2.6.11 International Labour Organisation

Since 1919, the International Labour Organization (ILO) has developed and maintained a system of international labour standards aimed at promoting opportunities for women and men to obtain decent and productive work, in conditions of freedom, equity, security and dignity.

International labour standards are legal instruments drawn up by the ILO's constituents (governments, employers and workers) and set out basic principles and rights at work. They are either *conventions*, which are legally binding international treaties that may be ratified by member states, or *recommendations*, which serve as non-binding guidelines. Some of the key provisions that must be observed under the standards include:

- Freedom of association of workers;
- Prevention of Forced labour;
- Prevention of Child labour; and
- Prevention of Discrimination

Kenya is a signatory to ILO since 1963 and all labour conditions in the country are expected to abide by the ILO standards and international best practices.

3 DESCRIPTION OF PROJECT ENVIRONMENT

3.1 Physical Environment

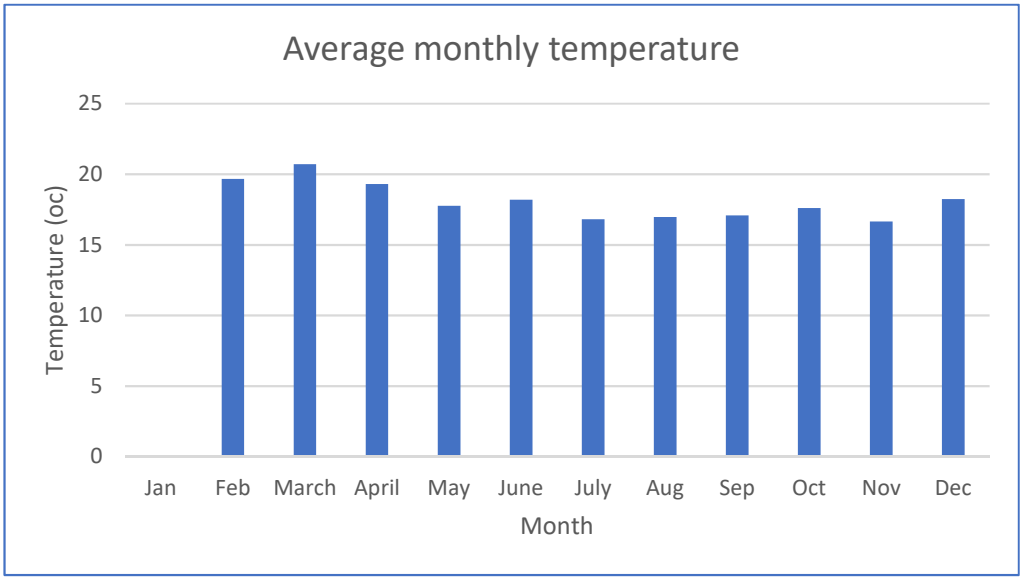
3.1.1 Climate

The project area is classified into two main agro-climatic zones. The lowland areas of Mogotio and Kisanana in the north are located in semi-arid zone IV with an annual rainfall of 800 mm and mean temperatures of 30°C. Njoro, Bahati and parts of Kampi ya Moto divisions with an altitude of between 1800 m and 2400 m above sea level and average rainfall of between 760 mm and 1270 mm per year fall within a dry sub-humid equatorial climatic zone.

(a) Temperature

In the general area, temperatures vary with topography, the highest average monthly temperature during 2017 was recorded in March (20.7^{o}C) whereas the lowest average temperature recorded in November (16.7^{o}C). The data that was provided for the year 2018 was not consistent and therefore not able to be used for analysis.

Mean temperatures were analysed from meteorological data at the GDC Control Room site (within the Menengai Geothermal Area) that is near the Project site for the period January 2017 – December 2017 are illustrated in Figure 3-1 below.



Source: GDC Meteorology data,2019

Figure 3-1: Mean monthly temperatures for the Project site

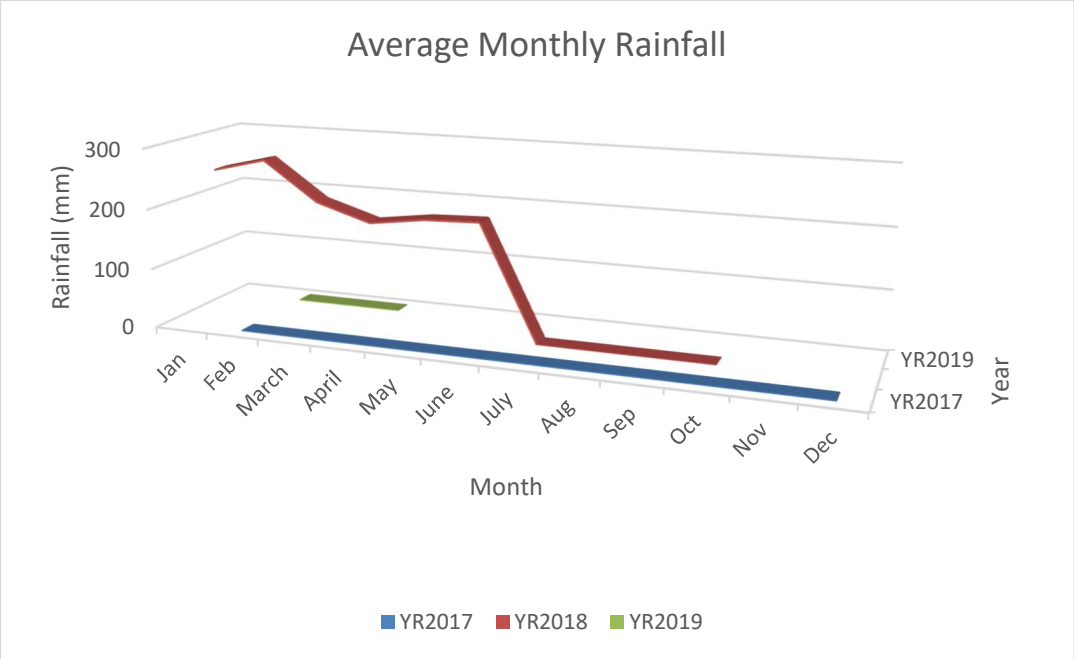
During the day, temperatures increase to reach maximum at around 12:00 in the afternoon. Ambient air temperature decreases to reach a minimum at around 06:00 i.e. just before sunrise.

Air temperature is important, both for determining the effect of plume buoyancy (the larger the temperature difference between the plume and the ambient air, the higher the plume is able to rise), and determining the development of the mixing and inversion layers.

(b) Rainfall

Around Nakuru area, mean annual rainfall is approximately 900 mm. The rainfall regimes are bimodal with the long rains occurring in March to July and the short rains in September to November.

Meteorological data for the monthly rainfall from GDC's Control Room near to the Project site (January 2017 – April 2019) is given in Figure 3-2. Average total annual rainfall for the year 2017 is 0.14694mm showing that there was almost no rain throughout the year but just precipitation. In the year 2018 the average annual rainfall was 106.662mm, there was more rain between January and June. There was no data for January 2017 and also between November 2018 to January 2019.



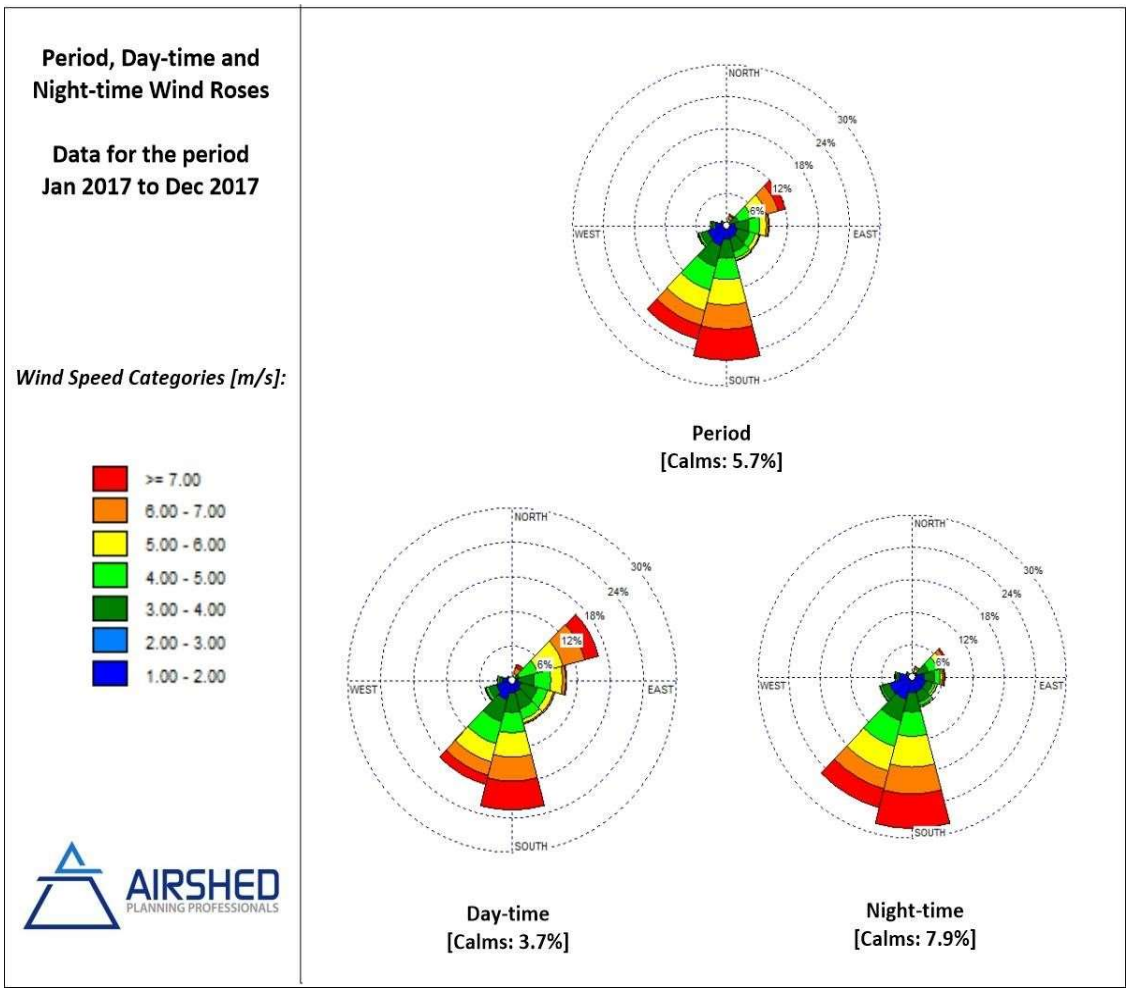
Source: Airshed Planning Professionals, 2015

Figure 3-2: Monthly rainfall for the Project site (January 2017 – April 2019)

(c) Surface wind field

Wind roses comprise 16 spokes, which represent the directions from which winds blew during a specific period. The colours used in the wind roses below, reflect the different categories of wind speeds; the red area, for example, representing winds in between 6 and 10 m/s. The dotted circles provide information regarding the frequency of occurrence of wind speed and direction categories. The frequency with which calms occurred, i.e. periods during which the wind speed was below 1 m/s are also indicated.

Figure 3-3 depicts the predominance of southerly winds with speeds of greater than 5m/s. The day-time wind rose shows an increase in winds from the north easterly sector and lower calms (3.7%), whereas the night-time wind rose shows an increase in the southerly winds and higher calms (7.9%).

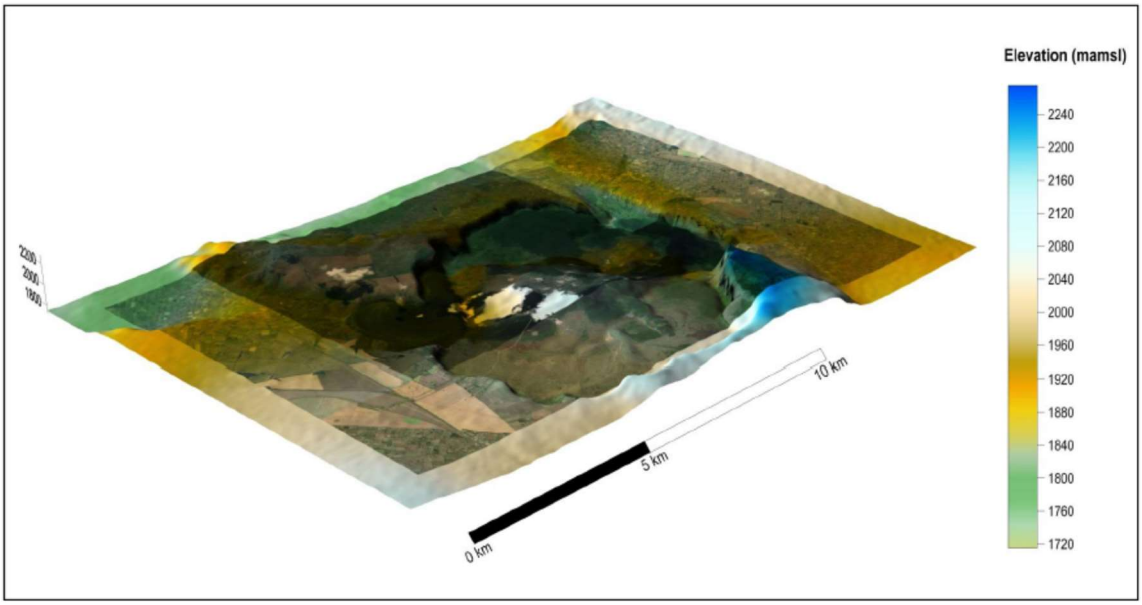


Source: Airshed Planning Professionals, 2019

Figure 3-3: Period, day- and night-time wind roses (Control room data, 2017)

3.1.2 Topography

An analysis of topographical data indicated a slope of more than 1:10 from areas of operations to the nearest elevated point. The topography of the study area is shown in Figure 3-4 overleaf.



Source: Airshed Planning Professionals, 2015

Figure 3-4: Topography of study area

3.1.3 Geology and Soil

Menengai Caldera is characterized by two trachytic main rock series by age. The older one is that of Pliocene which is characterized by two successive strata. The earlier one is of Pliocene and is characterized by phonolitic trachytes. These appear to have formed during volcanic processes before the formation of the caldera as depicted by their outcrops on the walls of the caldera ‘s ring-structure. Overlying the phonolitic trachytes is the successive stratum that comprises welded vitreous tuffs and ignimbrites. These extend briefly outwards from the ring-structure, except markedly longer extensions towards south east and north-west, with bias towards northwest direction (Figure 3-5). This implies a major direction of flow during the volcanic episode.

The younger rock series is recent (Quaternary) and is characterized by trachyte flows. Glassy flows are common among the recent series. This series cover almost all the caldera floor (Figure 3.1) and its occurrence depicts products of volcanic processes that accompanied or followed after the caldera-collapse.

Like in many other sections Eastern African Rift System, Menengai Caldera occurs within a normal-fault-system. Generally, the occurrence appears as an interruption of intense faulting and fracturing that runs north-south Kenya ‘s Rift Valley. However, at and around the caldera, the ring-structure of the fault created by formation of the caldera is conspicuous. Other associated faults are also observed in and around the caldera. Other noticeable structures are lava flow structures that are depicted by the rock structures. These include ropy, bandy, blocky and glassy structures of rocks observed inside the caldera during this study. The lithological and structural geology play a part in the physiography of the project area.

The soils in the prospect area are volcanic soils of varying thickness. These occur together with superficial deposits. Due to the physiography of the caldera, patches of alluvial deposits are found in some basinal features within the caldera, and the lower areas from the base of the volcano outwards.

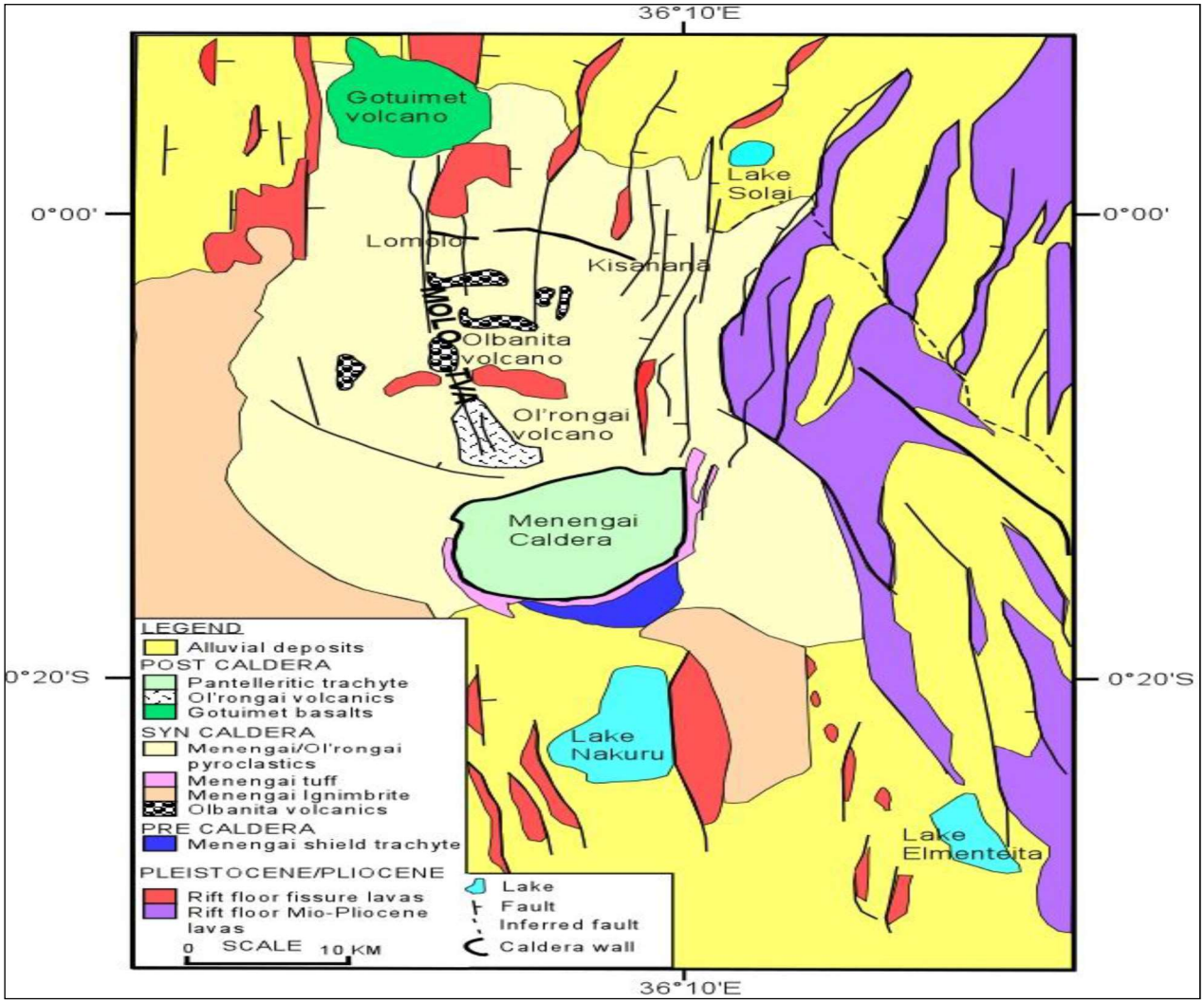


Figure 3-5: Geological Map of Menengai Caldera

Source: GDC

3.1.4 Hydrology and Hydrogeology

The Menengai area lies on the rift floor that gently slopes northwards. On the east, the Bahati and Marmanet scarps bound the eastern inner rift trough and are relatively higher and wetter grounds. To the west, the rift floor slopes gently into a series of ridges connecting the Mau-Londiani-Kilombe hills. The surface drainage system is therefore largely internal from the east and the western scarps (

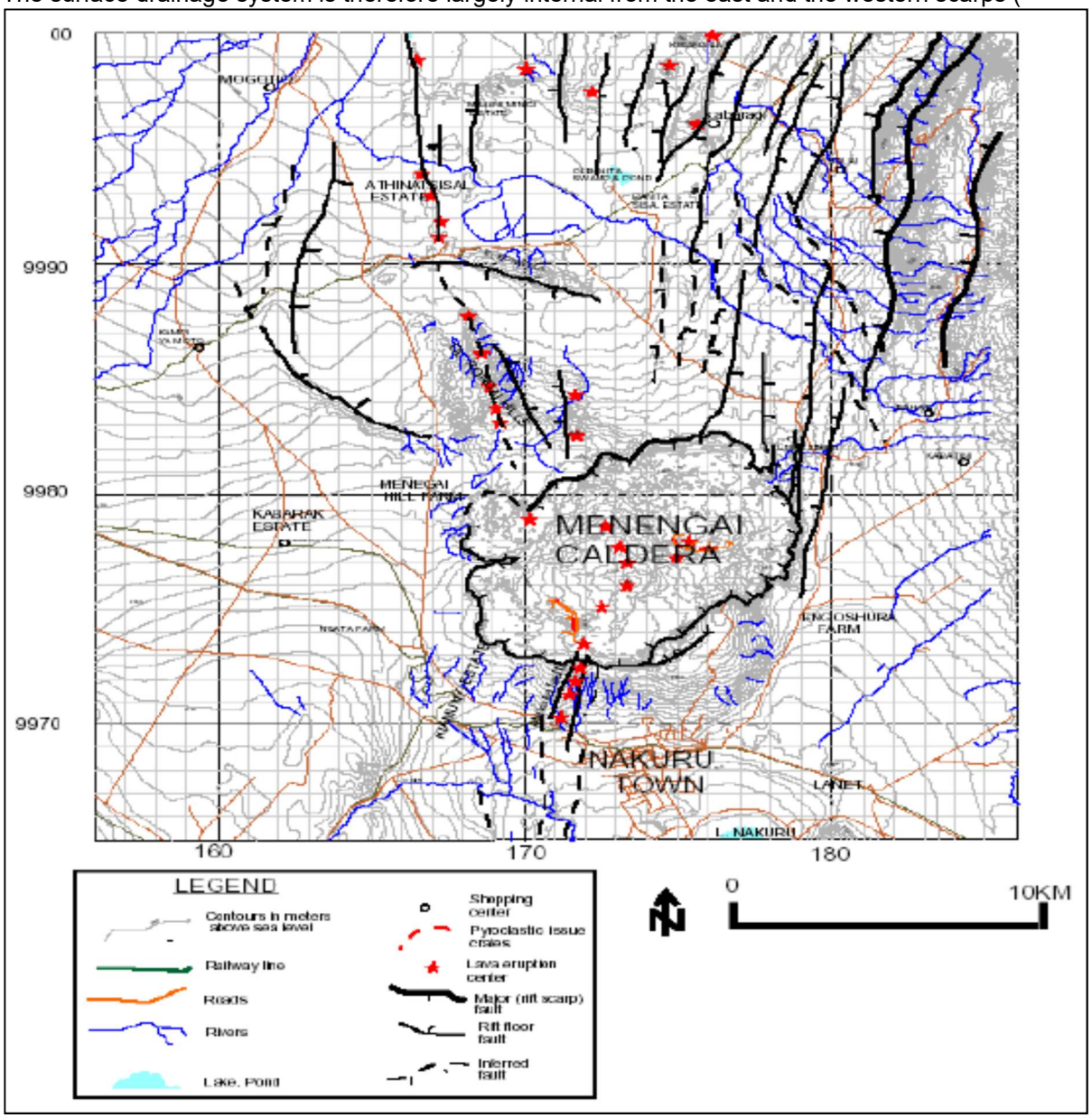


Figure 3-6). On the rift floor, the drainage is mainly from Menengai Caldera northwards with the exception of the drainage from the southern rim or slopes of Menengai Caldera into Lake Nakuru. The permanent rivers in the area (but which are located outside the caldera) are Molo and Rongai in the NW area. The perennial rivers are the Crater and Ol Banita streams in the eastern parts. The N-S, NE-SW, and NW-SW trending fault/fracture systems provide underground channels resulting to stream water disappearing underground at some places interrupting the Ol Banita stream at several places. Other surface water bodies outside the caldera include Lakes Nakuru and Solai, and the Ol Banita swamp.

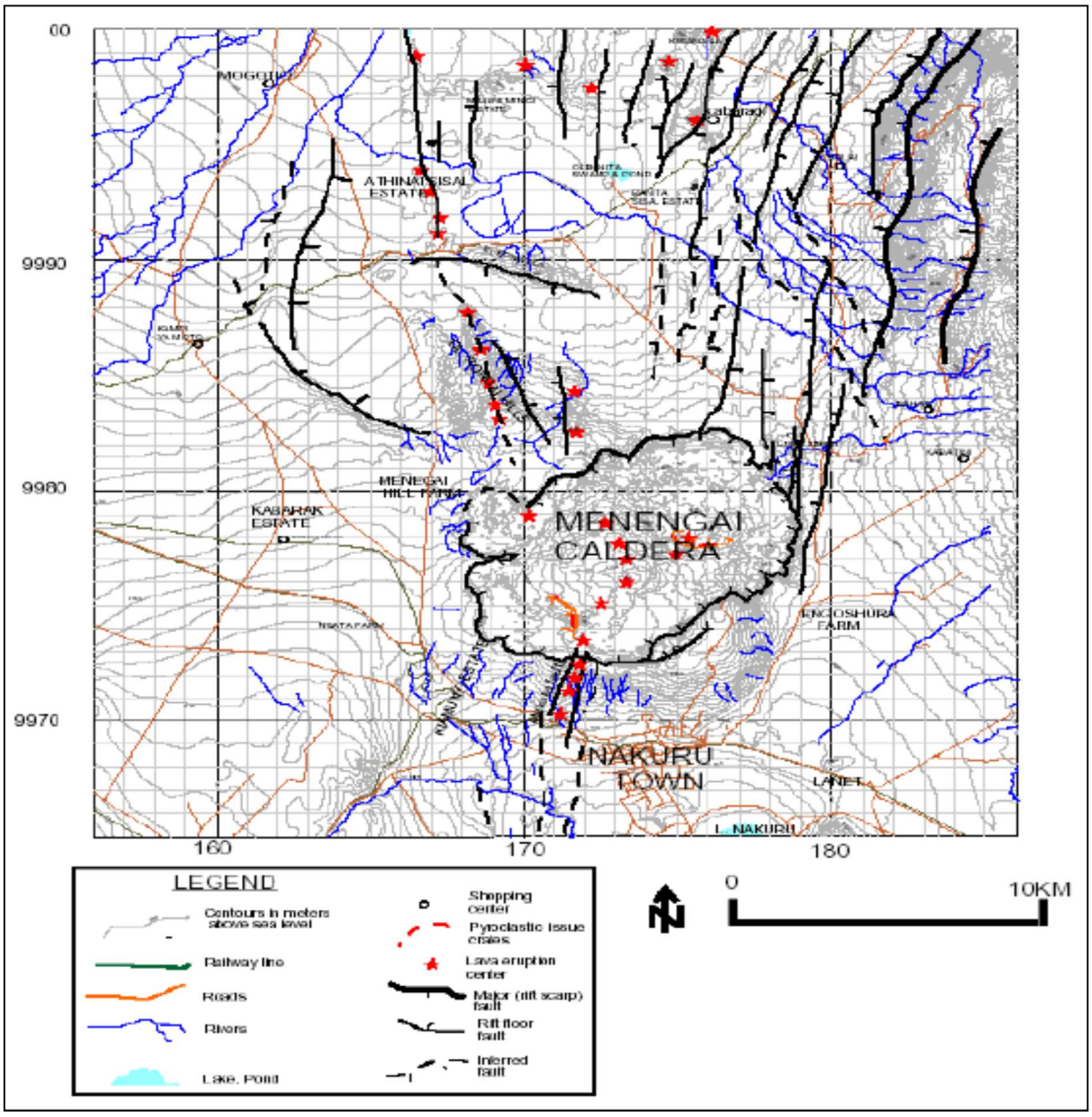


Figure 3-6: Map of Menengai Volcano illustrating surface drainage patterns and lava eruption centres
Source: GDC

Lake Nakuru represents the intersection of a piezometric surface and a topographic surface (see Figure 3-7). The ground water around Lake Nakuru and northwest of the lake is controlled by a sedimentary formation comprising of lake sediments and reworked pyroclastics. The boreholes immediately to the north and northwest of the lake show lake water contamination indicating interconnection (Geotermica Italiana Srl, 1987). The same sedimentary formations are found in the boreholes located in the east of Menengai caldera implying connectivity with the N-S running Solai tectonic axis. There is one location inside the caldera on the eastern rim where a cold spring (seasonal) occurs at the foot of the caldera, further confirming that the southern part of the Solai tectonic axis is an important control for groundwater movement.

The Ol Banita swamp is located in an area dominated by dry and thermally anomalous boreholes. The productive ones are characterized by very shallow, low-yield aquifers that get depleted fast since the deeper formations are impervious. These are perched water bodies adjacent to the swamp. The swamp owes its existence to impervious bedrocks that have been affected by hydrothermal alteration. The formations underlying the swamp are the ignimbrite beds that show marked hydrothermal alteration.

Majority of the boreholes in the prospect area were drilled to between 100-200 m depths. The relative yields may be matched with petro-physical property of the feeder formations expounded below.

1. *Very high yield boreholes (>20 m^3/h)*: Hosted in fractured, fresh lavas and talus. These are boreholes located on the eastern scarps and Bahati areas and are normally fed by channels along rift scarps faults.
2. *Moderate high yield boreholes (9-15 m^3/h)*: Aquifers include lacustrine beds, reworked volcanicalstics and fractured lavas in the rift floor. These are mainly found in boreholes around Lake Nakuru, Nakuru town, to the east and north east of Menengai caldera along the Solai TVA and around Kisanana.
3. *Poor yield Boreholes (<6 m^3/h)*: Aquifers are inter-bedding contacts between tuff and ignimbrite beds. These types of boreholes are found to the east of Menengai caldera, Kampi ya Moto and Rongai areas.
4. *Dry and thermally anomalous boreholes*: These include the completely dry boreholes and those that encountered perched water bodies and therefore dried up after the aquifer was depleted and those that produced low-pressure steam, hot water and CO_2. These are distributed along the Molo TVA that extends from the Menengai caldera northward through the Ol Rongai volcano, Lomolo, Goitumet volcano (See Figure 3-7).

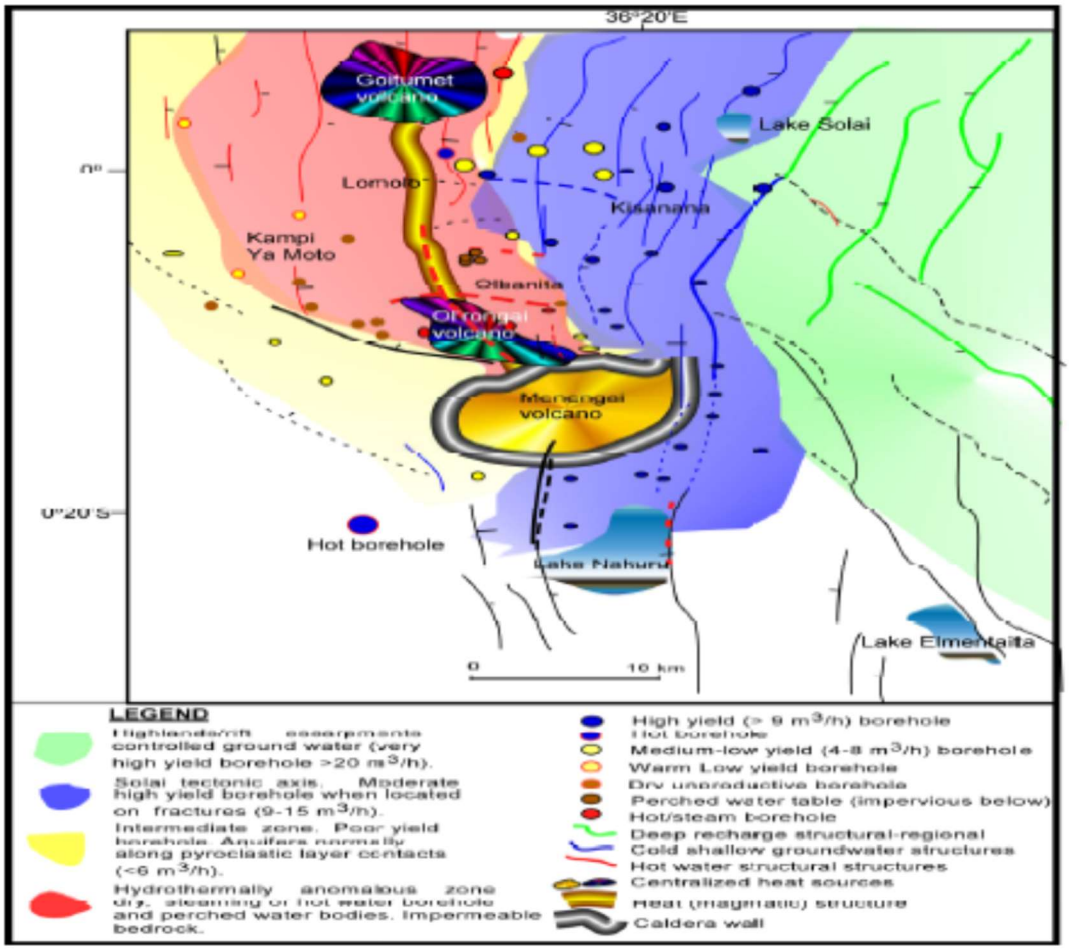


Figure 3-7: Hydrogeological regime of the Menengai and the surrounding

Source: GDC

The geology and soils of Menengai volcano partly control the surface run off pattern which is generally radial. Radiating away from the rim of the caldera are gullies and stream valleys along which run off water flows. The streams are seasonal and discharge into rivers at the floor of the rift valley. From the walls of the fault surrounding the caldera, similar gullies and seasonal

streams drain radially into the caldera. One of the streams flows over structures within the caldera as illustrated in photo plate 3.1 below. This seasonal stream is located near the GDC pump station on the eastern side of the caldera at about 7.5km from the proposed power plant site.

Photo plate 3.1: A Stream adjacent to the water pump station inside the Caldera (Note the white coloration at the centre caused by a fumarole)

The presence of boreholes in and outside the caldera is depictive of the hydrogeology of the project area. GDC has successfully drilled bore holes inside the caldera, while numerous other bore holes have been drilled in the wider Menengai area (**Figure 3-8**).

Geothermal wells with over 2km depth have been drilled in the caldera mainly in the central parts. This is indicative of occurrence of aquifers at different levels and with different water qualities. The structural geology and possible presence of porous volcanic rocks could be the main features that allow for ground water at the different levels and therefore different chemical composition depicted by the white colour geothermal spring at the bottom of the stream (See Plate 3.1 above).

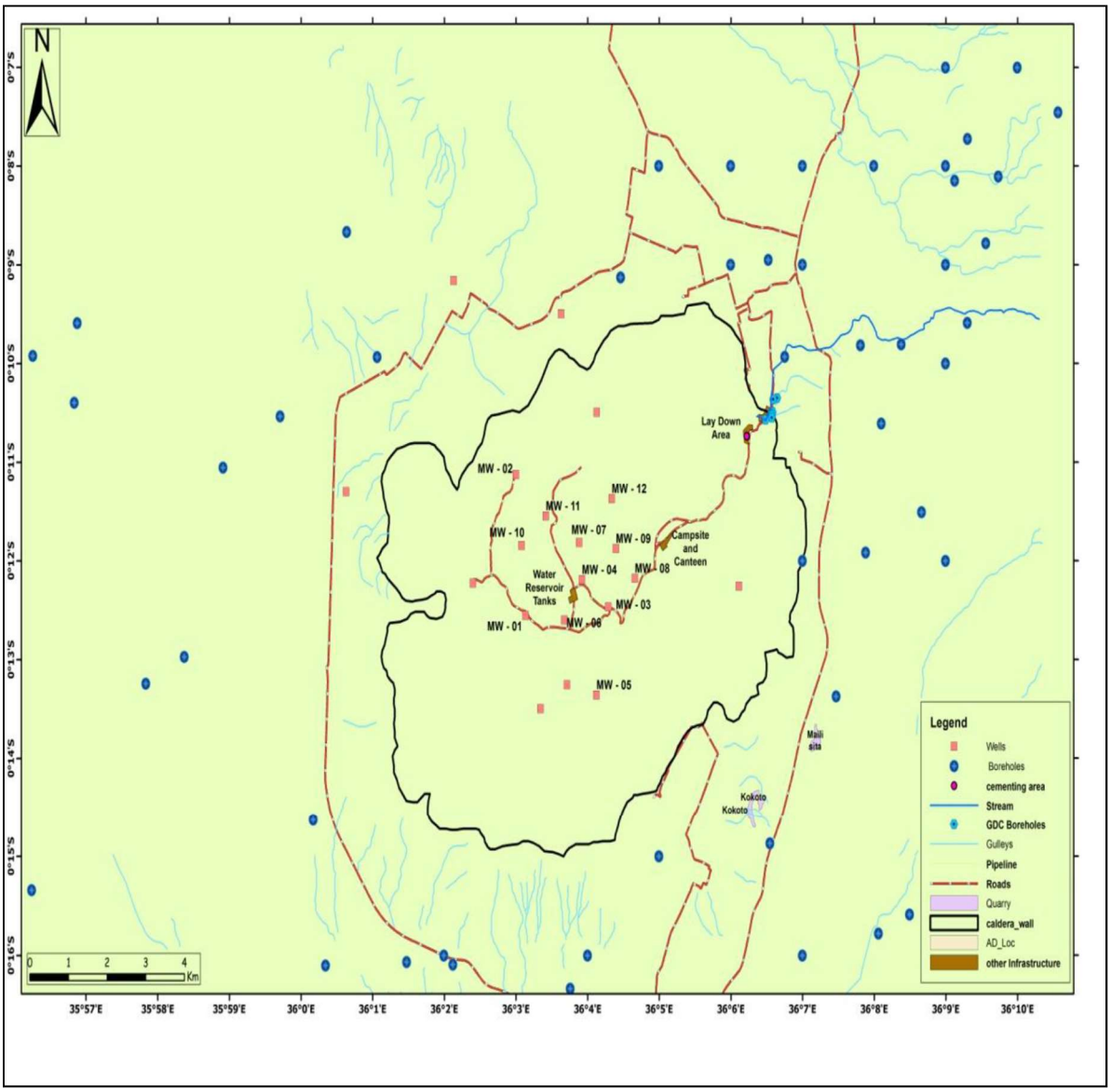


Figure 3-8: Map Showing Surface and Ground Hydrology at the Menengai Volcano
Source: GDC

3.1.5 Water and Effluent Quality

Laboratory analysis results of the quality of drilling water returns, geothermal brine and hot spring are presented in Table 3-1 and Table 3-2 below.

Table 3-1: Quality of the Stream Water, Hot Spring and MW-01 Geothermal Brine

Parameter	Stations			NEMA effluent standards
	Geothermal feature (Plate 3.1)	Stream at Pump Station Menengai	MW-01 Brine	
pH	7.63	7.31	9.24	6.5-8.5
Chlorides(ppm)	7.18	0.69	444.8	
Total dissolved solids (ppm)	690.00	354.00	190.90	1.0
Conductivity (µS/cm)	544.00	95.30	313.00	10
Fluorides (ppm)	1.20	0.72	2.76	10
Turbidity (NTU)	15.17	291.00	0.14	0.5
Silica(ppm)	ND	ND	17.90	1.0
Aluminium(ppm)	0.81	10.57	0.05	1.0
Iron(ppm)	0.12	6.34	0.37	250
Potassium(ppm)	8.24	5.74	392.00	1.5
Manganese(ppm)	0.02	0.22	NIL	0.01
Lead(ppm)	ND	ND	0.10	2.0
Zinc(ppm)	0.02	0.12	ND	0.01
Cadmium(ppm)	ND	ND	ND	0.01
Copper	ND	1.13	ND	
Boron	ND	ND	ND	

Table 3-2: Effluent Quality of Drilling Water Returns and MW1 Geothermal Brine

Parameter	Stations		NEMA effluent standards
	MW1 Drilling Water Returns	MW1 Brine	
pH	7.58	9.72	6.5-8.5
Conductivity (mS/cm)	1.13	15430	
Sulphur (S)	117.3		1.0
Iron (Fe)	0.66	ND	10
Manganese (Mn)	2.89	ND	10
Zinc (Zn)	0.03	0.2	0.5
Copper (Cu)	<0.01	ND	1.0
Boron (B)	0.43	ND	1.0
Chloride (Cl)	10.99	1.0	250
Fluorides (F)	10.95	193.71	1.5
Cadmium (Cd)	<0.01		0.01
Chromium (Cr)	<0.01	0.007	2.0
Lead (Pb)	0.02	ND	0.01
Selenium (Se)	<0.01		0.01

Source: GDC Monitoring Report

The brine is alkaline whereas chloride concentration is high (444.4 ppm) which is typical of chloride geothermal water. Silica was also higher than the NEMA recommended limits. Except for chlorides and conductivity, which varied significantly (subject to experimental errors), compared to the GDC monitoring data, the rest of the data obtained during the ESIA study, fairly matched with the GDC data.

Toxic heavy metals such as lead, cadmium, zinc and copper were below detection limits. With proper disposal, the dangers of accumulation of heavy metals in the environment is minimal and even non-existent considering that the brine is alkaline and therefore uptake by plants especially lead and cadmium from geothermal water is inhibited (Simiyu, 2004). The drilling water returns and brine effluent will be discharged in lined ponds and later re-injected, to safeguard ground water.

Wanyororo spring water and raw water from Nakuru Water Sanitation Services Company (NAWASSCO) before treatment have elevated fluoride concentrations (See Table 3-3). However, after treatment the fluoride levels reduced to below recommended safe limit (1.5 ppm). Thus, water treatment is necessary in this area if fluoride associated effects have to be minimized**.**

Table 3-3: Quality of drinking water sources in Menengai project area

Parameters	NAWASSCO Treat Water	NAWASSCO Raw Water	Wanyororo Spring Water	KEBS Standards	W.H.O Standards
pH	8.91	8.87	1.4	6.5-8.5	8.5
Conductivity µS/cm	13.86	1030		2500	<1500
Chloride	1.0	50	4.93	250	<250
Fluoride	0.07	13.31	2.01	1.5	1.5
Sulphide	0.001	0.001	1.68	0.1	<84
Copper	ND	0.02	<0.01	1.0	<2.0
Zinc	0.72	0.23	<0.01	5.0	<3.0
Chromium	0.004	0.008	<0.01	0.05	<0.05
Boron	ND	ND	ND	<0.01	<0.3
Cadmium	ND	ND	ND	<0.01	<0.1
Lead	ND	ND	ND	0.01	<0.01
Nickel	ND	ND	ND	0.01	<0.02
Selenium	ND	ND	ND	<0.01	<0.02
Mercury	ND	ND	ND	<0.01	<0.01
Arsenic	ND	ND	ND	<0.01	<0.02

Source: GDC Monitoring Report

3.1.6 Air Quality

The proposed geothermal power plant is located in an area affected by natural sources of atmospheric emissions, including steam, carbon dioxide, and H_2S, via natural geothermal features such as vents and fumaroles and in some areas the smell of hydrogen sulphide is perceptible. It is notable that a number of geothermal production wells have already been drilled within the caldera by GDC while some new well drilling and testing, including construction of drilling infrastructure (well pads and access roads) are still ongoing. These activities already have implications on the project area air quality.

Potential atmospheric emissions from the Project are discussed in section 7; the only air pollutant considered to be of concern in the study is H_2S. Monitoring for H_2S levels in the ambient air from existing geothermal features (wells within the caldera) was conducted by the University of Eldoret in 2013. The results of this campaign are given in Table 3-4.

Table 3-4: Summary of pre-development ambient air quality sampling results for H_2S in ppb (2018).

Monitored Sites	Jan	Feb	March	April	May	June	July	august	September	October	November	December
MW 17	0.21	22.50	62.77	1.01	0.70	0.1223		58.755	0	0	0	
MW 03	70.78	76.00	1.57	0.52	0.62	0.70	18.125	98.155	8.51 UP, 131 DW	0.63 UP, 13.17 DW	4.59 UP, 117.6 DW	
camp site	0.87	109.00	50.82	1.09	0.18	0.5455	10.39	1.28	1.38	0.79	1.78	
tree nursery	0.48	0.39	1.18	0.00	0.001	0	1.25	1.32	0	0	0	
laydown	51.12	136	0.16	0.14	0.001	0.095	0.86	1.37	1.42	1.53	2.34	
MW 18	240	0.19	0	0	0	0	0	0	0	0	0	
control room	0.82	0	0	0	0	0	0	0	0	0	0	
MW 10	16.31	81.39	51.38	0	0	0	0	0	0	0	0	
MW 19B	0.35	0.01	0	0	0	0	23.595	104.45	171 UP, 32.7 DW	1.06 UP, 1414 DW	0	
MW 01	0	64.99	0	0	0	1.2135	0.125	61.72	1330	0	0	
MW 21	0	0.18	0	0	0	0	0	0	0	0	0	
MW 13A	0	121.33	0	0	0	0	0	0	0	0	0	
MW 13B	0	23.42	0	0	0	0	0	0	0	0	0	
MW 19A	0	2.73	0	0	0	0	0	0	0	0	0	
MW 20	0	49.70	0	0.001	0	0	0	1.86	0	0	0	
MW 08	0	0.024	140	0	0	0	0	0	0	0	0	
MW 15	0	0	611.58	0	0.003	0.1165	103.9	1.05	1.15	2.45	0	
MW 20B	0	0	0	0	0.93	0.1113	0.8	0	0	102.3	1.34	
MW 10B	0	0	0	0	2.22	0.755	0	0	0	0	0	
MW 33A	0	0	0	0	0	0	1.67	1.55	0	0	0	
MW 34	0	0	0	0	0	0	0	0	0	1.86	2.41	

KEY	
UP	Upwind
Dw	Downwind
	No Monitoring

Source: GDC Air Quality Data

The concentrations of H_2S were monitored and it was found that they were high at the weir box in the discharging wells while in the rest of the working areas the concentration levels were zero ppm. At most of these monitored wells, the odour threshold (0.00046 ppm-0.002 ppm or 0.76-3.21 µg/m3) is frequently exceeded, as well as the ACGIH TLV for hydrogen sulphide which is set at 1 ppm (1.5 mg/m^3) for an eight-hour exposure.

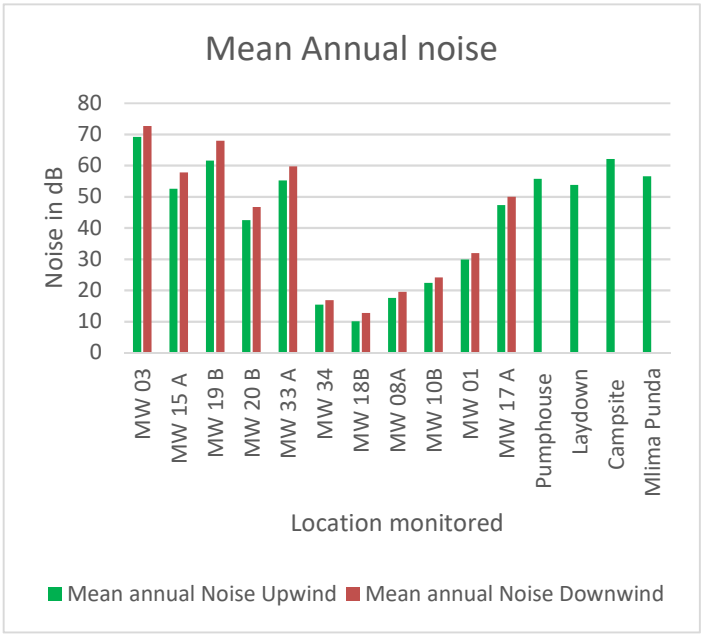
3.1.7 Noise

Noise environment in the proposed project has already been modified by the existing activities of drilling operations and associated infrastructure development. The existing major sources of noise in the Menengai Caldera are generators supplying power to the rigs, discharging wells, electric motors, air compressors, mobile machinery, mud pumps, drilling operation, all of which operate around the clock. The environmental noise impact of geothermal drilling operations results from a combination of noise from all these sources.

Noise level monitoring and assessment in Menengai is carried out at least three times per week to establish both background and operational noise levels. This monitoring is carried out in compliance to the provisions of Environmental Management and Co-ordination (Noise and Excessive Vibration Pollution) (Control) Regulations 2009 regarding noise limits at the work place and also the Occupational Safety and Health and Act 2007. The noise level in the proposed project area was assessed using an Integrated Handheld Sound Level meter (Model Extech 407768). The results are summarized in Table 3-5 below.

Table 3-5: Average noise levels at various locations in Menengai taken in 2018

Sites Monitored	Mean annual Noise (Decibell)		Bar Graph
	Upwind	Downwind	
MW 03	69.11	72.68	
MW 15 A	52.53	57.76	
MW 19 B	61.58	67.91	
MW 20 B	42.52	46.67	
MW 33 A	55.18	59.75	
MW 34	15.37	16.90	
MW 18B	10.13	12.80	
MW 08A	17.61	19.57	
MW 10B	22.42	24.15	
MW 01	29.91	31.95	
MW 17 A	47.32	49.98	
Pumphouse	55.73		
Laydown	53.78		
Campsite	62.05		
Mlima Punda	51.46		



Source: GDC Noise data 2018

The highest noise level at the discharging well which was recorded was at 72.7dB, which is between the recommended ambient and occupational standards (45 and 85 dB) respectively. It is below the industrial noise level but above the domestic level. The lowest average noise level that was recorded was 10.1 dB at the MW 18B.

Noise levels during drilling operations are higher closer to the drilling rig under weather conditions that allow drilling noise to dominate the overall noise levels such as light winds from the drilling sites towards the neighbour, low cloud, temperature inversions etc.

There are no nocturnal baseline noise levels from available data to help analyse background noise at night-time. Similarly, no baseline noise data exists for the nearby settlements just outside the caldera. From the existing data, the monthly day time noise levels picked at the pumphouse (ranging from 51.7 to 70.7) in 2018 are comparable to levels in other locations (e.g. the weather station at Mlima Punda) within the caldera which have no major anthropogenic noise sources nearby. It can therefore be inferred that the pump house noise levels are representative of the baseline levels at the potential noise sensitive receptors outside the caldera.

For estimating cumulative impacts within Menengai crater, the following conservative representative background noise levels were used in the noise modeling:

- 45.2 dBA (lowest median value) for the night; and
- 55.2 dBA for the day.

3.2 Biological Environment

A detailed ecological survey covering flora and fauna in both the disturbed and undisturbed areas of the caldera was carried out by the University of Eldoret. The idea behind this survey was mainly to determine biological baseline before implementation of the proposed project.

3.2.1 Flora

The survey identified a total of 119 plant species in the Menengai Caldera (See Appendix II). These species consist of herbs (33), shrubs (40), climbers (6), ferns (3), sedge (3) grass (10), parasitic plant (1) and trees (23). The *Rhus natalensis*, *Dodonea sp.* and *Tarchonanthus comphoratus* are among the most dominant species. *Nicotiana glauca* (a shrub), *Eucalyptus spp*. (a tree) and *Grevillea robusta* (a tree) were recorded as exotic species. The most common tree species were *Protea gaguedi*, *Faurea saligna, Hymenodictyon parvifolium* and *Agauria salicifolia.* Common shrubs in the Caldera include *Rumex usambarensis*, *Conyza newii*, *Anthospermum welwitschii*, *Lippia javanica* and *Rhus natalensis*.

The Menengai Caldera also contain some plant species that are believed to be rare and unique to this area such as *Artemisia afra* (Photo plate 3.2)*, Protea gaguedi, Tetradenia riparia, Diplolophium africanum, Agauria salicifolia* and *Osyris lanceolata.* Remnants of endangered tree species the East African sandalwood (*Osyris lanceolata*) was sighted in the Caldera (Photo plate 3.3). An online search of these species' conservation status established that they have not been assessed for the IUCN red list (IUCN, 2014). However, *Osyris lanceolata* is of national conservation importance and is listed as endangered in the sixth schedule of wildlife conservation and management Act of 2013.

Figure 3-9: *Protea gaguedi* Present at the Caldera

Fimbristylis exilis commonly known as geothermal grass is present in the Menengai Caldera. The grass is associated with areas having geothermal manifestations hence a potential indicator of geothermal resources.

Three (3) floral species were considered of conservation importance and seven of various medicinal values:

- *Osyris lanceolata* (Sandalwood)

  The species is protected under Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) (See the Biodiversity Checklists in Appendix II). The species is listed as Endangered under Kenya's Wildlife Conservation and Management Act (2013).

- *Aloe kendongensis*

  The bitter juice from the leaf's inner skin is a safe and stimulating purgative.

  Aloe kedongensis and *A. volkensii* are listed as protected species in Appendix II under Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

- *Withania somnifera*

  Grows as shrub/herb, the roots are used to prepare traditional medicine.

- *Rothea myrcoides (Clerodendrum myricoides)*

  Root decoction is used to treat rheumatism, malaria and venereal diseases.

- *Myrsine Africana*

  A shrub with bitter fruits used against intestinal worms.

- *Ajuga remota*

  A herb used to treat malaria, pneumonia, stomach-ache and liver problems.

- *Artemisia afra*

  Leaf infusion is used to expel intestinal worms, treat coughs, headaches, fevers, loss of appetite and malaria.

- *Maytenus senegalensis*

  Decoction from the roots is used to treat chest and joint complaints.

- *Tetradenia riparia (Iboza multiflora)*

  Leaf infusion is used to treat coughs, fevers, colds, sore throat and headache.

Figure 3-10: *Rhus spp* and *Nicotiana glauca* present at the Caldera

A fruiting *Rhus* plant

A Flowering *N. glauca*

In the field survey report prepared in 2010, imagery analysis of the vegetation within the Caldera resulted in 8 vegetation types: Bushlands (23%), Grasslands (21%), Forests (18%), Disturbed land (14%), Woodlands (10%), Rocky outcrops and larva vegetation (9%), Montane forest (3%) and riverine vegetation (2%).

From consultations held with the local forest manager in earlier studies, the main interest of putting the area under forest management was its unique landscape features. Though it is regarded as a forest lands and managed by the KFS, the Caldera is currently being conserved as a multifunctional landscape. The main forested section if the eastern/south eastern flans of the caldera rim is mainly composed of planted *Eucalyptus spp*.

The flora of Menengai caldera provides forage for livestock kept by some of the nearby communities and fuelwood (firewood and charcoal). However, most of these uses are illegal with only few cases of fodder collection (cut and carry) or grazing having been sanctioned by KFS.

Within the immediate Sosian power plant's site, the vegetation cover has been cleared and site levelled in anticipation of power plant construction works. Similarly, the common access road to all the three IPP sites had been cleared of vegetation. The nearby Orpower plant site which had not been cleared generally had interspersed vegetation cover comprising stunted trees, shrubs and tufted herbs. Open spaces between the vegetation had light trails indicating foraging visit by herbivores (livestock had been sighted nearby at the time of the visit). See Figure 3-11. 10 (No.) of floral species were readily identified from random observation made on site.

Figure 3-11: Floral Species within the plant site

Cleared and levelled area for one of the other IPPs next to the proposed plant site

Typical vegetation cover in proximity to the Sosain site

Acacia hockii (shrub)

Monsonia angustifolia (Herb)

Faurea saligna (Tree)	*Rhus natalensis* (Shrub)
Myrsine africana (Herb)	*Oldenlandia wiedemannii* (Herb)
Pappea capensis (Tree)	*Protea gaguedi* (Tree)

3.2.2 Fauna

(a) Mammals

Large mammals whose presence was confirmed during the ecological studies undertaken in June 2015 include:

- Tree hyraxes (*Dendrohyrax arboreus*),
- Rock hyraxes (*Procavia capensis*),
- Olive baboons (*Papio anubis),*
- Vervet monkey (*Cercopithecus aethiops*),
- Mountain (Chandlars) Reedbucks (*Redunca fulvorula*),
- Common duikers (*Sylvicapra grimmia*)
- steenboks (*Raphicerus campestris*)
- Porcupines (*Hystrix cristata*),
- Kirk's Dik diks (*Madoqua kirkii*),
- Spring Hares (*Pedetes capensis*),
- Zebras,
- Bush Squirrels, and
- Various rodents (mice, rats and mole rats)

Other species known to be in the area are Free-Tail bats, Ant bears and African Hares.

From local community interviews, carnivores known to be in the area include Leopards (*Panthera pardus*), Spotted Hyena (*Crocuta crocuta*), Stripped hyena (*Hyaena hyaena*), Small Spotted Genet (*Genetta felina*), African Civet (*Civettictis civetta*), Slender Mongoose (*Herpestes sanguineus*), African wild cat (*Felius catus*) and Honey Badger (*Mellivora capensis)*.

Of the above mammals, Leopard *P. pardus* and stripped hyena *Hyaena* are both listed nationally in the Wildlife Conservation and Management Act (WCMA), 2013 as endangered. Internationally, *P. pardus* is classified as Vulnerable and *H. hyaena* as Near Threatened (IUCN, 2019). Species under CITES listing include *Panthera leo, Papio anubis* and *Cercopithecus aethiops* in Appendix II and *Mellivora capensis, Civettictis civetta* and *Hyaena hyaena* in Appendix II.

Menengai crater is not listed as a wildlife conservation area. The nearest listed wildlife conservation area according to WCMA is Lake Nakuru National park, about 25 km (direct distance) from the caldera and separated by from it by the Nakuru urban zone.

No wildlife population monitoring data exist for the Menengai caldera and no particular animal breeding areas have been documented from the existing reports. Given that KWS currently do not have active interest in the caldera, it will be important that GDC undertakes seasonal mammal population survey within the caldera, liaising with the KWS Nakuru office and KFS as necessary.

(b) Herpetofauna

Four reptile families (Chamaeleonidae, Agamidae, Boidae and Elapidae) were encountered in the project sites. The reptiles include two species of Chameleons (*Chamaeleo spp.*), five species of lizards namely; Redheaded Rock Agama, Elementaita Rock Agama and the Common lizards, Monitor lizards, and other lizards.

Snakes include the Spotted and Striped Forest snakes (*Philothamnus spp*.), African Rock Pythons, Puff Adders, the eastern green mamba (*Dendroaspis angusticeps*), also known as the common mamba, East African green mamba or green mamba, and Cobras.

According to WCMA, 2013, Rock Python is nationally listed as endangered while Puff Adders and green mambas are listed as protected reptiles. However, internationally both of these reptiles are listed as of Least Concern (IUCN, 2019).

Rock Agama (*Agama agama*) is listed in the Seventh Schedule of WCMA 2013 as an invasive species.

Figure 3-12: Female *Agama agama* spotted at the Menengai Substation

(c) Avifauna

In and around Menengai, a total of 237 species in 63 families are known to occur. Of these, 3 species are Endangered; 4 species (Lesser Flamingo, Grey-crested Helmet-Shrike, African Crowned Eagle and Pallid Harrier) are near threatened globally (NT), 5 species are vulnerable globally (VU) under the IUCN Redlist database. 32 species were also listed under CITES. Moreover, 20 species are Palearctic migrants (PM), 12 species are Afrotropic migrants (AM), 4 species are Palearctic or Afrotropical migrants (pm/am) occurring alongside resident individuals, 18 species are rare sighting (X). Noteworthy, the lesser flamingos that are resident in millions at the nearby Lake Nakuru located to the south of the caldera and use the area as a flight path. They are in the IUCN Redlist as near threatened species and Afro-tropical migrants (NT, AM). 160 species are resident species.

Table 3-6: Avifauna Species of Conservation Interest under IUCN database

No.	Common name	Scientific name	Status
1	Veraeux's Eagle	*Aquila verreauxii*	VU
2	African Crowned Eagle	*Stephanoaetus coronatus*	VU
3	Martial Eagle	*Polemaetus bellicosus*	VU
4	African Crowned Eagle	*Stephanoaetus coronatus*	VU
5	Martial Eagle	*Polemaetus bellicosus*	VU
6	Grey-crested Helmet-Shrike	*Prionops poliophus*	VU

A full checklist of avifauna is provided in Appendix II**.**

(d) Entomological Survey

A total of 41 invertebrate species were recorded during the survey. This included 3 species of Coleoptera (Beetles), 1 species of Hemiptera (true bugs), 4 species of Orthoptera (grasshoppers and crickets), 10 species of Hymenopetra (Bees,Wasps and ants), 4 species of Diptera (true flies), 10 species of Lepidoptera (Butterflies and Moths), 1 species of Blattodea (wild cockroaches), 2 species of Diplopoda (millipedes), 1 species of Chilopoda (centipedes) and 2 species of aranaea (spiders), 1 species of Isoptera (termites), 1 species of Isopoda (sow bugs and 1 species of Mantodea.

A full checklist of invertebrates is provided in Appendix II.

3.3 Socio-Economic Environment

3.3.1 Background

A household socio-economic survey aimed at assessing and establishing the current social, cultural and economic conditions of the persons living in the projects primary and secondary zones of impact was conducted between 20 October 2014 and 19 November 2014. The survey was conducted in a total of fourteen sub locations. Mercy Njeri sub location was the only one located in the primary zone of impact whereas the other 13 sub locations were within the secondary zone of impact. These sub locations include:

- Kabatini;
- Maili Sita;
- Teachers;
- Kiamaina;
- Maili Kumi;
- Wanyororo;
- Bahati;
- Ol Rongai;
- Kampi ya Moto;
- Menengai;
- Landi Mawe;
- Ndunguri; and
- Kirima.

The proposed geothermal power plant will be constructed within the caldera area which falls in Mercy Njeri sub location. This will be the primary zone of impact whereas the secondary zones of impact are the neighbouring settlement bordering the caldera. These sub locations are within Nakuru North and Rongai sub counties.

(a) Administrative boundaries

The Menengai Geothermal field lies within Rongai and Nakuru North Sub Counties of Nakuru County. It borders Subukia Sub County to the North, Bahati Sub County to the East and Nakuru West Sub County to the South. The project area of influence covers locations such as;

- Kabatini;
- Teachers;
- Kiamaina;
- Bahati;
- Ol Rongai;
- Kampi ya Moto;
- Menengai;
- Solai; and
- Kirima.

3.3.2 Population and Household Characteristics

The population figures for the two Sub counties as per the 2009 Kenya Population and Housing Census are presented in Table 3-7 below.

Table 3-7: Population figures for Sub Counties within the Project Area

Sub County	Male	Female	Total Population 2009	Projected Population-2015	Projected Population-2017
Nakuru North	103,316	108,375	211,691	262,074	278,558
Rongai	82,665	81,199	163,864	202,864	215,624

Source: 2009 Population and Housing Census

The projections of population sizes in 2015 and 2017 assume exponential growth and are based on the Nakuru County population growth rate estimated at 3.05% per annum (Nakuru County Integrated Development Plan, 2013).

(a) Demographic characteristics

The demographic characteristics of the study area population are presented in Table 3-8. Persons between the ages of 30-34 have the largest proportion of 11.0%. When taken together, as large as 29.4% of the sample are below the age of 15. The productive segment of the population (20 – 55yrs) is about 52.1% while old people (> 55 years) accounted for 8.4%. This indicates that the dependency ratio in the project area is relatively low, meaning that those not in working age do not have pressure on the working age group.

Table 3-8: Demographic characteristics of the study area

Age Distribution	Percentage Distribution		Grand Total
	Male	Female	
0-4	10.0	10.4	10.2
5-9	8.3	10.4	9.4
10-14	13.3	6.7	9.8
15-19	9.2	11.1	10.2
20-24	6.7	11.9	9.4
25-29	10.0	10.4	10.2
30-34	9.2	12.6	11.0
35-39	10.8	8.1	9.4
40-44	8.3	3.0	5.5
45-49	3.3	2.2	2.7
50-54	3.3	4.4	3.9
55-59	0.8	0.7	0.8
60-64	0.8	2.2	1.6
65-69	0.8	2.2	1.6
70-74	2.5	2.2	2.4
75-79	0.8	0.7	0.8
80-84	1.7	0.0	0.8
85-90	0.0	0.7	0.4
Grand Total	**100**	**100**	**100**

Source: Field Survey November 2014

The situation is presented in Figure 3-13 below.

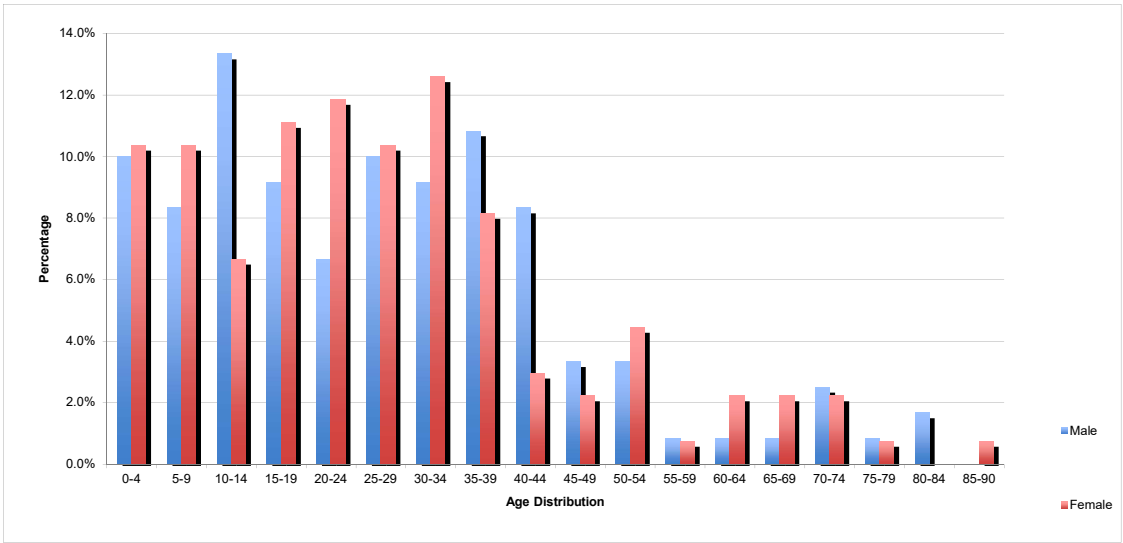


Figure 3-13: Demographic structure according to the Ages and Sex of the Population neighbouring the Study Area (Field Survey, November 2014)

According to the county integrated development plan 2013, the average life expectancy for Nakuru County is 52.9 years for the males and 58.2 for the females.

(b) Household Headship

As presented in Table 3-9 below, majority of households surveyed are male-headed (81.7%) whereas 18.3% of the households are female-headed.

Table 3-9: Household headship of the study area

Sex	Distribution	Area		Total
		Project area (Caldera)	Project neighboring communities	
Male	Frequency	3	656	659
	% within Area	75	88.4	81.7
Female	Frequency	1	86	87
	% within Area	25	11.6	18.3

(c) Religion

A survey of the households in the primary project area revealed that all the inhabitants were Catholics. Within the project neighbouring communities, the survey revealed two major religions professed by inhabitants of the area. These are Islam and Christianity. Muslims accounted for about 0.3% while Christians are over 94.4%. Only a small proportion (5%) had no religious affiliation. This distribution is shown in table 3.5 and illustrated in Figure 3-14 below.

Table 3-10: Religious affiliation in the project neighbouring communities

Area	Distribution	None	Catholic	Protestant	Muslim	Total
Secondary impact zone	Frequency	151	577	2108	8	2844
	Percent (%)	5.3	20.3	74.1	0.3	100.0

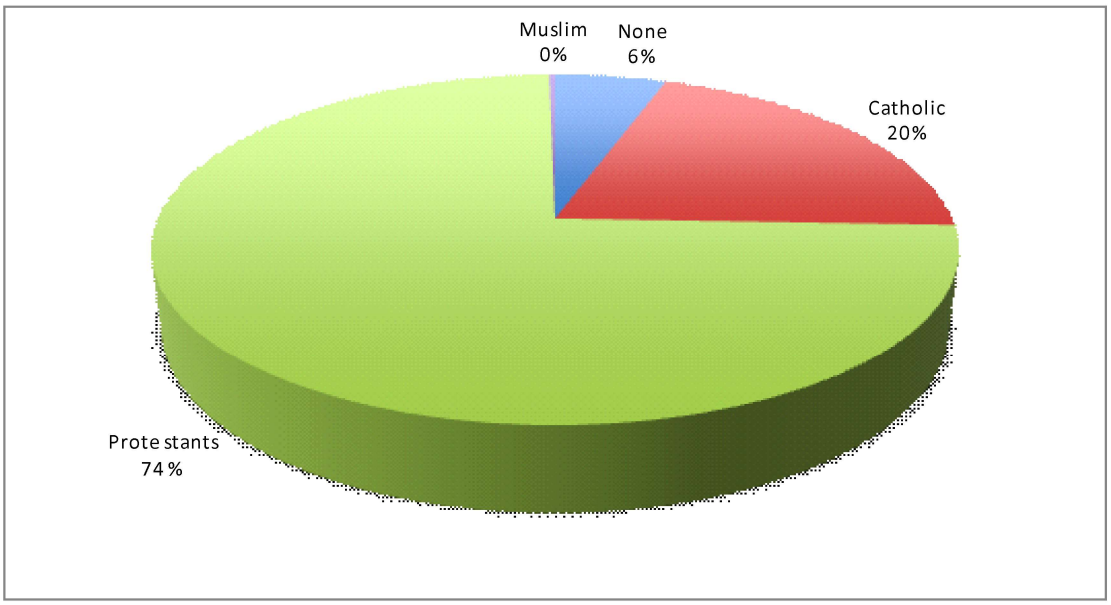


Figure 3-14: Proportion of religious groups of respondents neighbouring the project area

(d) Education

Educational institutions are organised into zones. The zones in the area covered by the project are Bahati and Solai zones. The number of various institutions and enrolment by third term (as at November 2014) are as indicated below.

Table 3-11: Student enrolment in Education institutions in Nakuru North Sub County

Category	No.	Students			Teachers		
		M	F	Total	M	F	Total
Public ECD	24						
Private ECD	45						
Public Primary	20	7,469	7,363	14,832	117	276	393
Private Primary	45	1,538	1,899	3,437	109	112	221
Public Secondary*	16						
Private Secondary*	16						
Tertiary (Public Polytechnic) *	1						

Source: Education office, Maili Sita.

**Enrolment data for the secondary and tertiary schools had not been shared at the time of completing the study*

Teachers to pupil ratio from Table 3-11 is 1:38 in public primary schools and 1:16 in private primary schools.

Table 3-12: Student enrolment within educational institutions in Rongai Sub County

Category	No.	Boys	Girls	Total
Public ECD	88	3,710	3,655	7,365
Private ECD	92	2,221	2,195	4,416
Public primary	73	16,055	15,376	31,431
Private Primary	42	3,091	2,912	6,003
Public secondary	34	4,963	4,549	9,516
Private secondary	16	1,963	2,097	4,060
Tertiary college	-	-	-	
University	1	Not available	Not available	
Total		32,007	30,784	62,791

Source: Education office Rongai Sub County

3.3.3 Housing conditions

Shelter is one of the basic human needs and good quality of life includes having comfortable housing. Good housing is one of the first steps in any meaningful attempt to tackle social problems. There is generally a strong relationship between household economic conditions and quality of housing and as such information on housing characteristics is critical to explaining associations between households' social and economic conditions. Housing as a shelter is one of the basic needs of a human being. In this survey, we assessed the quality of respondent's houses in terms of roofing, walls and floor.

Out of the four households present in the caldera, one had a thatched roof and the rest were roofed with corrugated iron sheet. All the four houses had mud walls and earth floors.

Table 3-13 below shows the roofing, wall and floor characteristics of houses sampled neighbouring the project area (secondary impact zone).

Table 3-13: Housing characteristics of neighbouring the project area

Roofing Characteristics						
Area	**Distribution**	**Thatched**	**Corrugated Iron Sheet**	**Tiles**	**Others**	**Total**
Neighboring communities	Frequency	14	714	4	2	734
	(%)	1.9	97.3	0.5	0.3	100.0
Walls characteristics						
Area	**Distribution**	**Mud**	**Stone**	**Bricks**	**Other**	**Total**
Neighboring communities	Frequency	325	386	5	30	746
	(%)	43.6	51.7	0.7	4.0	100.0
Floor characteristics						
Area	**Distribution**	**Earth**	**Cement**	**Wooden**	**Others**	**Total**
Neighboring communities	Frequency	362	376	1	6	745
	(%)	48.6	50.5	0.1	0.8	100.0

3.3.4 Access to water and sanitation

According to the survey, the main source of water for the households in the Caldera area is water vendors whereas for the communities neighbouring the project area are: rainwater, piped community water and water vendors. Rainwater accounts for over 62% whereas piped community water and water vendors account for 45% and 31% respectively. Other sources of water include shallow wells (0.8%), rivers (4.4%), piped water to homesteads (12.5%), boreholes (3.2%), water pans (2.4%) and springs (1.5%). The distribution is shown in the table below.

Table 3-14: Sources of water for households neighbouring the project area

Distribution	Springs	Boreholes	Shallow wells	Rainwater	Water pan	Piped Community	Piped homestead	River	Water vendors
Frequency	12	24	6	468	18	340	94	33	233
%	1.6	3.2	0.8	62.2	2.4	45.2	12.5	4.4	30.9

Time taken to fetch water from the different sources of water ranges from 30 minutes to more than an hour. Quantities of water by households and used per day is as illustrated in figure 3.7 below.

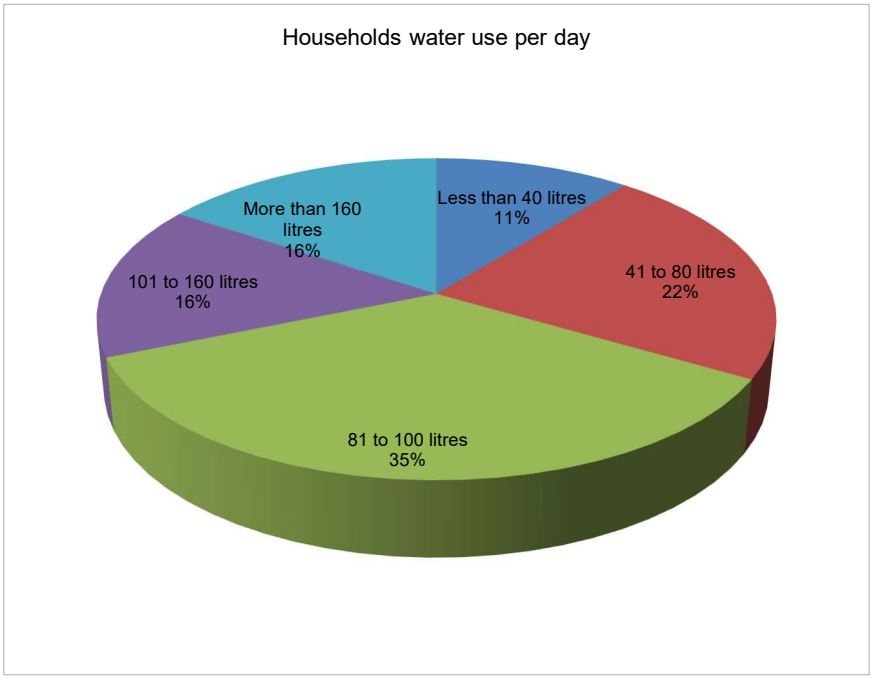


Figure 3-15: Household water consumption per day

(a) Water treatment

Within the project area, households treat water by boiling. Communities neighbouring the project area treat their water by boiling (40%), chlorination (9%) and water filtering (0.5%). Majority of the respondents did not treat their water (59%) whereas less than 1% did not know what is done with their water.

(b) Sanitation

Pit latrines are the only type of toilet used by households in the project area (caldera). Within the communities neighbouring the project area, majority of the households sampled use pit latrines (92%) and the rest use flush toilets (8%). None of the respondents went to the bush to defecate.

3.3.5 Health conditions

(a) Disease prevalence

According to the public health officer of Nakuru North Sub County, the most common prevalent diseases are as shown in Table 3-15 below.

Table 3-15: Common diseases affecting the population in Nakuru North Sub County

Diseases affecting persons under 5 year	Rank	Diseases affecting persons over 5 years	Rank
Disease of the respiratory system	1	Disease of the respiratory system	1
Diarrhoea	2	Disease of the skin	2
Disease of the skin	3	Dental diseases	3
Clinical malaria	4	Rheumatism: joint pains	4
Confirmed malaria	5	Clinical malaria	5
Pneumonia	6	Typhoid fever	6
Eye infection	7	Confirmed malaria	7
Mumps	8	Diarrhoea	8
Chicken pox	9	Urinary tract infections	9
Ear infection	10	Pneumonia	10

In Kampi ya Moto and Ngata divisions, Rongai Sub County, the most common diseases affecting the population are;

1. Upper Respiratory Tract Infections (RTI);
2. Diarrhoea;
3. Pneumonia;
4. Skin diseases;
5. Rheumatism: joint pains;
6. Typhoid;
7. Eye infection;
8. Malaria;
9. Hypertension;
10. Chicken pox.

HIV/AIDs prevalence in the two Sub Counties stands at 3.7% in Rongai and 3.2% in Nakuru North sub counties. Most vulnerable groups to HIV/AIDS include; commercial sex workers, employees of flower farms, sisal estates, widows and orphans and vulnerable children.

(b) Health institutions

Health institutions in the study area are categorised as either public or private. Public health institutions consisted of dispensaries, health centres and hospitals whereas private facilities are mainly private clinics and medicine stores.

Table 3-16: Health institutions in Nakuru North Sub County

Division	Public Facilities	Private
Kiamaina	4	8
Bahati	3	1
Dundori	3	5

Source: Public health office, Nakuru North Sub County

In Rongai Sub County, the numbers of health institutions are:

- Health centres-5
- Dispensaries -14
- Others (private and FBO)-10

Doctor to patient ratio stands at 1:60,670 and 1:10,000 in Rongai and Nakuru North respectively which is higher than the WHO recommended ratio of 1:1,000.

3.3.6 Community problems

The community in the study area experience various social and environmental problems:

(a) Social problems

A number of social problems exist in the project study area as identified by the respondents:

- Insecurity;
- Water scarcity;
- Youth unemployment;
- Poor infrastructure (roads);
- Lack of health facilities.

(b) Environmental problems

Environmental problems experienced by the communities in the project area are mainly associated with geothermal exploration activities such as:

- Air pollution;
- Noise and vibrations;
- Dust;
- Bad odours.

3.3.7 Archaeological background

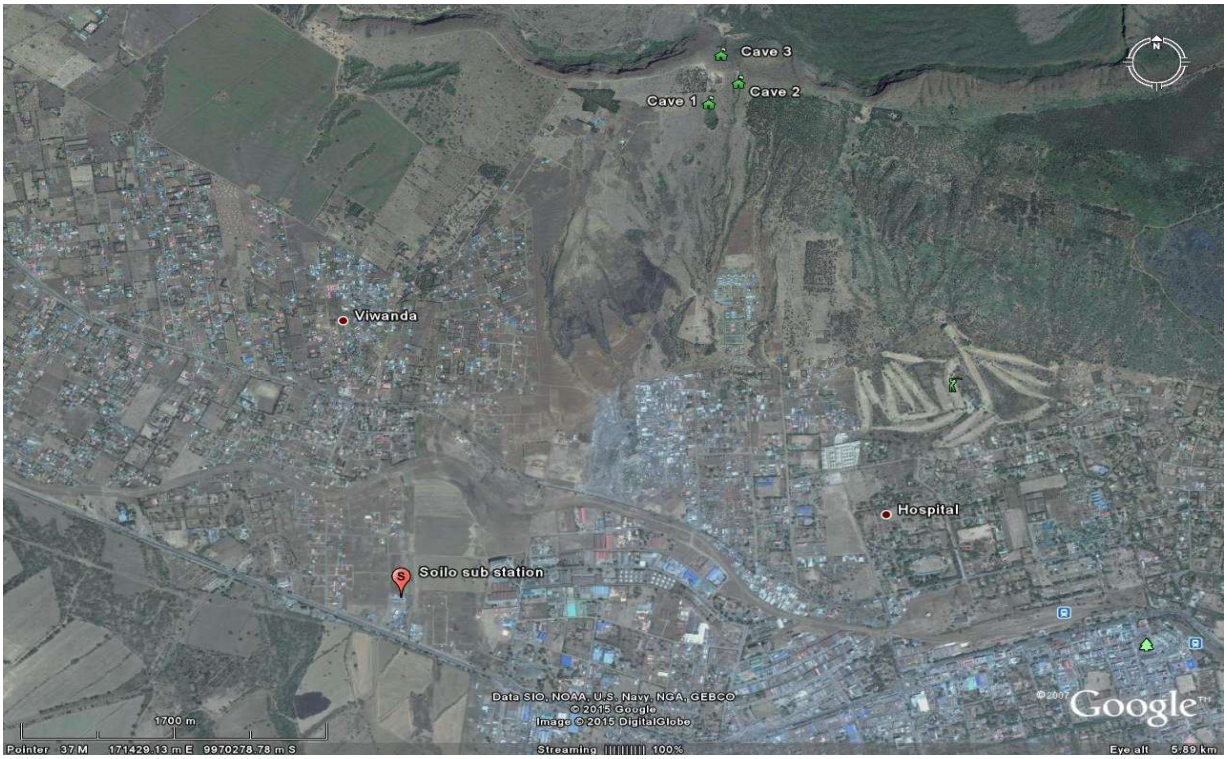
No previous archaeological surveys have been carried out in the crater, and therefore no archaeological sites are recorded. However, there are several sites recorded on the map covering this area, Sheet Number 119/1, Series Y731. The sites, named GqJi 1-6 all belong to the Later Stone Age (LSA) with artefacts such as pottery, stone bowls and stone tools recovered from them. The closest site to the crater, GqJi6 is located about 5 km from northern edge of the crater. The area south of Menengai crater covered by map Sheet number 119/3 also has LSA sites (GrJi 1-70) with artefacts similar to those mentioned above. This area is interesting because it contains many prehistoric human remains at sites such as Makalia, Bromheads and Nakuru burial sites. The high density of artefacts found in these sites is an indication of intense occupation over long periods of time. It is therefore likely that some form of evidence of human occupation may be present in parts of the crater.

A rapid field survey was conducted in the project area on the 11 February, 2015 by a specialist from National Museums of Kenya carried out to establish whether there are any archaeological sites, monuments or features within the area proposed for development. No archaeological objects or features were seen on the surface. There are no caves, rock art or fossils at the site. Neither are there objects of historical, cultural, artistic and religious value located on and around the proposed area of development. None of the obsidian is worked and there is no evidence of human modification on any objects found here. There is however a slight possibility that human remains may be present, as they have been found in similar settings on Mt Suswa. These burials are usually marked with piles of loose stones commonly referred to as cairns. In addition, three caves were sited at the vicinity of the power evacuation line as shown in the Figure 3-16 with their respective coordinates in Table 3-17. These caves are not used by any particular group but used by individuals who visit them for prayers.

Table 3-17: Coordinates of the Cave 1, 2 and 3

Way point	Eastings (m)	Northings (m)	Elevation(m)
Cave No. 1	171866	9972323	2082
Cave No. 2	172032	9972455	2142
Cave No. 3	171935	9972634	2118

Figure 3-16: Map showing the location of the three caves from the proposed site



3.3.8 Economic Characteristics

Nakuru North and Rongai are predominantly agricultural sub counties with maize and wheat crops being the predominant crops grown and cattle rearing for milk production, especially in areas neighbouring the project area.

There are several trading centres around the project area. These include:

- Ol Rongai;
- Kampi ya Moto;
- Kipng'ochoch;
- Wanyororo;
- Maili Kumi;
- Maili Tisa;
- Maili Saba;
- Maili Sita;
- Menengai.

(a) Employment status of persons living in the project area

The survey of the study area identified that 13.8% of the respondents interviewed were formally employed, 72.9% were informally employed and 13.3% were unemployed. The informally employed forms the largest proportion of the population since they are mainly semi-skilled and unskilled labour.

(b) Income sources

The primary source of income for the households in the project area is farming. In the neighbouring communities the primary source of income is farming followed by trading and salaried employees.

Table 3-18: Primary income sources

Area	Distribution	Farming	Trading	Salaried	Artisan	Other sources
Project Area (Menengai Geothermal Field)	Count	4	0	0	0	0
	% within Area	100	0	0	0	0
Neighboring communities	Count	656	219	202	102	102
	% within Area	51	17	16	8	8

(c) Income profiles

The monthly income of sampled households in the study area is shown in the Table 3-21 shows that more than three-quarter of the respondents (81.3%), earn less than Kes 20,000 per month. Some 8.2% of the surveyed population earn between Kes 20,000 and Kes 29,999. However, only 10.2% admitted that they earn between Kes 30,000 and Kes 99,999 monthly. Finally, 0.5%, which is a small proportion of the respondents, earn above Kes 100,000 monthly.

The income profile is not surprising because perhaps majority of those interviewed are subsistent farmers, casual labourers and small-scale traders who earn a lower income and encompass the largest proportion of the population.

Table 3-19: Estimated Monthly income of the respondents in the Study Area

Income Distribution per month in KES	Count	%
Below 20,000	1,106	81.3
20,000-29,999	111	8.2
30,000-39,999	72	5.3
40,000-49,999	31	2.3
50,000-59,999	13	1.0
60,000-69,999	13	1.0
70,000-79,999	6	0.4
80,000-89,999	2	0.1
90,000-99,999	1	0.1
100,000-109,999	1	0.1
120,000-129,999	1	0.1
150,000-159,999	2	0.1
200,000-209,999	1	0.1
290,000-300,000	1	0.1
Grand Total	**1,361**	**100**

3.3.9 Land tenure and ownership

The land tenure systems in Kenya are categorized as private, community and public land. The Menengai crater is public land under the management of KFS.

Land ownership in the communities neighboring the project area as presented by the respondents, is 86.2% privately owned, 12.8% public land and 1% communally owned.

(a) Land use potential and agricultural activities

Land in the project study area is used for agriculture, residential and commercial purposes. Within the primary impact zone, residential and agriculture are the main land uses. Land use in the project neighbouring areas is as shown in the Table 3-20 below.

Table 3-20: Land uses in the project neighbouring areas

Distribution	Land use in the project study area				
	Residential	Cash crop farming	Subsistence farming	Commercial	Grazing/Pasture/Fodder
Count	621	83	477	29	294
% within Area	41.3	5.5	31.7	1.9	19.5

3.3.10 Energy sources

The main source of energy for cooking is firewood (60.6%). This is followed by charcoal, which accounts for 32.8% as reflected in Table 3-21 below.

The main source of energy for lighting is kerosene (48.1%) that is used in kerosene lamps to light homes in both the primary and secondary impact zones of the project. 44.5% of the households sampled are connected to the national electricity grid and use electricity for lighting their homes. 0.1% of the respondents do not light their household whereas 2.1% and 2.4% use battery powered lamps and LPG lamps respectively.

Table 3-21: Energy sources for cooking and lighting

Sources of energy for cooking							
Area	**Distribution**	**Firewood**	**Charcoal**	**Kerosene**	**Electric cooker**	**LPG**	
Project Area	Count	4	0	0	0	0	
	% Within the Area	100	0	0	0	0	
Neighboring communities	Count	453	222	13	7	52	
	% Within the Area	60.6	29.7	1.7	0.9	7.0	
	Sources of energy for lighting						
Area	**Distribution**	**Battery lamp**	**Kerosene lamp**	**LPG Lamp**	**None**	**Electricity**	**Other**
Project Area	Count	0	4	0	0	0	0
	% within Area	0	100	0	0	0	0
Neighboring communities	Count	15	344	17	1	318	20
	% within Area	2.1	48.1	2.4	0.1	44.5	2.8

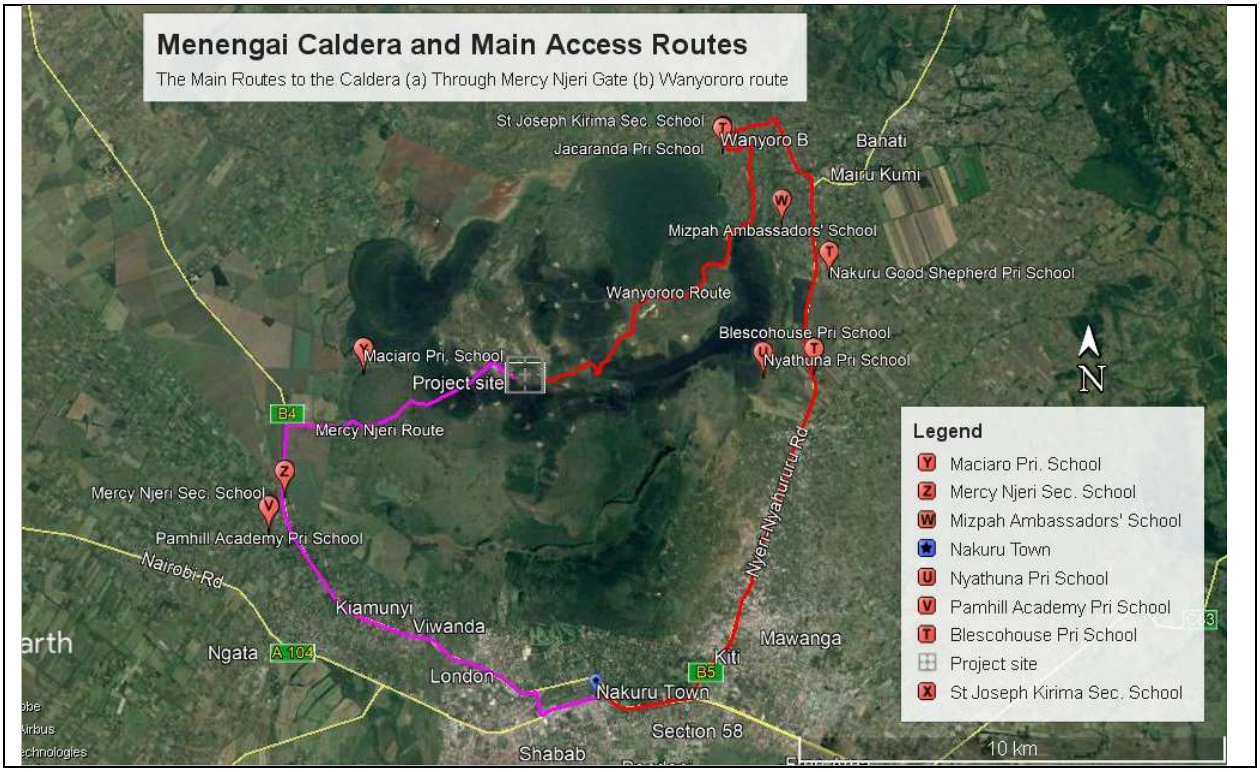
3.3.11 Access roads

The project area is in the suburbs of Nakuru town. As a result, it enjoys good road networks including ready connection to the Mombasa – Nairobi - Eldoret Malaba road, an international trunk road. The major roads off which the site can be accessed include the Nakuru – Bahati/Nyahururu road (bitumen surface) and Nakuru – Kabarak/Marigat (bitumen surface) road. Both of these roads are managed by the Kenya National Highways Authority (KeNHA) with exception of a short stretch of Maili Kumi - Solai section (off the Nakuru - Bahati) road which is under the Kenya Rural Roads Authority (KeRRA).

Within the study area, communities are connected to each other by earth roads, constructed and maintained by the local county government. Some of the settlements are linked by poor road network and thus may be inaccessible during the rainy seasons.

Off the existing public roads, access roads to the caldera and the internal roads within it are maintained by GDC and were in fairly good conditions at the time of site visit. Figure 3-17 below shows the major roads.

Figure 3-17: Map Showing the major road networks and access Routes to the Project Area



Source: Modified from Google Earth

3.3.12 Tourism and hotel accommodation in Nakuru

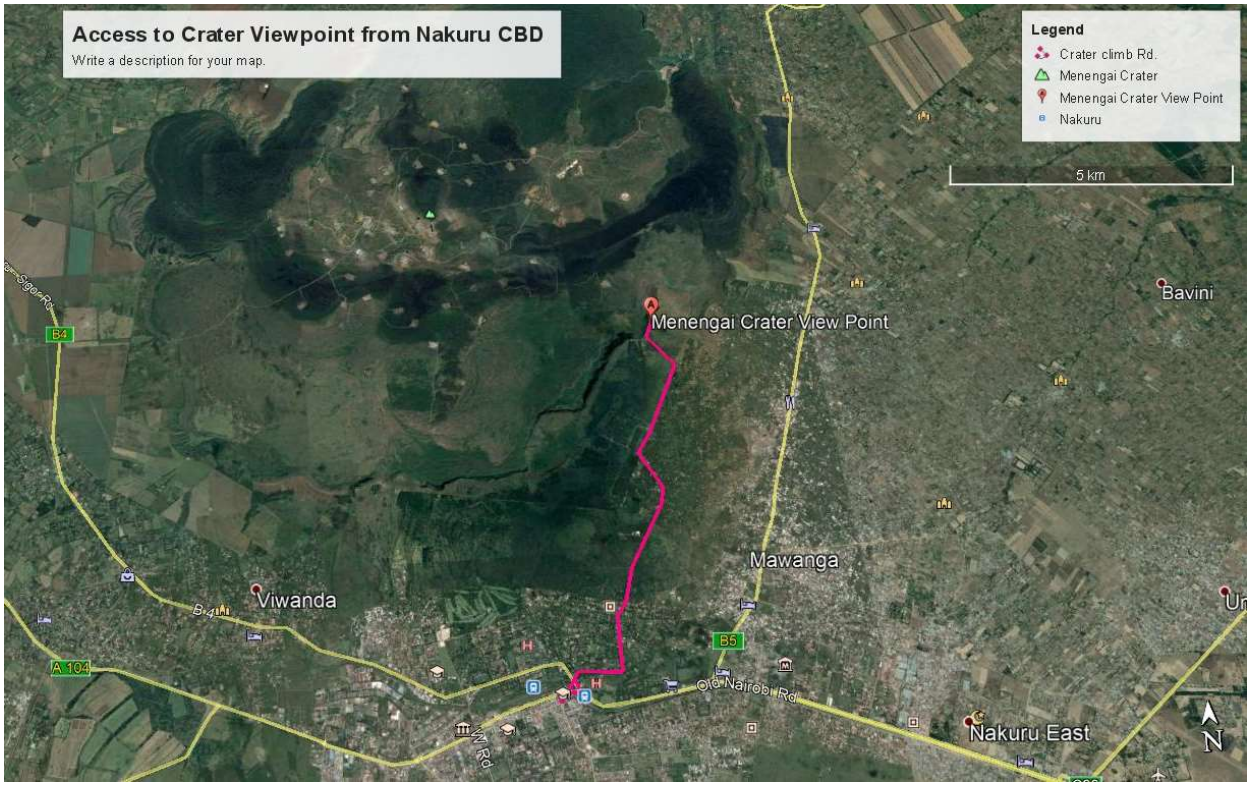
According to the Nakuru county integrated development plan (CIDP 2018-2022), Menengai crater (for picnics/nature trails and hiking) is among the tourist attractions in Nakuru County. National Parks in the County including Lake Nakuru National park, Hells Gate National Park and Mt. Longonot National Park are the major tourist attractions. Other tourist sites include; Menengai Crater, Subukia Shrine, Lord Egerton Castle, Lake Naivasha, Lake Elementaita, Hyrax hill prehistoric site, Ol-doinyo Eburru volcano and Mau forest. Private wildlife conservancies that attract tourists in the county include; Marura, Oserian and Kedong in Naivasha sub-County and Kigio and Soysambu in Gilgil sub-County. The main tourist activities include; bird watching, hiking, picnics, excursions and game drives. None of the above national parks and wildlife conservancies is in close proximity to the Menengai caldera.

Tourism Regulatory Authority (TRA) categorises hotel establishments into five categories namely; town hotels, lodges and tented camps, vacation hotels, villas cottages and apartments. According to the Nakuru CIDP 2018-2022, the following are available in Nakuru County; town hotels 40, lodges 10 and one tented camp. The total bed occupancy for the classified establishments is approximately 1300 beds. The County has two 2-star hotels, four 3-star hotels, three 4-star hotels and one 5-star hotel. Unclassified hotels are numerous.

Standard hotel accommodation or rental housing for non-local workers can possibly be available along the Nakuru – Kabarak/Marigat road or within Nakuru town.

Tourism activities in Menengai crater are concentrated around the crater viewpoint area. This is at the extreme east of the caldera and about 2km from the power plant site (Figure 3-18).

Figure 3-18: Menengai crater viewpoint and access route relative to project site



Source: Modified from Google Earth

The viewpoint has a different access route from those used to access the geothermal development areas hence no interaction between tourists and project construction activities are anticipated. From the existing number of classified town hotels in Nakuru (See Section 3.3.12), worker's accommodation is unlikely to affect tourist accommodation and associated business.

3.4 Existing infrastructure and activities

The project location is not pristine. Various types of infrastructure are already developed within the Menengai caldera through the preceding geothermal exploration, drilling of steam production wells and a number of activities related activities are still ongoing. These include:

- Access Roads: graded access roads to all established drilling pads' locations for all weather passage. These are currently used by various vehicular categories from light vans to heavy trucks. New one area also being opened up;
- Drilling pads and associated features required for the drilling rigs and facilities including:
  - Drilling rigs;
  - Storage areas (laydown areas) for drilling materials;
  - Parking for service vehicles;
  - Ponds or 'sumps' for settling of drilling fluids; and
  - Space for well testing equipment.
- Additional well pads under construction;
- Drilling camps (mainly for rig operating teams) with several containerised or portable cabin style buildings providing sleeping accommodation, kitchen and dining facilities, food and water storage, recreation room, showers, toilets and septic tanks to form a single accommodation unit;

- Satellite for communication, Power and water supplies: Existing camps and drilling pads are connected to grid power supplies and internal piped network of water lines, mainly running along the access roads. New connections were ongoing at the time of field visit.

Photo plates presenting some of the existing facilities and activities within the caldera are presented below.

<table>
<tr><td>
Section of newly done access road and well pads within the caldera as observed from the Menengai view point</td><td>
Section of an access road through Wanyororo area</td></tr>
<tr><td>
Green houses under preparation within the Menengai well 3 site</td><td>
A fenced Brine pond with lining</td></tr>
<tr><td>
Some of the GDC drilling rigs within the caldera as observed from the view point</td><td>
An existing discharge well at Menengai well 3 site. These are some of the activities contributing to the existing noise and H2S levels within the caldera</td></tr>
</table>

A telecommunication mast near the view point/Mlima Punda

Control room at the Menengai Sub-station

Pit latrine near the entrance through Mercy Njeri

A weather station at Mlima Punda

Water storage tanks viewed from Mlima Punda.

Non-functional discharge wells

GDC has 10 existing boreholes within Menengai field that produce an average total yield of 360m^3/hr. The boreholes have varying pumps depending on yield, depth and pump chamber level. The current abstraction levels are less than the aquifer discharge potential in the area. The boreholes have good recharge potential with abstraction depths range between 16.1-50 m bgl. Generally, the Borehole yields are generally high (GDC, 2103). Water for domestic use is sourced from NAWASCO. Summary details of existing water situation is presented in the tables below.

Table 3-22: Current Abstraction Capacity

Source	Unit	Average Yield	Qty	Total	Remarks
Groundwater	Borehole	30m^3/hr	10	300m^3/hr	
NAWASSCO	Line	90m^3/day	1	7.5m^3/hr	Contractual agreed amount-domestic
Stream/runoff/ temporary	Ponds	200m^3/hr	1	200m^3/hr	During rains
Brine	Ponds	100m^3/hr (MW-01 only)	1	100m^3/hr	Wells continuous discharge
TOTAL				607.5m^3/hr	

Source: GDC, 2013

Table 3-23: Current Lifting/Pumping and Storage Capacity

Pump 1- 10" Line	Pump 2-8" Line	Total	Remarks
240m3/hr	240m3/hr	480m3/hr	Continuous pumping
Storage Capacity		17,600m3/hr	This requires 40hrs (approximately 2days to fill)

3.4.1 Existing waste management within the Menengai geothermal area

From existing general GDC operations within the Caldera, waste generally emanates from rig operations, the drillers camp, central workshop and storage yards. It mainly consists of plastic containers, cartons, scrap metals, bentonite sacks, paper, waste oil and other food/domestic refuse. A waste inventory has been developed to keep track of the amount and types of wastes generated for mitigation measures. A compost pit was constructed to turn all organic (food) waste into manure which is then used at an existing tree nursery. This facility is yet to be operational (Mutia and Simboyi, 2015).

For the other wastes, a licensed waste handler is contracted to collect the waste on a regular/daily basis. Other wastes such as drill cuttings are contained in the lined waste water ponds. Liquid waste generated is mainly separated water (brine) during well-testing. This water is contained in lined (high density plastic) waste water ponds (the ponds are fenced with chain-link), mixed with potable water and re-used for drilling. Future plans entail reinjection of the water. The ponds will also eventually be covered upon successful well testing and area rehabilitation.

Disused oils/hydrocarbons are accumulated in designated site within the lay down area. The disused oils have commercial market and once quantities reach commercial levels, class for auctioning is done by the GDC disposal committee (chaired by the supply chain manager) and the winning bidders (licensed to handle/recycle used oil) collect the materials for subsequent reuse.

3.4.2 GDC afforestation program

GDC has an established tree nursery within the caldera for use in on site rehabilitation and social afforestation. Among its objectives, the GDC environment department is keen on restoration of the Menengai environs. The department sets an annual target of raising, planting and issuing 60,000 tree seedlings to farmers and institutions within the project area.

4 PROJECT DESCRIPTION

4.1 Introduction

The Project is to design, build, own and operate one of three 35MW geothermal powerplants on a site provided by GDC. GDC responsibilities, which are Associated Facilities for the Project and are provided according to the PISSA, include:

- Provision of the site, which is clearly marked measuring 140m by 180m and it is 50m far from QPEA's power plant.
- Construction and maintenance of site access roads;
- Supply of steam during Operation;
- Disposal of condensate during Operations;
- Supply of construction and service water;
- Supply water at the water supply interface at the plant boundary.

Additionally, evacuation of the generated electrical power will be carried out by KETRACO, who has already constructed the following Associated Facilities:

- 15km 132kV transmission line; and
- 132kV substation.

4.2 Project Design

Sosian Geothermal Power Plant Ltd shall supply the Power Plant and guarantee its performance, both based on functional specifications provided by GDC in the PISSA and KPLC in the PPA.

The design of the Plant is based on a single-flash steam cycle with a condensing turbine, a type of technology which is fully developed and well-proven in the geothermal power industry. Nominal gross capacity will be 37.7 MW and Guaranteed Net Plant Output 35 MW.

4.2.1 Project components

Below is a technical description of the major components of the Project

Table 4-1: Project components and descriptions

System	Description
General	• The power plant consists of a single production unit. • The power plant is primarily designed for base load operation. The plant is assumed to be started up and shut down only for the scheduled maintenance and an emergency case, which means the plant would be started up and shut down a few times per year • The power plant shall comply with the Kenyan Grid Code. • The initial start-up of equipment such as filling water, system warming, operating the vent/ drain/ isolation valves etc. require the manual operations by the multiple operators. Also, the roving operators shall execute the periodic surveillance, monitoring and local operation as required to assist the operator in the plant control room. • The power plant can be continuously operated from 40% to 110% of the rated gross output. At the overload condition (>100% load of the rated), the pressure increases accordingly (sliding pressure). The low load operation less than 40% load including the house operation, the operating hours shall be

System	Description
	less than one (1) hour per such operation. If the power grid system does not recover within one hour, the plant is to be shut down. • Rated power output of the turbine generator unit is 37.63 MW as measured at the generator terminal • Turbine is double flow, upward exhaust and double inlet. The continuous operation speed range is from -5% to +3% of the rated speed 3,000 rpm. • Rated conditions turbine inlet pressure is 5.77bara, as measured at turbine strainer inlet. • Operating range is 2.8 to 6.36 bara at turbine inlet between which the plant will be able to continuously operate between 40% and 110% of rated output. • Generator is totally-enclosed, water to air cooled, global VPI and brushless excitation. • Generator rating is made with 0.8 (lag) power factors. Generator size is 51.9MVA. • Generator voltage is11kV • Design ambient wet-bulb temperature for the cooling tower is18°C. • Steam that condenses in the condenser will mix with cooling water and act as make-up water for cooling tower. No other make-up water is estimated to be required during normal operation, only for initial filling and after maintenance stops.
Steam System	• High pressure steam piping is carbon steel with 3 mm corrosion allowance, ANSI150, rock wool insulated with aluminum cladding. The design pressure and temperature of main steam system is 11 barg and 190°C. • Main steam venting will be through pressure regulation in GDC steam supply system. • Emergency steam vent station will be fitted upstream of the droplet separator. The vent station will be of rock muffler type, consisting of emergency valves, with perforated outlet pipes under a rock filling in a concrete basin. • Turbine unit overpressure protection will be done via rupture disks located before the droplet separator. • Droplet separator is vertical, cylindrical and vane-element type. It is carbon steel with 3 mm corrosion allowance. It is designed to receive 2.0 wt% wet steam and leave it as 0.05 wt% wet steam. • The ejector motive steam piping is branched off from the main steam line. It is carbon steel with 3 mm corrosion allowance, ANSI 150, rock wool insulated with aluminum cladding. • The turbine gland seal steam supply piping is branched off at the downstream of the turbine steam strainer. It is carbon steel with 3 mm corrosion allowance, ANSI 150, rock wool insulated with aluminum cladding. • The turbine gland leakage steam piping is stainless steel 316L without corrosion allowance, ANSI 150. • Turbine wash pump piping is branched off from the hotwell pump discharge. The turbine washing pump suction piping is stainless steel 316L without corrosion allowance, ANSI 150 and turbine washing pump discharge piping is stainless steel 316L without corrosion allowance, ANSI 300.
Steam metering and purity monitoring system	• Steam flow rate at the boundary will be measured by the venturi flow meter consisting of single tube and double metering/differential pressure transmitter. • Steam flow rate at the downstream of droplet separator will be measured by vortex flow meter for reference. • Steam purity (SiO concentration, Cl- concentration, pH, and NCG weight percent in steam) at the downstream of droplet will be monitored by the steam purity monitor.

System	Description
Condenser and turbine drain system	• Condenser is direct contact, spray type. Shell is clad of stainless steel 316L and carbon steel. Internal pipes, nozzles, internal ribs are stainless steel 316L. Exhaust duct and external ribs are carbon steel. • Steam pipe drain system piping and atmospheric flash vessel is stainless steel 316L without corrosion allowance, ANSI150
Gas extraction system	• NCG venting will be through a 30m high steel stack. • Flashing of overpressure fluid from drains (atmospheric flashing) shall be done in the same stack to provide higher buoyancy in the stack to aid with NCG dispersion. • Gas extraction system configuration is 50%x2sets Ejector, 25%x1set Ejector, 125% inter condenser and 50%x2 sets Vacuum pump and 25% x1set Vacuum pump. • First stage steam jet ejector and Inter Condenser are stainless steel 316L. • Vacuum pump type is liquid ring.
Main and Auxiliary cooling water circuit	• Cooling tower is fibreglass, counter flow; mechanical draft and low-clog film fill type. • Main cooling water piping is stainless steel 316L or FRP without corrosion allowance, ANSI150. • Auxiliary cooling water piping is stainless steel 316L or FRP without corrosion allowance, ANSI150 • Condensate reinjection piping is FRP without corrosion allowance, ANSI150 • Condensate reinjection pump required head is designed as 3.0 m (1.4barg at pump discharge, if condensate reinjection pump is required, gravitational flow to be determined). • Hot well pump is vertical centrifugal type, 100% x 1set. • Auxiliary cooling water pump is horizontal centrifugal type, 100% x2ses
Compressed air system	• Compressed air system supplies air to pneumatic operated valves. • Air compressor is screw compressor, oil lubricated, and built-in water separator, air-cooled. • Backup compressor will also be supplied and installed into system. • Air tank is cylindrical vessel, freestanding. • Compressed system will have air filters for, general-purpose, dust protection and for high efficiency. • Compressed air system will have heatless freestanding hairdryers. • System is design for PN10. • Material is Stainless steel 316. • A general service air compressor will also provide for maintenance purposes.
Electrical system	• The voltage levels in the system are 415V,690V,11kVand132kV,50Hz • Connected power is dimensioned to 50MVA at the main transformer with11kV at the MV side and 132kV at the HV side. • The Generator power output is 37.63MW electrical power. • Distribution voltage and generator voltage is 11kV and all connected loads are specified for 415/240V including motors <3 kW or 690V for all motors, 3 kW or bigger. • In general, the load factor/power factor of generator is assumed to be quoted at between 0.8 lagging and 0.9 leading. • The electrical system has built-in protection and connection to the DCS supervision including communication and HMI presentation • Prioritized loads are supplied via UPS systems • The DCS system shall be capable of storing at least 12 months historical data
Earthing and Lightning protection	• The plant will be protected via an earth system that is dimensioned to handle protective earth (PE), potential equalization within the power plant and lightning or the power plant and includes connection to the transmission grid system.

System	Description
Lighting	• Indoor lighting, including emergency lighting, shall follow normal standard of lux, as specified. All areas in the building will have to be classified according to the type of room and usage of it. Based upon this classification the lighting will be dimensioned and specified. • Outdoor lighting will be arranged via pole lights for roads and walking areas, facade lights and entrance lights to light up the power plant for different purposes.
Transformers	• Transformers will be located outdoors. The HV/MV transformers to be oil cooled. ONAN natural cooling will be provided. • The LV transformer to be of dry type • All connection will be open (oil to air bushings) • Preliminary power requirements as stated in this document, will be confirmed when all loads and requirements are finalized and provided by actual Vendors: o Step Up transformer: 11/132 kV, 50 MVA o Station Service transformer: 11/0,69 kV, 4 MVA o Auxiliary transformer: 690/415 V, 315 kVA
Instrument and control system	• Distributed Control System (DCS); • Interface via fibre cable to the GDC steam control system and the KPLC transmission system; • Redundant I/O servers; • One engineering workstation and two operator workstations; • A redundant fiber ring connection between data collection and operator interface and between data collection and process control; and • Redundant control net connection between CPUs and I/O.
Process Control System	• Control system for the total power plant will be based upon Distributed Control System (DCS), including the SCADA functionality with I/O, internal and external communication. • The control system shall have backup redundancy, except for the I/O´s. • All DCS equipment shall be power supplied by batteries (UPS). • All control equipment will be located in clean rooms, sensors, transmitters and other control equipment not located inside a clean room shall be protected separately from H_2S.
Standby power system	• Prioritized subsystems, objects and parts in the power plant is supplied via UPS for all critical loads in order to not lose control in case of a power shutdown situation appears in the transmission line. Critical loads and emergency conditions to be defined. • The UPS systems are designed in combination with a Standby Diesel Generator in order to optimize the efficiency and total cost of the system. o The UPS 220 VAC is sized to power DCS system, plant control & operation, prioritized servers, communication, security and emergency systems for at least 1 hour o TheUPS110VDCissizedtopowerelectricalcircuitprotection, communication, security and emergency systems for at least 1 hour.
Stand by Diesel Generator	• The Stand by Diesel Generator shall be sized to power the UPS220VAC and UPS110VDC systems. • Start-up time is limited to max 1minute with the auto-start feature. • The storage tank system shall contain fuel for 24hours of operation. Refilling of the storage tank has to be organized.
Ducting	• The layout of the powerhouse includes ducting for all cables: MV, LV, control, indications, and lighting and communication. The ducting consists of ladders and conduits from the electrical rooms to all the objects in the power plant. • The layout of the power plant includes space for cable trays, ducting and conduits between buildings and all parts that are to be connected. (Lighting,

System	Description
	entrances etc.) Outdoor located cable trays and ladders shall be protected by covered metal frames. • Connection to/from the 50MVA transformer to the HV yard goes via an underground cable and is terminated to the first advised connection point according to the specification from the HV yard owner (KETRACO).
Motors	• Smaller motors (<3 kW) will be supplied with 415V and bigger motor sizes supplied with 690V. • All motors are supplied via direct on-line start.
Fire, Security and Detection System	• Fire protection and alarm systems shall be installed in addition to portable and service water systems. • The fire water tank to be installed shall be designed to also serve the service water system • Project area to be secured, fenced and suitably lit. • H_2S detection systems at points to be identified during design. • Mobile H2S detection monitors for operations personnel during operation.
Water supply (Potable-, Fire- and Service- water)	• Water will be supplied to raw water storage tank which shall receive water from GDC water supply tanks. This tank, which is a panelled prefabricated steel tank, will also be used as a fire water tank. • The water storage tank on site will also contain the potable water required for normal plant use as well as the fire water storage capacity required under the NFPA. The tapping point for the potable water, which shall be pumped to the treatment plant, will be at such a high elevation so that it is not possible to draw from the fire water reserve. • Delivery water will also be capable of being delivered by bowser truck via a connection and lift pump. • Water for domestic use (potable water in the toilet and kitchen) will be drawn from the raw water storage tank and treated in a containerized treatment plant and get stored in a 2000 lit plastic water tank. • Main fire pump will supply 30l/s with 30m to outdoor Fire hydrant system as well as indoor sprinklers, firehoses. • A jockey pump will supply the fire water system with 0,6l/sat30m head. • Potable water system will supply water to building via a 2x3l/s30m head pumps. • Potable water pumps are located in the pumping station open shade.
Waste water system	Two options will be considered during execution of the project: *Option-1*: The sewer and grey water from toilet and kitchen in the control room will be collected in to water tight septic tanks. This domestic sewer will be emptied from the septic tank periodically by a honey sucker and disposed a waste water treatment plant/ disposing area allocated by the local municipality (Nakuru water and Sewerage company). *Option 2:* The sewer and grey water will be drained into a bio digester type septic tank, which will have two compartments. While keeping the sludge behind the digested liquid will be drained into a French drain to soak in to the ground. This will avoid the need for a frequent emptying of the septic. We would rather de-sludge in a longer duration.
Storm water drainage	The project drainage system shall be designed for the following: • Since the surrounding area is an open veld, storm water will be allowed to flow on the ground as a sheet flow. • Where it crosses roads, a possibility of low water drift or buried pipe culvert could be used. • Storm water drainage design will be based on 20-year return period of flood.

System	Description
	Any spillage of oil in the floors of the turbine hall will be washed and drained to the oil separator manhole, located just outside the turbine hall, where by the drainage after the oil is removed from it, will be released to the storm water drainage. The oil that is captured in the oil separator can be extracted by a recycler, should there be anyone locally. Should there be spillage in the lube oil pump and vessel holding pit next to the turbine, it needs to be pumped and stored in the oil storage sump outside the turbine hall, to be emptied by a honey sucker and transported in to a disposing site.
Heating, ventilation and Air Conditioning (HVAC) system	• Turbine hall will be supplied with fresh air through louvered windows. H2S cleaning is not required here • Air handling in clean rooms (control annex) will be supplied by four air handling unit, one for pre-cleaning and another for specific room air supply • H_2S air filtering will be done with Purafil cleaning mechanism or similar • Air in clean rooms is circulated and partly re-cleaned to maintain H_2S level at minimum for electrical equipment protection
Principle for fire protection system	• The fire prevention and protection are in accordance with recommendations from NFPA 850: Recommended practice for fire protection for electrical generating plants and high voltage direct converter stations, as well as from other NFPA and European standards.
H_2S safety system	• Two separate H_2S safety systems will be supplied, the human hazard detection system. • The human hazard detection system is designed for 1 ppm. The human hazard detection system will contain one central unit with 4 ports and 4 fixed detectors for 1-500 ppm H_2S level. Fixed sensors will be located in potential H_2S hazard zones, such as low point, pit and near NCG extract systems and exhausts • The human hazard detection system includes 10 hand held sensor for personnel • The equipment protection system will be located in the electrical and control rooms (clean rooms). The equipment protection system is design for 1-1000 ppb H_2S detection.
Buildings and Structures	• Power House with Plant equipment mounted on appropriate reinforced concrete foundation blocks separate from the foundations of other structures and buildings. • Workshop and storage for safe storage and controlled issue of equipment, materials and chemicals, serving as offices for engineering and maintenance personnel. • Administration building for Plant personnel and management. • Transformer yard/station with restricted access containing a GSU, auxiliary and service transformers mounted on reinforced concrete base slabs. • Air-tight control and electrical rooms, air conditioned to protect equipment and instruments from hydrogen sulphide (H_2S). • The buildings will be made of structural steel and cladded with galvanized (zinc coated) IBR steel sheets 0.58mm thick; and • The buildings which require walling will have brick walls.
Structures (trench) for underground cable to Switch yard	This will be a cut and cover trench. The trench will have sand bedding and a sand blanket cover, which will be overlain by the back fill of the excavated material. This trench will commence from the step-up transformer and crosses the plant boundary fence and runs up to the tie in point of the KPLC switch yard. The length of this cable trench will be approximately 200m.

System	Description
Structures for transformers	Both main step up and auxiliary transformers will be placed on a concrete bunded enclosure. It will be a slab with 500mm high bund wall sitting on the ground. The bunded enclosure will be filled with crushed stones. It will also have a 3m high wall fencing made of steel mesh on square hollow section posts.
Control annex structure (clean rooms)	The control annex structure will be a lean-to structure to the turbine hall. It is made of a steel structure framing with brick wall in fill between the members. It will have galvanized IBR sheet roofing 0.58mm thick. The PLC room and electrical rooms will be clean rooms with air pressurization of 100Pa. This building consists of the LV room (5x13.5m), MV room (5x13.5m), Control room (8x13.5m), workshop and tools room (6x13.5m), other service rooms (6x13.5m).
Structures for water supply (tank and pumping station)	The raw water storage tank will be made of paneled modular steel, to be procured from prefabricated modular ranks supplier. It will be placed on the ground with dwarf wall foundation. The pumping station will be an open shade with structural steel frames, with galvanized IBR sheet roofing.
Support structures for steam and NCG systems	The non-condensable gas system support structure will be of structural steel, with platforms made of non-slip grating supplied by Mentis or equivalent. It will also have access stairs with steps, also made of non-slip grating supplied by Mentis or equivalent. The steam pipes will be supported on concrete plinths, which will have a structural steel support to variable heights depending on the head room requirement of the particular area.
Turbine generator foundation structure	The turbine generator foundation will be a large reinforced concrete block laid out as per suppliers/Fuji's drawing. It will have 30 to 50mm grouting between the base plate and the concrete block.
Structures for cold end systems (Condenser/Hotwell pit, underground piping finish and cooling tower basin and sump structure)	The condenser/ hotwel pit will be a reinforced concrete slab base and wall, all situated below natural ground level. The cooling tower containment basin is also made of reinforced concrete base slab and wall, to be coated with epoxy based water proofing internally to prevent exposure to the hydrogen sulphide present in the cooling water.
Turbine hall building	This will be a made of structural framing with reinforced concrete foundations. It will be cladded with galvanized IBR roof sheeting both the roof and the side cladding. It will be fitted with a 30ton overhead crane. The turbine hall has a size of 18x30m.
Service building (Workshop)	This building is incorporated in to the control (annex building).
Road, walkways, fencing and site finish	All the roads will be gravel roads, to be made of selected excavated material layer works, to be finished with imported granular fill material. There will not be any walk ways except the 1m apron around the buildings, to be made of concrete. The construction of roads will be limited to only inside of the power plant site.
Noise allowance	The noise that will be emitted from the turbine generators will be 90 to 95dB (according to Fuji/supplier), the machines will not have noise attenuation facility, thus hearing protection will have to be worn at all times when in the turbine hall, as the noise levels are a health hazard. The control room noise level will be limited to a maximum of 65 to 70dB, while the electrical and other rooms will be limited to a maximum of 85dB.

System	Description
Fencing and gate	The plant site is 140x180m in size and it will be fenced with galvanized steel mesh type fence, which has a maximum height of 2.5m above NGL. It will only have one access gate. A guard house will also be situated next to the gate. The size of the guard house will be 3.5x6.5m

The project site layout is presented in Figure 4-1.

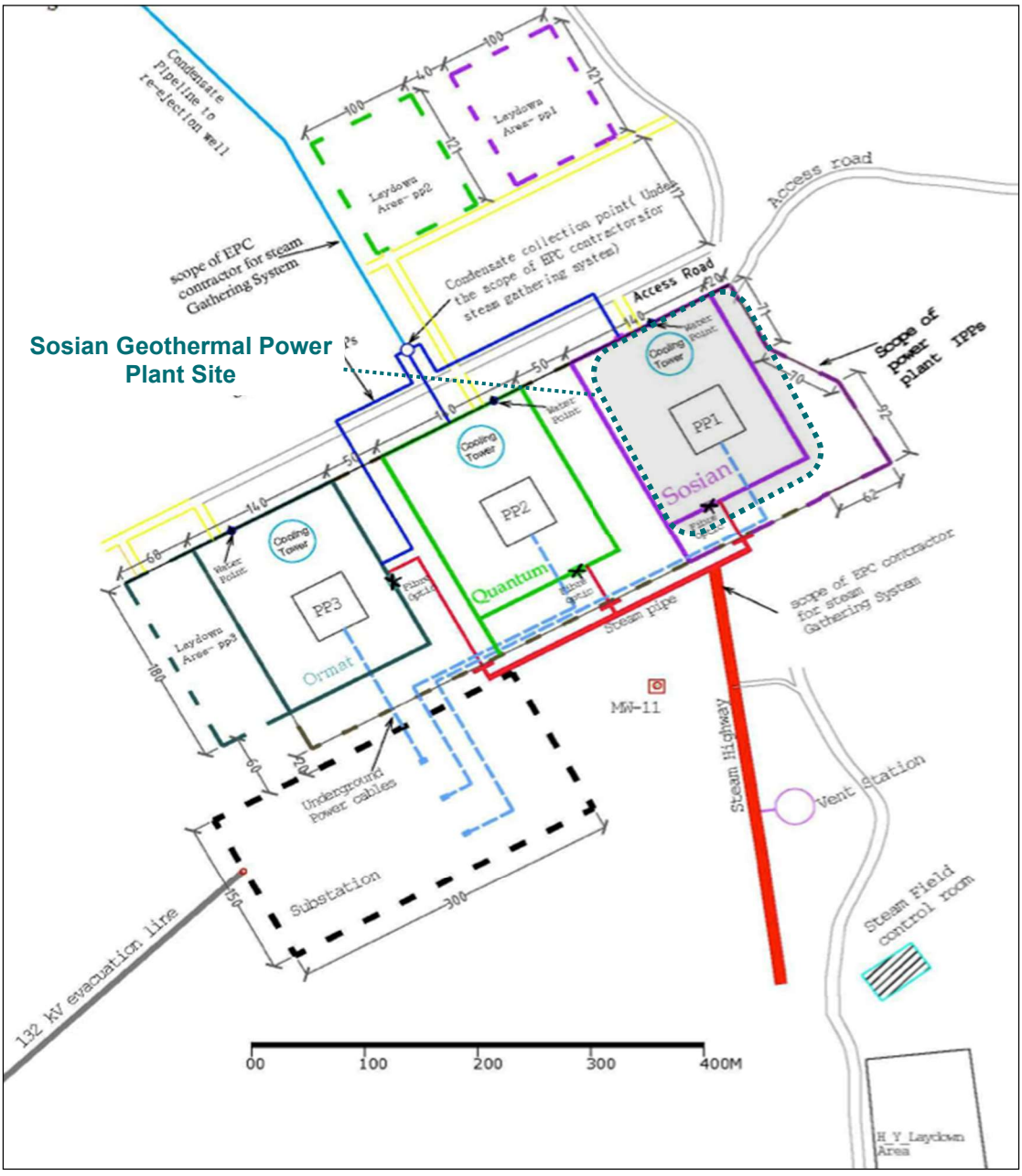


Figure 4-1: Project Site Layout

4.2.2 Steam supply

GDC will supply/deliver steam to the plant based on parameters in the PISSA. Currently a number of wells have been drilled, tested and a feasibility report provided in respect of the geothermal resource at the Menengai Geothermal project area. GDC will develop the Steam

gathering facilities and condensate re-injection systems before the testing and commissioning of the plant.

4.2.3 Process description

GDC will deliver 98% dry saturated geothermal steam at 6 bars (absolute) through their steam gathering system to a steam turbine through a droplet separator, steam purity meter, main and backup meter, strainer, main stop valves, and control valves.
The saturated steam is expanded in the turbine, where some of the steam energy is transformed into mechanical energy in a shaft coupled with the electrical generator to produce 37 MW of gross electricity. 2 MW of the electrical output from the generator will be used within the Plant (parasitic/captive) and the balance of 35MW will be evacuated by KETRACO.

Steam exhaust from the turbine through its exhaust duct is cooled without mixing using cold water from the cooling tower basin in a direct contact main condenser. The goal is to condense this steam by extracting energy because it requires less work to pump an incompressible liquid than compressible gas or steam. An expansion joint and rapture discs will be installed between the turbine and the condenser to accommodate erection allowance and thermal expansion. The heat exchange is determined by the temperature difference usually at least 5°C; therefore, the maximum temperature of the cooling water must not exceed the condensation temperature in the condenser.

The Geothermal steam includes non-condensable gases (NCG) all the time. Based on the steam analysis supplied by GDC, the composition of the non-condensable gases is 3.3-4% of steam. Carbon dioxide is typically about 98% of the gas content and will be released to the atmosphere. Non condensable gases cause a problem in the condenser; while the steam is condensed and pumped out, the gases are kept on in gaseous form producing an increase in the pressure in the condenser. The solution to this problem is to compress the gases and suck them out of the condenser.

NCGs are cooled down in the main condenser to reduce the accompanying steam and are extracted by the gas removal system by the cooling tower fan stacks, exhaust stack and seal water discharge separator for dispersion into the atmosphere. The gas removal system consists of a 1st Stage steam ejectors (50%/50%/25%), an inter condenser (125%), a 2nd stage Liquid Ring Vacuum Pumps (LRVPs) (50%/50%/25%), and a Seal water discharge separator. After first stage compression, an inter condenser is installed to condense motive steam. The separator will be installed after the liquid ring vacuum pump to separate NCGs from the LRVP seal/working fluid. The motive steam for the ejectors is drawn from the main steam line. Drainage from the inter condenser and the LRVP separator is led into the main condenser. Some NCGs are then released to the atmosphere through the Seal water discharge separator.

In the extraction process, some amount of steam will always be included since the steam is mixed with other gases inside. Hence, the gas mixture is then assumed to be saturated with steam when it is sucked out from the condenser. In this case, air cooling in a forced flow/draught cooling tower is used to accommodate the heat load from the condensing steam.

A cooling tower is an evaporative heat transfer device in which atmospheric air cools warm water with direct contact between the water and the air, by evaporating part of the water. The mixture of cold water and condensate is sent to the top of the cooling tower and the GDC re-injection line by a circulating hot well water pump. In the cooling tower, the mixture is cooled down and sent back to the condenser by gravity and condenser vacuum from LRVPs.

Cold water from the cooling tower basin is used not only for the condenser cooler but also for the turbine oil cooler, generator air cooler, air compressor cooler, the inter condenser and the seal water discharge separator. The cooling tower is of the multi cell mechanically induced-draft wet, Fibreglass counter-flow type.

4.2.4 Power Evacuation

Currently the Project area is within 15 km from an existing 132kV double circuit Tororo – Lessos – Juja line and about 30km to the Lanet 132kV substation. A 33KV line has also been extended into the Project area.

KETRACO has already constructed and commissioned a 15km 132kV double circuit transmission line from Menengai to an existing Soilo sub station (which has been expanded) and a 132kV substation next to the project site. KETRACO conducted ESIA and ARAP studies for the new transmission line. The ESIA for the transmission line and the accompanying sub-station was approved by NEMA through Licence No. NEMA/EIA/PSL/526 issued on 5 September 2014 and the ARAP implemented prior to the line's construction. The transmission line was aligned to minimize impacts on settlements and mainly passes through government land.

Menengai sub-station within the geothermal field next to the proposed power plant site

Soilo sub-station that will provide connection to the national grid

Transmission line approaching the Soilo sub-station from the Menengai sub-station.

4.3 Project Inputs

4.3.1 Geothermal steam

Geothermal steam is the sole primary raw material in the project. This shall be supplied to the Power Plant from the production wells in the GDC Steam Gathering System for power generation and the resultant condensate will be pumped back into the reinjection wells.

Sosian, Quantum and OTTL steam interphase point with the GDC installed steam gathering system

About 8,000 kg of steam will be consumed to generate one (1) megawatt (MW) of electricity per hour. The measured composition by volume of the main steam flowing through each of the existing turbines is:

- Steam – 96.7%; and
- Non-Condensable Gases (NCGs) Contents – 3.3%.

The composition of NCGs is provided in Table 4-2 below.

Table 4-2: Composition of non-condensable Gases (% by Volume) in Menengai Wells

NCG Contents (3.3% normal,4% max)	**% of NCG**
Carbon dioxide (CO2)	96.2%
Hydrogen Sulphide (H_2S)	3.0%
Hydrogen (H_2)	0.4%
Methane (CH4)	0.1%
Oxygen (O2)	0.3%
Total NCG flow	**100.00%**

4.3.2 Chemical dosing

Chemical dosing system shall be installed in the Power Plant for the cooling water circuit to prevent pH levels getting too low as well as prevent algae growth in cooling tower. These chemicals are biocides, dispersants, anti-sealants and pH control dosing chemicals. The chemical dosing system shall include its waste management system.

4.3.3 Water

Raw water supply is required for construction, fire water, and potable water for drinking and domestic and for plant maintenance.

Water will be supplied to the Project from GDC water supply tanks within the Menengai Geothermal project area into a water storage tank on site for potable water required for normal plant use as well as the fire water storage capacity required under the NFPA. Water will also be capable of being delivered by bowser truck in case water is not available from GDC.

GDC shall provide water to Sosian at the water supply interface point at the plant boundary in the quantities presented in Table 4-3.

Table 4-3: Estimated construction and operation water requirements

Use item	Quantity (m^3/d)
Construction phase	
Domestic consumption (sanitation) during construction	10
Concrete mixing	60
Dust suppression in high traffic areas	60
Operation phase	
Testing and commissioning	10
Operation and maintenance (sanitation)	10

It is estimated that 230 cubic metres of water will be required for firefighting and an average of 30 litres per second as potable water for the operation phase.

Water provided by GDC does not guarantee the water quality and availability and therefore Sosian shall make its own contingency measures for the provision of water for operation/construction in the event that GDC is unable to provide the water. GDC shall be responsible for financing, supply, installation, testing and commissioning of the water supply system and meters up to the water supply interface point from the effective date. Sosian shall be responsible for the financing, supply, installation, testing and commissioning of the water supply system delivering water to the Lay Down Area and its water storage facility.

4.3.4 Oil

The turbine generator oil system is required to:

- Supply lubrication oil for the bearings and mechanical seals of turbines and/or the generator;
- Supply the control and governor system with hydraulic oil.

Each turbine/generator island features necessary oil pumps, filters, coolers, tanks, control valve, relief valves and instrumentation. In the event of electrical supply cut out, emergency systems pump the oil round the system.

4.4 Project Schedule and Phasing

The Project is to be commissioned within 17 months from the effective date of the PISSA as shown below.

Table 4-4: Project schedule

Milestones	Time (months)
PISSA Signature Date	S
Target Effective Date	S + 6
Actual Effective Date	E
Plant ready for commissioning	E + 13
Required Grid Available (T-Line and substation commissioned)	E + 13
Required Steam Available (GDC works commissioned)	E + 13
Full Commercial Operations date	E + 15
Exit and Site restoration	9 Months after Expiry of Steam Supply Period.

Where “S” is the Signature date and “E” is the Effective date between GDC/KPLC and the Sosian in the mutually agreed PISSA/PPA. The schedule is subject to updates as per the PISSA.

4.4.1 Construction Phase

The construction phase of the power plant by an EPC contractor is estimated to take approximately 13 - 15 months. Similar projects would engage several sub-contractors with specialised skills. The entire construction work force would be of varying size based on the various stages of the project and the tasks on hand with an estimated 100-200 persons with varying skills.

It is expected that the unskilled and semi-skilled workers will be recruited from the immediate local community and Nakuru town while the skilled workers will be a mix of locals and expatriates. It is expected that the recruitment of unskilled workers or semi-skilled workers from the local community will be coordinated with GDC and the stakeholders committee which will include some youth community leaders.

The proposed accommodation arrangement for non-local construction staff is yet to be defined. However, as a requirement by both KFS and GDC no teams of the IPPs will be housed on site (within the caldera) overnight during the construction phase apart from those providing security services. Therefore, the non-local construction workers would need to be housed in the suburbs of Nakuru town in an area closer to the site and or within the town, with provision for trucking to and from the site. The caldera is accessible via two routes: the Wanyororo route off the Nakuru – Nyahururu road and the Mercy Njeri route off the Nakuru – Mogotio/Eldama Ravine road. According the to the PISSA agreement, Sosian is supposed to use the Wanyororo access only for equipment transportation. Standard hotel accommodation or rental housing for non-local workers can possibly be available along the Nakuru – Kabarak/Eldama Ravine road (Kiamunyi and Mercy Njeri estates) or within Nakuru town. These range from approximately 15 to 25 km from the caldera.

Sosian intends to have regular engagement with other stakeholders to ensure coordination with other IPPs and GDC and provide a channel to monitor and manage any arising concerns.

The 33kv existing power line constructed by KPLC will provide the power required during the construction period.

Source of the necessary natural materials, such as sand, ballast, cement etc., as required is not yet defined. However, these can be obtained from existing GDC quarries within the caldera and nearby commercial sources.

4.4.2 Operations Phase

During the operations phase Sosian will operate the power plant on a 24hrs basis. The actual number of operation staff is not yet defined. However, similar plant would have a team of 20 – 30 staff and allow for contracted cleaning services and night and day cover of contracted security services. The first and second schedules of the PISSA describe the process-inbuilt safety controls.

From the foregoing project description, it is clear that the main responsibility of Sosian will be within the site area (140m by 180m) set aside for the power plant. However, the power plant associated facilities including the vital input in the power generation, geothermal steam as well as the power evacuation system with be the responsibility of other players as summarised in the Table 4-5.

Table 4-5: Project and key Associated Facilities' management responsibilities

Project feature	Responsibility for construction and maintenance
1. Menengai geothermal field	GDC (with head lease from KFS)
2. Production wells and steam gathering system up to the plant boundary	GDC
3. Brine collection and Steam re-injection system	GDC
4. Power Plant (1x35MW)	**Sosian (with sub lease from GDC)**
5. Access roads and internal roads within Menengai caldera up to the power plant area boundary	GDC
6. Water supply network up to the boundary of the plant area	GDC
7. Power evacuation line and substations	KETRACO (construction and KPLC (operation and maintenance)

4.4.3 Cumulative Activities

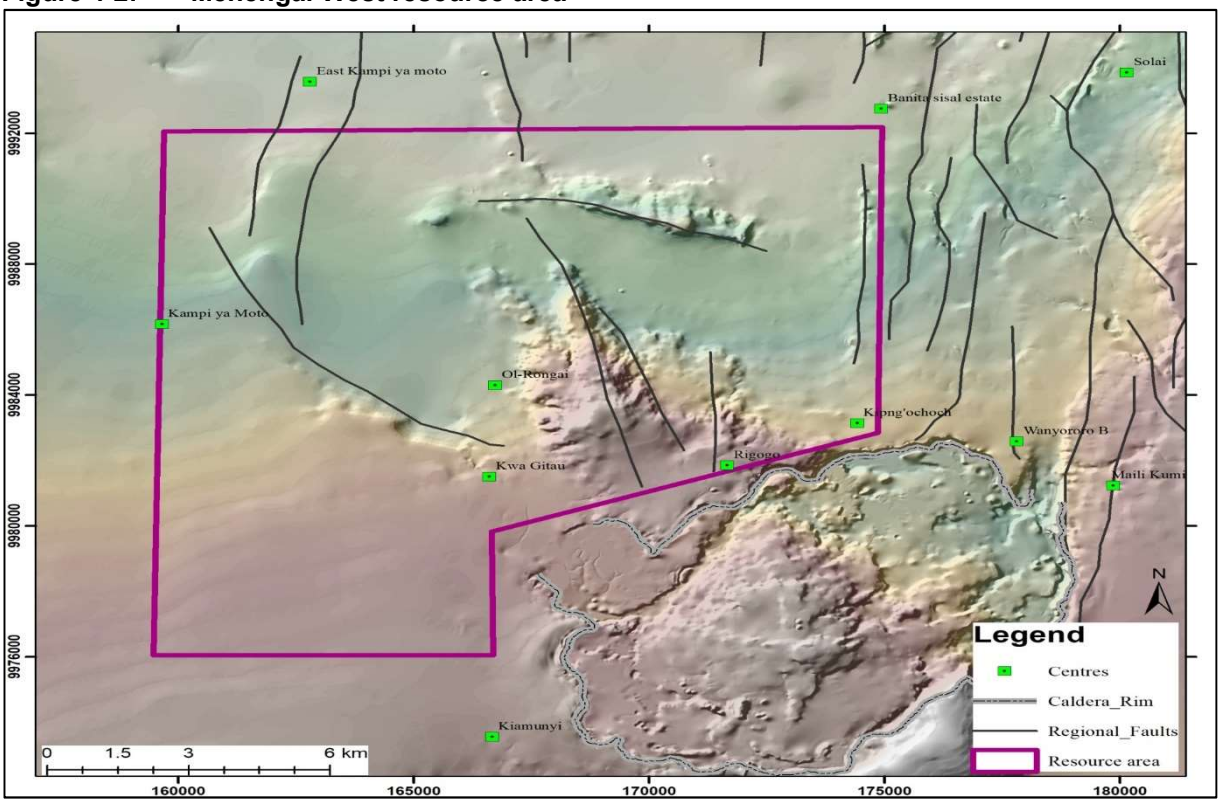
(a) Construction and operation of 2X35MW plants by two other IPPs

As indicated in the introduction, the Sosian power plant is one of the three plants to be developed side by side by three IPPs under Phase I of the Menengai geothermal field development with a total of 105MW power generation capacity. The other two power plants to be development by QPEA and Orpower are also in advanced planning stages. It is not certain whether construction of all the three power plants will be constructed concurrently. However, given their associated facilities are already in place, their operations will certainly occur concurrently for a significant portion of their operational life.

(b) Development of Menengai geothermal field Phases II and II

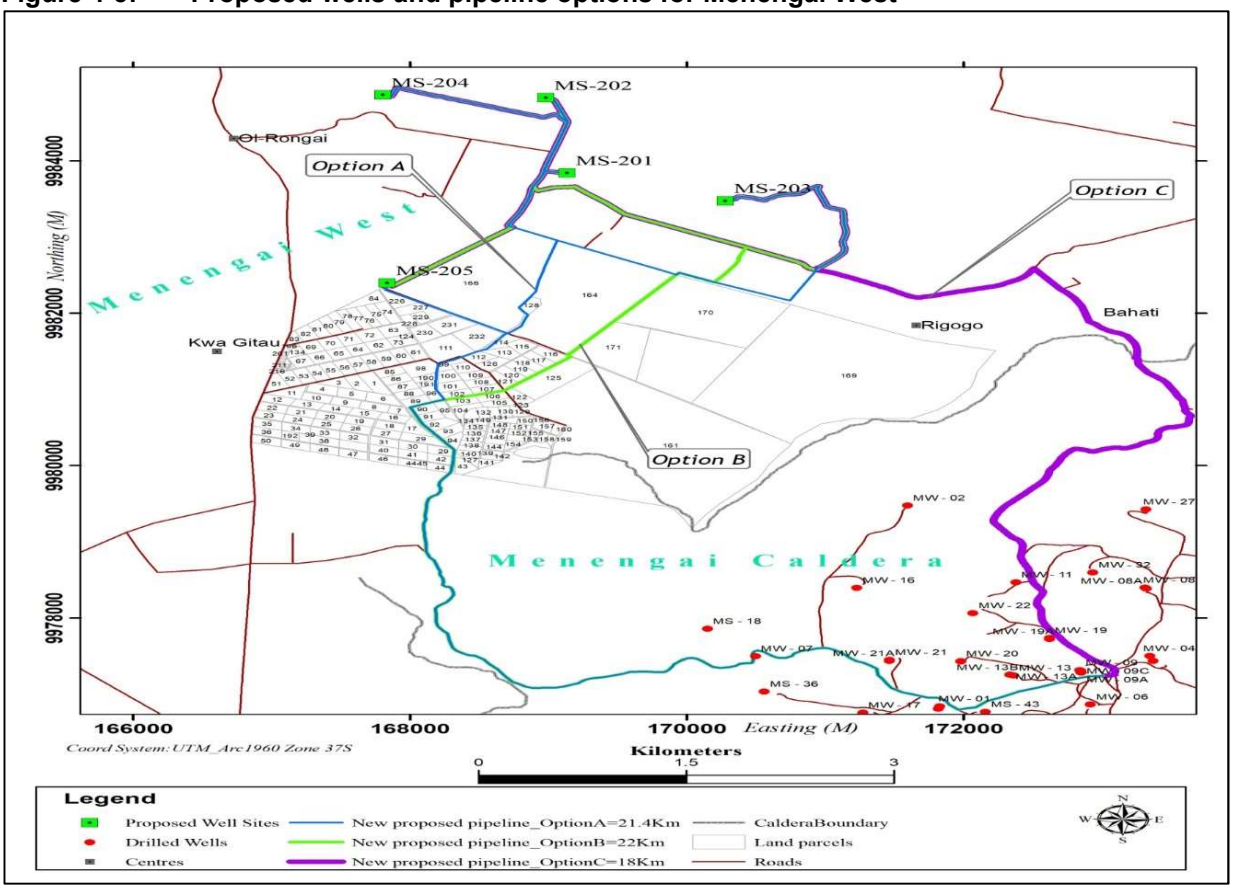
In addition to the development of the three power plants in Phase I, GDC has plans for Phases II and III of Menengai geothermal field development which is estimated to respectively have a capacity of 60MW and 300MW. Phase II will be done within the caldera and some of the production wells for Phase II development are already in place while additional ones will continue to be drilled. Similarly, the supporting steam gathering system and supporting infrastructure will be developed. The exact locations of the Phase II power plants were however unknown at the time of compiling this report. Phase III will be located in Menengai West, with the main resource area lying to west of the caldera. (See Figure 4-2 and Figure 4-3).

Figure 4-2: Menengai West resource area



Source: GDC, 2019

Figure 4-3: Proposed wells and pipeline options for Menengai West



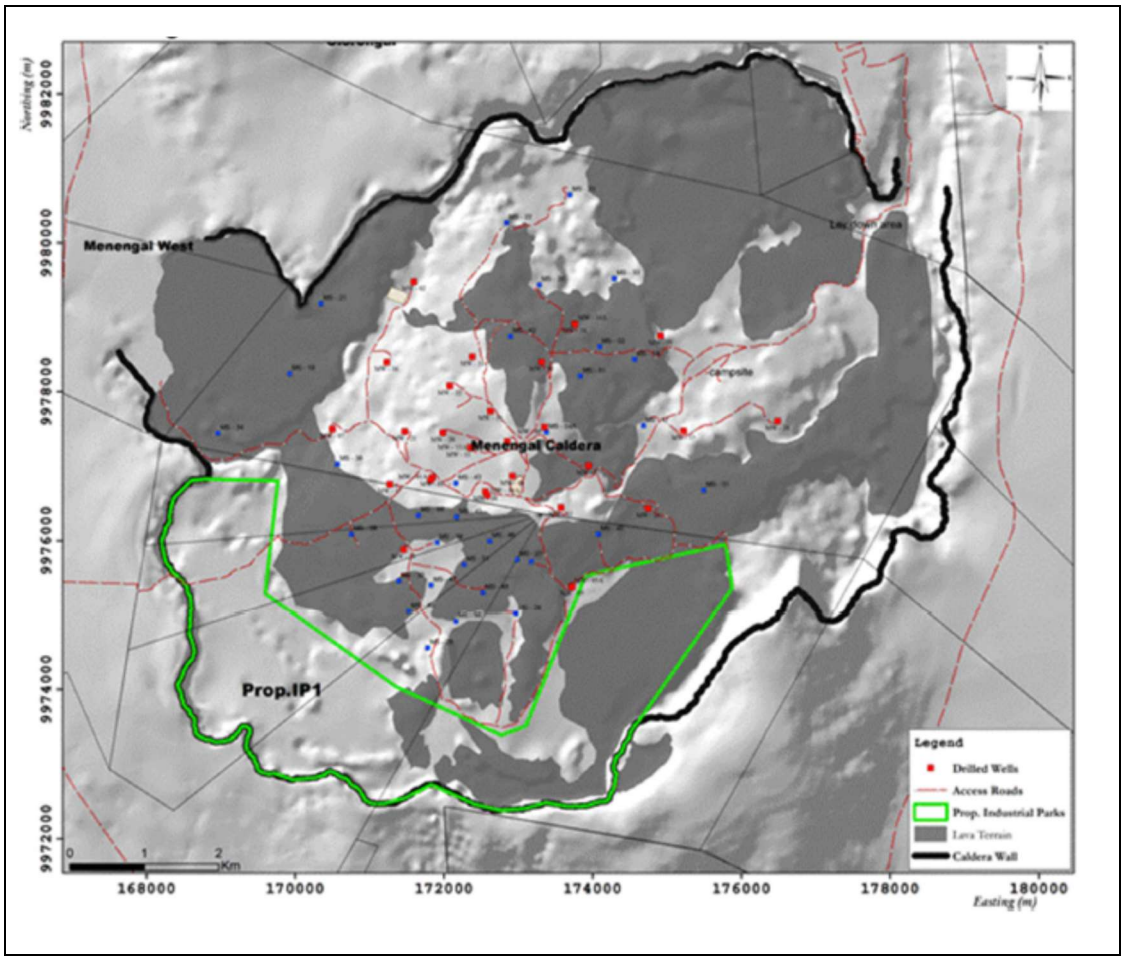
Source: GDC 2019

(c) Menengai Geothermal Industrial Park

As the drilling for geothermal energy continues in Menengai, more energy will become available for electricity generation. As a result, the production of separated geothermal brine, which is a by-product of geothermal electricity generation will also increase. The separated brine is normally reinjected back into the ground to replenish the geothermal reservoir. However, at the separation pressure of 7 bar absolute, the brine is at a temperature of around 165°C. The energy in the brine could be harnessed before reinjection. In addition, geothermal power generation produces other by-products such as no condensable gases and water; as well as dissolved substances, which can be extracted and turned into useful products.

The proposed geo-industrial park in Menengai is where the utilisation of these by-products of geothermal electricity generation or direct use of geothermal energy will take place. GDC has identified a potential location for the park on the south-western part of the Menengai geothermal field as shown in Figure 4-4.

Figure 4-4: Proposed Menengai geo-industrial park



Source: GDC 2016 as cited by United Nations University, 2017

On this land, the energy will be provided centrally for utilization by the industries. Besides energy supply, the industrial park will also be served with fresh water supply, access roads and telecommunication equipment. Proposed industrial activities to be supported in the industrial park include mainly horticulture, aquaculture, milk processing, crop drying among others. However, the detailed implementation arrangements are still unavailable. During site visit, a GDC demonstration green house was already in place within the caldera.

5 PROJECT ALTERNATIVES

5.1 Alternative Forms of Energy for development

The project proposes to use geothermal form of energy. Below is the comparison of the different forms of energy development available in Kenya and their suitability for the Menengai site.

Table 5-1 Form of Energy

No.	Form of Energy	Comparison
1	Geothermal	Ideal for Menengai as the resource is abundant
2	Hydro	It is affected by hydrology and not ideal for Menengai
3	Wind	Requires constant blowing of wind throughout the year. Not ideal for Menengai field.
4	Thermal	Uses fossil fuel and therefore not clean energy. Not ideal for the Menengai site

5.2 No Action Alternative

The no-action alternative is often defined by the baseline information and is crucial in the assessment of impact because other alternatives are weighed with reference to it. This alternative would mean that the project does not proceed.

According to the latest report posted by energy regulatory commission, the country's installed capacity of nominal and effective power generation is as presented in Table 5-2 below.

Table 5-2: Installed capacity of nominal and effective power generation in Kenya

Source (as June 2018)	Capacity (MW)	Capacity %
Hydro	705	30.0%
Fossil Fuels (incl. gas, diesel and emergency power)	306	13.0%
Geothermal	1,105	47.0%
Bagasse Cogeneration	42	1.8%
Wind	310.0	11.7%
Others	183.0	7.8%
Total	2,651	100.0%

Source; ERC annual report, 2018

Kenya has an installed capacity of 2.6 GW. Whilst about 30% is hydro power, about 47% is geothermal and emergency thermal power. Wind power play a minor role contributing less than 11.7%. 13% Fossil fuels. Bagasse Cogeneration 1.8%. and others such as solar 7.8%. Thermal energy sources have been used to make up for these shortfalls, geothermal sources contribute to the highest amount of electricity generated in the country.

However, Kenya Electricity Generating Company (KenGen), is responsible for generating approximately 90% of installed capacity. Independent Power Producers (IPPs) are responsible for about 10% of installed capacity. The following IPPs are active in Kenya:

(a) Westmont
(b) AEP Energy Africa (Iberafrica)

(c) OrPower Kenya Limited (a subsidiary of Ormat Technologies)
(d) Tsavo Power Company
(e) Aggreko
(f) Africa Geothermal International
(g) Quantum Power East Africa (QPEA)
(h) Sosian

Due to over reliance in the hydropower over the last ten years the country has paid a high price over heavy reliance on single source of power. In 1999 and in 2002, severe droughts nearly brought the Kenyan economy to a standstill after the hydropower dams dried out leaving power rationing in its wake. This experience has underscored the need to diversify the power sources in Kenya.

The “No Action Alternative” will therefore involve several losses both to the proponent, the community and the Country as a whole. GDC, a 100% Government of Kenya owned company, is tasked with accelerating development of geothermal resources to support development of at least 10,000 MW by 2030 in line with Vision 2030. To this end, GDC has invested a lot in research and steam exploration with the ones in Menengai now ripe for development with agreement already signed between GDC and the IPPs.

Without implementation of the project, the following shortcomings are expected:

- The government will be unable to timely develop the energy resources required to spur Vision 2030;
- Reduced business opportunities due to lack of infrastructure in the proposed project area;
- Reduced interaction both at local, national and international levels by the community, hence education and general awareness is a major loser;
- No employment opportunities will be created for the local community in project area and for Kenyans in general who would have worked in the proposed project area;
- Increased urban poverty and crime in Kenya.
- Discouragement for investors;
- Development of infrastructural facilities (roads, electrical etc.) associated with the project in its host areas will not be undertaken;
- Lack of development, research and innovation in the Country; and
- Loss of money by government because money has been spent on exploration and well drilling phases.

The ‘no action alternative’ is therefore not feasible development option for this project.

5.3 Alternative sources of electricity generations

The summary of the key issues with the Power generation options available in Kenya is given in Table 5-3 below.

Table 5-3 Summary of the Key Issues Associated with the Different Fuel Types in Kenya

Fuel Type	Location	Positive	Negative	Availability
Geothermal power	Rift Valley	Sustainable Non-polluting Little environnemental impact.	It can only be economically developed in selected areas with particular volcanic features	Medium to long term solution – Available
Hydropower	Tana River Catchments Western Kenya Small micro schemes	Compact; a large amount of electrical power can be produced by a moderately sized station Sustainable	The building of dams is usually environmentally destructive. River valleys are often fertile and densely populated resettlement. The water released from a hydro-power station often comes from the bottom of a dam. Water is often released from a hydro-power dam at times that depends on power consumption not ecological needs.	Medium to long term solution – Available
Solar Power	Throughout Kenya	Sustainable It is a well proven technology; Well suited to providing power in home or single building applications.	The manufacturing process requires large amounts of energy; Does not produce much power when the sun isn't shining, and negligible power at night. An alternative power supply is needed for these periods. Electricity generated by solar panels is quite expensive.	Short term but limited solution - Available
Wind Power	Limited application	Sustainable Non-polluting A well proven technology	Does not produce power when the wind isn't blowing, so a back-up electrical supply is also needed If batteries provide the backup, they have the disadvantage of being expensive and needing to be replaced every few years	Medium to long term solution
Liquid Fuel	Imported via Mombasa	Generators are very compact. Produces less CO2 than coal.	Not believed sustainable long term Produces carbon dioxide (CO2), The world's oil reserves are limited. Oil spills, cause severe pollution. Some oils contain high levels of sulphur.	Medium to long term solution
Coal	Prospects in Mombasa and Kitui	Relatively low cost compared to other fuel type options.	Not sustainable Produces more carbon dioxide (CO2) per Watt-hour of energy than any other generation method; Very large quantities of ash have to be disposed of some coal contains significant amounts of sulphur,	Long term solution

Fuel Type	Location	Positive	Negative	Availability
			one of the main causes of acid rain. Coal also contains small amounts of heavy metals.	
Gas	Tanzania	Relatively low cost fuel option when available generators are very compact Produces less CO2 than coal or oil Can be used in HFO plants with minor alterations.	Not available, needs to be imported from Tanzania need to build extensive pipeline not sustainable produces carbon dioxide. (CO2), natural gas reserves are limited.	Medium to long term solution
Electricity from Waste	Has to be near reliable sources of solid waste	Generate energy whilst reducing the volume of waste	Produces high levels of carbon dioxide and nitrogen dioxide Ash disposal and air pollution emissions Toxic materials include trace metals such as lead, cadmium and mercury, and trace organics, such as dioxins and furans.	Medium to long term solution
Conventional nuclear power	None	Compact a large amount of electrical power can be produced by a moderately sized station. Low fuel costs Small number of accidents; Normally does not produce any significant atmospheric Pollutants Quantity of waste produced is small	Expensive, especially in capital costs, maintenance costs, and due to the long lead time in planning and construction; There is a danger of radiation release. While there are few accidents the consequences of Some accidents may be catastrophic. Decommissioning a nuclear power station at the end of its useful life is very difficult and expensive. Safe long-term disposal of nuclear waste is difficult. The lead time in building a nuclear power station is around ten years A tempting target for terrorist attack.	Long term solution, 10year lead time.

5.4 Advantages and Environmental benefits of Geothermal Energy

5.4.1 Advantages of Geothermal Energy

Geothermal energy has the following advantages:

- Geothermal energy is generally considered environmentally friendly and does not cause significant amounts of pollution;
- Geothermal reservoirs are naturally replenished and therefore renewable;
- Harnessing geothermal energy does not involve any fuels, which means less cost fluctuations and stable electricity prices;
- Excellent for meeting the base load energy demand (as opposed to other renewable energy forms such as wind and solar);
- It makes small footprint on land;
- Recent technological advancements (e.g. enhanced geothermal systems) have made more resources exploitable and lowered costs of energy; and
- There is massive potential of geothermal resource making it the ideal form of energy.

5.4.2 Environmental benefits

The use of geothermal energy as a source of power generation has a number of environmental benefits.

The project will directly contribute to economic growth by alleviating the persistent electricity interruptions that affect the productivity of the industrial, commercial and agricultural sections of the Kenyan economy. It will mitigate the effects of power shortages that hinder economic development in the short and long term, by providing base load power supply which is consistent with the least cost expansion plan. Moreover, it will supply the much-needed back-up power for Kenya's hydroelectric dam system which is prone to water shortages and climatic uncertainty.

The project will use an indigenous energy resource for power generation. Therefore, it will reduce exposure of the economy to fossil fuel price fluctuations and the associated exchange rate risk for fuel procurement. In addition, it will benefit regional environment (especially air quality) since geothermal electricity production produces none of the conventional air pollutants associated with alternative fossil fuel generation options. It will also supply jobs to some local residents and be a source of local economic growth.

The global benefits of the project include avoided GHG emissions. In particular it provides for substantial carbon dioxide emission reductions in comparison to fossil fuel-based generation of a similar capacity. Existing geothermal electric stations, that fall within the 50th percentile of all total life cycle emissions studies reviewed by the Intergovernmental Panel on Climate Change (IPCC), produce on average 45 kg of CO2 equivalent emissions per megawatt-hour of generated electricity (kg CO2eq/MW/h). For comparison, a coal-fired power plant emits 1,001 kg of CO2 per megawatt-hour when not coupled with carbon capture and storage (CCS).

5.5 Alternative technologies for Geothermal Power Plants

Geothermal power plants can be divided into two main groups, steam cycles and binary cycles. Typically, the steam cycles are used at higher well enthalpies and binary cycles for lower enthalpies.

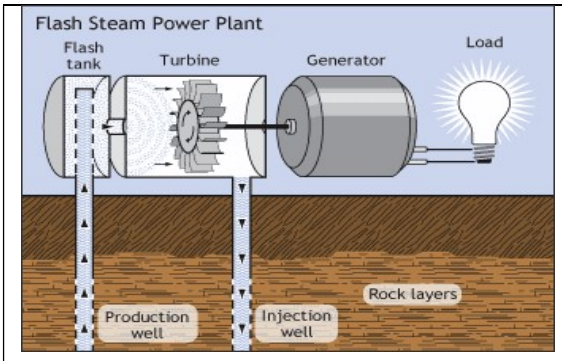
The steam cycles allow the fluid to boil, and then the steam is separated from the brine and expanded in a turbine. Usually the brine is rejected to the environment or re-injected. The brine can be flashed again at a lower pressure if double flash system is used.

A binary cycle uses a secondary working fluid in a closed power generation cycle. A heat exchanger is used to transfer heat from the geothermal fluid to the working fluid, and the cooled brine is then rejected to the environment or re-injected.

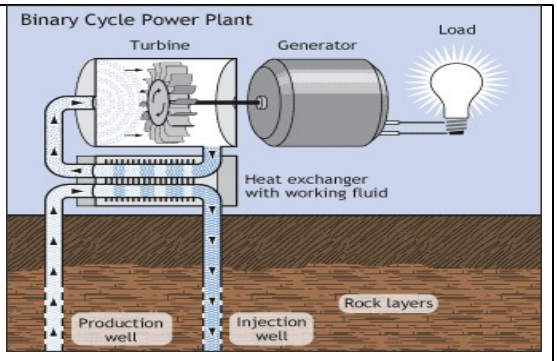
5.5.1 Steam Cycle Power Plants

Geothermal Steam Cycle Power plants are similar to other steam turbine thermal power stations. Heat from a fuel source (in geothermal case, the earth's core) is used to heat water or another working fluid. They use water at temperatures greater than 150^0C that is separated and piped, then condensed steam is cooled at the cooling tower and the excess condensate re-injected.

Flash steam cycle plants are the most common type of geothermal power generation plants in operation today, which use water at temperatures greater than 182°C (455 K; 360 °F) that is pumped under high pressure to the generation equipment at the surface. The working steam is then used to turn a turbine of a generator, thereby producing electricity. The fluid is then cooled and returned to the heat source.



Flash Steam Power Plant



Binary – Cycle Power Plants.

A single-flash steam cycle is proposed for Menengai geothermal power plant.

5.5.2 Binary-Cycle Power Plants

Most geothermal areas contain moderate-temperature water (below 400°F). Energy is extracted from these fluids in binary-cycle power plants. Hot geothermal fluid and a secondary (hence, "binary") fluid with a much lower boiling point than water pass through a heat exchanger. Heat from the geothermal fluid causes the secondary fluid to flash to vapor, which then drives the turbines. Because this is a closed-loop system, virtually nothing is emitted to the atmosphere. Moderate-temperature water is by far the more common geothermal resource, and most geothermal power plants in the future will be binary-cycle plants.

Binary cycle geothermal power generation plants differ from Dry Steam and Flash Steam systems in that the water or steam from the geothermal reservoir never comes in contact with the turbine/generator units.

The limitations of Binary Geothermal Power Plant include:

- High initial project cost;
- More maintenance costs;
- Binary cycles operate at lower enthalpies (temperatures); and
- Highly skilled & trained manpower required for installation and running the plant

5.5.3 Recommendation for Menengai Power Plant Design

A single flash Steam Cycle is recommended for the Menengai power plant. The advantages of this system are:

- The risk of well enthalpy turning out to be different than planned because of well drilling and plant building being done simultaneously;
- The risk of well enthalpy changing when utilization of the reservoir starts;
- The second separator stage is usually at pressures below silica saturation limit. This calls for acid or inhibitor dosing and has potential to cause increased maintenance cost or operational problems.

5.5.4 Alternative NCG extraction and dispersal technologies

There are two types of technologies that are commonly used for NCG extraction i.e. the stack and cooling tower technologies. A stack also known as a chimney is the duct built to expel NCG high above in the atmosphere. It may be conical or cylindrical in shape. It may be forced draft or natural draft in the stack to expel the gases.

A cooling tower is an evaporative heat transfer device in which atmospheric air cools warm water, with direct contact between the water and the air, by evaporating part of the water. Wet cooling towers have a hot water distribution system that showers or sprays the water evenly over a lattice work of closely set horizontal slats or bars called fill or packing. The fill thoroughly mixes the falling water with air moving through the fill as the water splashes down from one fill level to the next due to gravity. Outside air enters the tower via louvers in the form of horizontal slats on the side of the tower. The slats usually slope downward to keep the water in. The intimate mix between water and air enhances heat and mass transfer (evaporation) which cools the water. The cold water is then collected in a concrete basin at the bottom of the tower where it is pumped back to the condenser. The cooling tower comprise a number of cells modularized such that one complete cell, including the associated non-condensable gas (NCG) dispersion system can be pulled out. The cells can be taken out of service for safe cleaning or maintenance whilst the other cells remain in operation.

Based on air quality modelling findings, though the difference is marginal, cooling tower is preferred over the stack as far as dispersal of H_2S is concerned. Sosian has proposed to use cooling towers in the power plant.

6 PUBLIC AND STAKEHOLDER CONSULTATIONS AND DISCLOSURE

6.1 Introduction

Public consultation and disclosure is defined as the two-way communication between the project ESIA team and the targeted and affected groups. It is important in the environmental and social assessment study process as it promotes the feeling of ownership, cooperation, and accountability, and builds a good rapport with affected community.

Part III Section 17 of the Environmental (Impact Assessment and Audit) Regulations, 2003 requires that during the process of conducting an environmental impact assessment study, the project proponent seeks the views of persons who may be affected by the project. In seeking the views of the public, the project proponent will hold at least three public meetings with the affected parties and communities to explain the project and its effects, and to receive their oral or written comments.

6.1.1 Objectives of the consultation process

The overall goal of the consultations is to disseminate project information and to incorporate the views of the local community and other stakeholders in the identification of potential impacts, design of the mitigation measures and the management plan.

The specific objectives of the consultations are:

- Promote public understanding and acceptance of the project by minimizing potential perceived environmental impacts through education and open discussion;
- Obtain feedback that can be used as constructive input into improving the project design and management;
- To unearth the perception of the communities around on the project on the impacts;
- To inform the community on the correct details of the project; and
- To determine ways of communicating with the community.

6.2 Stakeholder Analysis

Howlett and Nagu (1997) define stakeholders as ‘all those people and institutions who have an interest in the successful design, implementation and sustainability of the project. This includes those positively and negatively affected by the project. Stakeholder participation involves processes whereby all those with a stake in the outcome of a project can actively participate in decisions on planning and management. They share information and knowledge, and may contribute to the project, so as to enhance the success of the project and hence ultimately their own interests.’

A stakeholder analysis will help the geothermal power plant project developers to identify:

- Interests of all stakeholders who may affect or be affected by the project;
- Potential conflicts or risks that could jeopardize the project;
- Opportunities and relationships that can be built on during implementation;
- Groups that should be encouraged to participate in different stages of the project;
- Appropriate strategies and approaches for stakeholder engagement;
- To unearth the perception of the communities around on the project on the impacts; and
- Ways to reduce negative impacts on vulnerable and disadvantaged groups.

Three essential steps were utilized in stakeholder analysis including:

- Identifying key stakeholders and their interests (positive or negative) in the project;
- Assessing influence, importance and level of impact upon each stakeholder;
- Identifying how best to engage stakeholders.

6.2.1 Stakeholder Identification

To enhance maximum participation and achieve a better output, the right stakeholders should be taken on board. This is done through stakeholder identification and involvement based on their needs, interests, relative power and potential impact on project outcome.

In this regard, two broad categories of stakeholders were identified. These include:

- *Primary stakeholders* – those who are the beneficiaries of a development intervention or those directly affected (positively or negatively).by the project;
- *Secondary stakeholder-* those who influence development or are indirectly affected by the project especially those stakeholders involved in resettlement planning and implementation. These include the implementing agency, relevant government departments, and local administration among others

The stakeholders identified and consulted during this update study, their affiliations and categorisation are presented in Table 6-1 below.

Table 6-1: Schedule of stakeholders consulted during the ESIA update study

No.	Name	Affiliation	Stakeholder category
1	Sosian Geothermal Power Plant Ltd	Project Proponent	Primary
2	Geothermal Development Company (GDC)	Special purpose vehilce to entre into steam sales agreements with investors in the energy sector	Primary
3	Settlements and communnities affected by both positive and negative impacts of the project	Project beneficiaries and persons advaersely affetced by the project's direct impacts	Primary
4	Director of Environment, Ministry of Environment, Natural Resources, Energy and Water	Host County Government	Secondary
5	Rift Valley Water Services Board (RVWSB)	Water Services Board	
6	Water Resources Management Authority (WRMA), Rift Valley Catchment Area	Water Regulatory Body	
7	Nakuru Water and Sanitation Services Company (NAWASCO)	Water Service Providers	
8	Olbanita Water Resource Users Association	Water Resource Users Association	
9	Kenya Forest Service-Mau Conservancy	Conservation agency	
10	Kenya Forest Service-Menengai Forest Station		
11	Kenya Wildlife Service, Nakuru office		
12	Directorate of Occupational Safety and Health- Nakuru County	National Government National Government Line Ministries	
13	State Department of Agriculture, Nakuru North sub county		
14	State Department of Agriculture, Rongai sub county		
15	Department of Gender and Social Development officer, Nakuru North Sub county		
16	Department of Gender and Social Development officer, Rongai Sub county		
17	Youth Development Officer, Nakuru North sub county		
18	Public Health Officer, Nakuru North Sub county		
19	Public Health Officer, Rongai Sub county		
20	Ministry of Education, Nakuru North sub county		
21	Ministry of Education, Rongai sub county		
22	National museums of Kenya (NMK)		
23	Friends of Menengai Crater (FOMEC)	NGO	

6.2.2 Stakeholder Engagement

Avenues for stakeholder engagement include:

- Key informant interviews; and
- Public meetings

The feedbacks from these forms of engagements are described in the following sections.

6.3 Key Informants Interviews

Key informant interviews were held with various heads and representatives of line ministries and other government agencies at both the county and national governments in Nakuru County as well as active NGOs identified within the project area. These stakeholders were identified based on their needs, interests, relative power and potential impact on project outcome and absence of documented evidence of consultation in the earlier ESIA study. Even though some of the contacted agencies have regional coverage, the consultations focused on Nakuru North/Bahati and Rongai sub counties as the two sub counties directly affected by the project in Nakuru County.

The objectives of these meetings were to:

- Introduce the project to the agencies/administration and present current status of the project to those who already knew about it;
- Obtain more information about the project area toward updating the baseline information on the 2 target Sub Counties i.e. Rongai and Nakuru North; and
- Obtain views of the stakeholders on updating the project's ESIA report.

During the consultations, both open ended discussions and thematic questionnaires were deployed. Notes of the consultative meetings, signed attendance lists and filled questionnaires are attached in Appendix III. Summary of the issues arising are presented in Table 6-2 below.

Table 6-2: Summary of the issues rising from the stakeholder's consultations

SN	Category of stakeholders	Issues and Concern	Positive Impacts and Suggestions	Response from the consultant team
1.	Department of Water, Nakuru North Sub County	• If the proposed plants get water supply from NAWASCO, there will be no problem. However, NARUWASCO has no adequate water and cannot even meets its current demands	• Any underground water for domestic use must be treated because of high fluoride contents	• Existing arrangement is such that GDC gets domestic supplies from NAWACO and the same is expected of the IPPs
2	Department of Gender and Social Development, Nakuru North Sub County	• Further land fragmentation in areas around the project area • Increased moral decadence due to increased levels of disposable income: more drinking, higher number of vulnerable children etc. • Destruction of scenic features characteristic of the Menengai landscape • Hostility and increased tension among youth of working age perceiving that jobs are benefiting non-locals • Environmental pollution: dust, noise and odour • Displacement of monkeys into settled areas • Adulteration of social norms occasioned by influx of non-residents working at the site; • Climate change: there is common belief that drilling geothermal wells is responsible for the heavy rains currently witnessed in the area	• Lobbying for zoning of the area so as to prevent fragmentation • Mobilization of individuals working at the site into self-help groups or investment-oriented groups • Institute environmental protection measures • Consistent and meaningful involvement of local residents at all levels of the project	Environmental and social management plans has been formulated within the ESIA study report to manage the predicted impacts Air and noise modelling are being undertaken as part of the study to establish likely levels of pollution and affected areas for informed management interventions. From past monitoring by GDC, hydrogen sulphide levels have been found to be within limits acceptable by World Health Organization Geothermal power production contributes least to climate change in comparison with other means like thermal power productions
3	Public Health Office, Ministry of Health, Nakuru North and Subukia Sub Counties	Nil	• Community will get employment opportunities • Improved road network and cheap energy • Improved water supply and security due to power supply	Nil

SN	Category of stakeholders	Issues and Concern	Positive Impacts and Suggestions	Response from the consultant team
			• Improved quality of education –reduction of eye problems due to straining	
4	Nakuru County Government, Ministry of Environment, Natural Resources, Energy and Water-Director of Environment	• Initial ESIA report was not shared with the county government of Nakuru as one of the lead agencies for comments	• The Nakuru county government embraces the project • The county government will also help a lot in ensuring that the project implementation conforms to the approved ESMP • The project will attract more investment into Nakuru County • It will also create more employment and investment opportunities for people in Nakuru County.	• It was noted that the first report was done in 2012 when the county government was still not in place. The consultant agreed to share the report under update via mail.
5	Nakuru Water and Sanitation Services Company (NAWASCO)	• Necessary protections around the aquifer to prevent dissipation of high temperature –already high temperatures ($33^{O}C$ to $42^{O}C$) have been noted at NAWASCO boreholes. This has seen increased O&M cost on borehole pumps and motors • NAWASCO has already raised the issue of increased borehole water temperatures with GDC who promised to undertake studies and give feedback • Increased hydrogen sulphide levels into the natural environment which may change the surface water quality and which constitutes the groundwater recharge for aquifers used by NAWASCO	• The project is a good initiative that would enhance economic growth probably enabling lower energy cost in manufacturing/production sector • Expect reduced power outages which are currently frequent and affects NAWSCO production capacity. Boreholes (powered by electricity) constitute 90% production capacity • Geothermal drilling goes beyond the aquifers used by NAWASCO (250-300m) and due care is necessary if no leakage is to be experienced from the water supply boreholes • Adoption of appropriate construction technology and provision of adequate insulation materials around the entire depth of aquifers used by NAWASCO • Incorporate adequate safety measures to safeguard against accidental damages or in case of plant breakdown	• Part of the study includes air dispersal modelling to help predict likely future scenario of hydrogen sulphide pollution and inform formulation of appropriate mitigation measures. Further, air quality monitoring will be an ongoing process at and around the power plants • Follow ups will be done with GDC on the issue of increased borehole water temperatures.

SN	Category of stakeholders	Issues and Concern	Positive Impacts and Suggestions	Response from the consultant team
6	Rift Valley Water Services Board (RVWSB)	• There have been complaints of rising borehole water temperatures since GDC commissioned the geothermal wells in Menengai • Emissions from the plants may affect local communities • Fear of cross contamination of aquifers during brine re-injection • If casing is not properly done, there is a risk that the water in the aquifers will be drained into the fault lines or contaminated by the minerals in the steam	• Geothermal power plants development will add more power to the national grid and reduce cost of electricity • Most boreholes in the project area are pumped by electricity. Anticipated reduced power cost will lower their cost of operation • Properly designed and controlled drilling process to ensure no contamination of aquifers • Ensure that brine is pre-treated before reinjection or dispose of safely • Reinjection wells should be well encased to prevent any potential contamination of borehole aquifers	• Respondent informed that study includes air dispersal modelling to help predict likely future scenario of hydrogen sulphide pollution and inform formulation of appropriate mitigation measures. Further, air quality monitoring will be an ongoing process at and around the power plants
7	Water Resource Management Authority (WRMA), Rift Valley Catchment Area	• If the plants depend solely on the groundwater pumped from the area, there are possibilities of depleting or over abstracting from the aquifer. It will also affect water supplies to local communities • It will affect ground water recharge as surfaces get covered by concrete • Increased population in the area is likely to have pressure on the available water resources and other environmental resources	• Trends in underground water in the area have been steady. The area has a god groundwater potential and it has not been overexploited • The project will create jobs for the locals and also come with development of social amenities • Alongside the underground water supplies, alternative supply sources should be sought e.g. storage for rainwater harvesting or alternative surface water supplies • Destruction of environment should be minimal. There should be plans to restore the natural environment as it was before the project • Alternative sources of water should be developed to cater for the increased population. •	• Large volumes of water are usually required where cooling of plants is necessary. However, the proposed plants are not anticipated to require large amounts of water for cooling. Water requirements will be mainly to meet the domestic needs of workers at the plants.

SN	Category of stakeholders	Issues and Concern	Positive Impacts and Suggestions	Response from the consultant team
8	Directorate of Occupational Safety and Health, Nakuru County Office	Nil	• DOSH enforces Occupational Safety and Health Act (OSHA), 2007 • In case of mishaps/accidents, DOSH also enforces Workers Injury and Benefits Act (WIBA) • Conducts registration of work places, ensuring workers are safe, have well access to work and are trained and instructed on safety • GDC is registered with DOSH and is regarded as the occupier of the Menengai Power Plant site. It is an occupier's responsibility to ensure that any contractors adhere to its safety and health policy	Nil
9	Friends of Menengai Crater (FOMEC)	• GDC is raising seedlings for sale and own planting. This is killing the local groups engaged in similar activities. Instead, GDC should buy seedlings from local groups engaging in tree nursery business • There are sacred caves within the caldera which are regularly patronized by various religious sect members. These should be preserved • Power plant staff will add pressure on already existing bad waste management system within the caldera • Use of poor-quality brine sump lining materials which break down • Erosion from accidental brine spillage • Uncontrolled leakages from existing GDC water pipelines. This has attracted livestock leading to increased soil erosion	• The development is positive for harnessing resources for clean power production • GDC has experimental agricultural field for use of brine. These should be enhanced with the development of the power plants • IPPs should know that pollution is a real issue in Menengai and proper waste management should be instituted • Exposed workers need adequate protection measures e.g. from noise, dust and smell • Recommend an environmental emergency management plan for any accidental brine spillage and associated erosion to ensure timely management • Recommend independent audit of the site activities and disclose findings to all stakeholders • There is need to create awareness among the local communities especially on	A joint site visit with FOMEC representative was agreed and undertaken to enable the mapping of the sacred caves. Recommendations on environmental management and annual independent environmental audits will be considered in the final ESMP developed for the updated report.

SN	Category of stakeholders	Issues and Concern	Positive Impacts and Suggestions	Response from the consultant team
		• Light pollution at the caldera will affect insect's survival	exposure to burst brine pipes and used brine sump linings	
10	Public Health Office, Ministry of Health, Rongai Sub County	Nil	• Creation of employment opportunities • Improvement of infrastructure e.g. road linkages to and from site • Improved power generation • Setting up of shopping centres	Nil
11	Department of Gender and Social Development, Rongai Sub County	• Youth in the area are underemployed and feel left out by GDC in favour of those from Nakuru North sub county • When the local community is hosting such development, what will they get in return?	• Local youth groups are not very strong and need to be empowered by the development stakeholders as it happened in Nakuru North sub county	A social survey is being undertaken as part of the study and any CSR by the developers will be informed by the findings from the survey and discussions with the locals
12	State Department of Agriculture, Rongai Sub County	• Labour used in the farms is mainly from young people. The project may reduce labour available to farmers and increase the labour cost • Erosion from trucks moving to and from the project site • Social issues: increased incidence of HIV/AIDS as experienced in Rongai flower farms • What kind of pollution is likely from the project? Pollution from acid rain is likely to impact crops while contamination of underground aquifer will impact people since most people in the area rely on borehole water	• Power plants workers will provide ready market for food (farm produce). Local farmers can benefit from increased capital for crop production • Increased power availability will increase crop production e.g. via irrigation • Developers should have a CSR activity for the community like tree planting, promoting 4K clubs and soil conservation activities	Potential pollution due to noise, dust and hydrogen sulphide gas as well as accidental spillage of brine. The current study also includes noise and air quality modelling to identify areas likely to be affected and inform formulation of appropriate mitigation measures
13	State Department of Agriculture, Nakuru North Sub County	• If hydrogen sulphide (H_2S) is not contained, it will affect crops and also contaminate soils by making it more acidic; • Quarries within the project area have been associated with structural issues affecting houses and masonry tanks through development of cracks. E.g. the	• Will bring development of infrastructure which will improve marketing of agricultural produce and even improve prices; • Employment opportunities created through the plants will reduce incidences of unemployment and alcoholism in the area which even affect agriculture	Nil

SN	Category of stakeholders	Issues and Concern	Positive Impacts and Suggestions	Response from the consultant team
		Kagoto quarry next to Kagoto primary school; and • Farmers in Menengai crater area (Kiamaina division) have already complained of acidic rain affecting their roofs and crops and that the rain water harvested from roof catchments is yellow and cannot be used	• The ministry hopes to have well-endowed stakeholders within the area including GDC which will boost agricultural activities as well • Proper management measures should be put in place to avoid soil and water pollution	
14	Department of Water, Rongai Sub County	• There is likely to be pressure on existing water supplies, which are mainly boreholes • Likelihood of environmental degradation if waste is not properly managed • Noise pollution from the plants' operations	• Community benefits from support to community water supplies • Increased power supply to the national grid will likely lower existing power interruptions • Eventual reduction in power cost will lead to improved living standards as the cost of living will come down • GDC and IPPs should monitor the impacts of their activities on water supply to the local community • There should be a link between the community and the developers to facilitate regular meetings with water users and service providers	Nil
15	Kenya Forest Service-Mau Conservancy	• There is a proposal to establish a model ecotourism site at the rim of the caldera. KFS is branding Menengai view point. It is not known whether any fumes emitted from the wells and power plants can affected the installations • The impacts of noise on wildlife should be addressed	• There are illegal activities within the forest including charcoal burning, illegal grazing and cutting of poles. We appeal to stakeholders having a MoU with KFS to complement activities undertaken through the Community Forest Association (CAF) to ensure that flora and fauna are not affected	• The study also involves air quality and noise modelling to show areas that may be exposed to dangerous levels of emissions and inform the need for any resettlement for safety reasons where necessary.
16	Kenya Forest Service-Menengai	• The area is naturally prone to wildfires (even in the absence of human interventions like charcoal burning).	• Electric fencing of all forest areas (both plantation and in the caldera) should be enforced together with conditions limiting	

SN	Category of stakeholders	Issues and Concern	Positive Impacts and Suggestions	Response from the consultant team
	Forest Station Manager	This implies that even any indigenous vegetation survival is difficult due o the natural conditions: stony surfaces and low water retention capacity, making dry vegetation a good conduit for wildfires • Any transmission line must be cleared of vegetation. The existing vegetation is mainly shrubs and therefore limited clearance is expected only for pylon sites	entry and controlling grazing. The surrounding communities currently access the forest area from any point leading to overgrazing. Part of Menengai forest association will allow grazers to be identified • Participatory Forest Management Plan (PFMP) advocates for management of areas on sustainable yield basis and hence no adverse impacts are expected • Introduce fruit trees like *Psidium guajava*, to help contain monkeys and baboons and reduce existing human-wildlife conflicts with farmers. • Pollution related issues are expected to be managed by the expertise available at GDC	
17	Kenya Wildlife Service, Nakuru office	Nil	• The project area is not protected by KWS but known to be inhabited by small mammal like vervet monkeys and baboons. Leopard's presence cannot be ruled out due to their hunting behaviour. • Detailed comments to be given only after site visit by KWS.	• GDC contacts were shared with the KWS officer to allow KWS make own arrangements for site visit
18	Education Officer, Bahati Zone in Nakuru North sub county	• Existing quarries in the area have caused problems in Kagoto primary school. When blasting, cracks have developed in the school buildings and even a fatal accident from blasted rocks involving a pupil in the school has been reported. There is a new Heshima secondary school with a storey building next to the Kagoto primary school. Due to fears on structural failure from cracks caused by blasting at the quarries, it has led to use of very stringent quality	• Ensure strict observation of labour laws to ensure that children remain in school with the help of local leaders	• The consultant however informed the respondent that in such projects, use of materials from NEMA licensed quarries is usually recommended and whenever the contractor has to establish a new quarry, a separate ESIA is usually undertaken

SN	Category of stakeholders	Issues and Concern	Positive Impacts and Suggestions	Response from the consultant team
		standard materials which are very costly. Further, the cost of maintaining the institutional buildings is his high. These are likely to increase if the project sources materials from these quarries; • The project might also lead to increased school dropout cases which is common in the area; • The project may reduce migration of locals to urban centres like Nakuru town and encourage spread of HIV/AIDS locally;		
19	Olbanita Water Resource Users Association	• Do not foresee any problem with the implementation of the proposed geothermal power plants since the resources used will be mainly underground-based. • Since the project is in our area, how will the local community and Olbanita WRUA benefit from it?	• GDC and partners should always invite Olbanita WRUA to any stakeholders' meetings with the locals, especially on water resources management and all should register with the WRUA to promote management of water resources in the area; • GDC and partners should consider putting up a water storage tank for Olbanita WRUA to facilitate supplies	• The consultant informed the WRUA that the local community already enjoys some water supply from NAWASCO following arrangements made by GDC as a CSR. GDC has contributed through community water tanks which facilitate local water supplies.

6.4 Public Meetings

A total of eight (8) public meetings were organized in the sub locations neighbouring the project area in collaboration with local chiefs and assistant chiefs. The schedule of the meetings held is as shown in Table 6-3 below.

Table 6-3: Schedule of public meetings

Rongai Sub County				
No.	**Sub Location**	**Date**	**Time**	**Venue**
1.	Kampi ya Moto	Thursday, 30th October, 2014	10.55 AM	GDC Kabarak Farm
Nakuru North Sub county				
2.	Kirima	Monday, 3rd November, 2014	11.30 AM	Full Gospel Church
3.	Ndunguri	Monday, 3rd November, 2014	12.15 PM	Ndunguri Cattle Dip
4.	Ol Banita	Monday, 3rd November, 2014	3.05 PM	Full Gospel Church
5.	Wanyororo	Wednesday,5th November, 2014	11.30 AM	Wanyororo Trading Centre
6.	Menengai	Thursday,6th November, 2014	11.40 AM	Menengai Trading Centre
7.	Mwaki Mugi	Friday,7th November, 2014	11.12 AM	Kabatini Chief's Office
8.	Mutukania/Landi Mawe/Karonga	Tuesday,11th November,2014	11.30 AM	Rehema Church Ahero

6.4.1 Objectives of Public Consultation Meetings

Public consultative meetings were held in the eight sub locations, listed above within the project area. The objectives of these meetings were as follows:

- Awareness creation about the project to the community with respect to scope of the project; stakeholders of the project; development approach to be employed in the project; roles and responsibilities of the community and other stakeholders and role of GIBB Africa Ltd. in the project;
- Explaining to the community on the different activities the study team will be undertaking in the ESIA studies and further explaining the communities' role.
- Informing the community on the environmental and social impacts of the project will be addressed;
- Getting feedback from the communities on their views on the project and issues of concern.

Some photos of the participants during the various meetings are presented in the table overleaf.

Photo 1: Public meeting in Ndugiri sub location at social centre grounds	*Photo 2: participants at a meeting held in Ol Banita sub location at Ol Banita Full Gospel Church*
Photo 3: Stakeholder meeting in Mercy Njeri sub location at the Chief's compound	*Photo 4: Stakeholder meeting at Mercy Njeri sub location*
Photo 5: Stakeholder meeting in Kirima sub location	*Photo 6: Attendance at a public meeting in Wanyororo sub location*
Photo 7: Attendance at a public Kiamaina sub location	*Photo 8: A participant contributing during a meeting in Kiamaina sub location*

6.5 Summary of Issues raised in Public Meetings

A total of eight public meetings were conducted at sub location levels during this update study. A summary of the issues raised by the consulted stakeholder community members during the public meetings are presented in table 6-3. Complete records of public meeting records are presented in Appendix IV.

Table 6.3: Summary of comments from public meetings

SN	Sub Location	Issues and Concern	Response from the consultant team
1.	**Kampi Ya Moto**	• Clarification on the actual route of the power transmission lines and the likely impacts. • The water supply source for the power plant due to concern over the perennial water problem in the area. • Benefits from the project to the local community. • As part of the IPP community social responsibility programme, attendants at the meeting asked that the following projects be given priority in respective order of water supply; Education; Development of a hospital (Kachwera); and Grading of access roads. • Education and awareness creation on the significant impacts associated with the power plant • Relationship between Independent Power Producers and Geothermal Development Company. • Local community to be prioritized when employing skilled and unskilled labour during the construction and operation phases of the project. Unskilled labour should not be sought from outside the project area. • The consultant to arrange for meetings with neighbouring communities after completion of the ESIA study to educate them on the outcome of the study and how the community will be impacted by the project and mitigation measures put in place to avoid or minimize the impacts.	• The power transmission lines from the power plants to the substation were a different project undertaken separately by Kenya Electricity Transmission Company (KETRACO). • Water supply to the power plants will be provided by GDC from their boreholes located in the Caldera. The anticipated benefits to the local community are: • Employment opportunities for both skilled and unskilled labour; • Sourcing of building materials such as building stones from quarries around the project area. • Point noted and will be forward to the project proponent for consideration. • Some of the significant impacts identified by the consultant in relation to geothermal power generation included Noise; Air quality; and cheap renewable energy. • GDC is a government parastatal mandated with geothermal exploration in Kenya whereas the IPPs are private companies involved in power generation. The two have signed an agreement where the IPPs purchase steam from GDC for power generation. • The ESIA study report will recommend to the Contractors and Sosian Geothermal Power Plant Ltd to prioritize the local community when employing unskilled labour. • A disclosure workshop will be organized in Nakuru after the approval of the ESIA study report where key stakeholders will be invited.

SN	Sub Location	Issues and Concern	Response from the consultant team
		• A nominated Senator present at the meeting informed the attendants that there is a new law (Natural Resources Sharing Bill) being debated in the Kenyan Senate which will ensure benefits from the exploitation of natural resources are shared with the local communities through a signed agreement.	• Point noted and acknowledged.
		• A local leader advised the community as a way forward to avoid being left behind was by the community members organizing themselves and setting up special committees to make follow up on the development in Menengai on technical, legal and socio-economic issues.	• Point noted and acknowledged.
		• The project size in comparison to Olkaria.	• Olkaria has several power plants with a higher capacity compared to the three to be constructed in Menengai.
		• Local community involvement prior to commencement of the project was welcomed as a right step.	• The public meeting was one of the avenues of involving the local community prior to commencement of the construction phase of the project.
		• The ESIA Study report should be disclosed at the local level for the community to enable discussion and debate by the project beneficiaries and affected persons.	• A disclosure workshop will be organized in Nakuru after the approval of the ESIA study report where key stakeholders will be invited.
2.	**Kirima**	• Employment opportunities for the youth and career choices for the youth in order to improve their chances of getting hired. • Increased incidences of human-wildlife conflict as animals invade private farm due to disturbances in the Caldera. • Geothermal development has restricted access to the caldera thus depriving the community benefits such as grazing grounds, firewood and poles for fencing.	• When hiring especially semi-skilled and unskilled labour, priority would be given to the project neighbouring community. Courses such as engineering and earth sciences would enhance their chances of getting a job in the geothermal sector. • Consultation to be done with KFS and KWS on suitable measure to be implemented to minimize incidences of human-wildlife conflict. • The ESIA stud report will recommend to relevant stakeholders not to restrict certain section of the caldera in order for the neighbouring communities to continue accessing goods from the caldera.

SN	Sub Location	Issues and Concern	Response from the consultant team
		• Brine to be supplied to local community to be used for irrigation farming and if it could be used to cure skin infections. • Follow up should be made by GDC to ensure success after providing tree seedlings. • Clarification as to whether rusting of iron sheet roofs in the area was as a result of geothermal steam • Cold weather experienced in the area was affecting their potato crops thus they wanted to know if it is as a result of geothermal development activities impacting the weather around the area. • Hiring for job opportunities in the project area is done through SACCO in Bahati which requires membership. Majority of the youth in the area do not have the funds to join the SACCO thus they are locked out. The SACCO itself discriminates when hiring favouring persons from where it is based. • When hiring unskilled workers, people from the neighbouring communities to be prioritized and not people from outside the project area. • The community wanted to know if rain water harvested from rusting iron sheet roofing had health risk when consumed.	• Brine has high levels of toxicants thus cannot be used for irrigation farming but can be used to treat skin infections. • Communication to be done to GDC. • There have been complaints raised in Olkaria Naivasha about rusting of iron sheet roofing being caused by geothermal emission but there is no evidence to show that geothermal emissions were the cause. Further investigations will be required to clarify the cause. • Changes in climatic conditions were attributed to global warming and climate change phenomenon and geothermal air emissions. • Job opportunities will be communicated through the area chief. Applicants will pass their credentials to the chief who will then pass them to the employer for review. SACCOs will not be involved in hiring. • Priority will be given to the project neighbouring communities. Job opportunities for semi-skilled and unskilled labour will be communicated through the area chief and not SACCOs. • Laboratory analysis of the water needs to be undertaken to verify if it has implications on human health.
3.	**Ndunguri**	• The expected environmental and social impacts from the project. • Initiation of afforestation program to improve ground cover. • Assistance sought from the client regarding the poor state of the access roads	Expected environmental and social impacts from the project include: • Air emissions (H2S and CO2) and air quality; • Noise and disturbances; • Employment opportunities during the construction and operation phase of the project; • Consultation to be sought from GDC on the issue of issuance of tree seedlings. • Client acknowledged the concern.

SN	Sub Location	Issues and Concern	Response from the consultant team
		• Direct benefits from the project to Ndunguri sub location	Direct benefits to people of Ndunguri Sub location from the project include: • Geothermal power plants can be a tourist draw when students, scientists, or interested individuals visit the site, thereby bringing business to the local community; • Geothermal development will bring significant economic advantages such as jobs and tax payments. Power generating companies will provide additional voluntary contributions to the neighbouring communities
		• Reservations that steam released from the wells is affecting vegetation growth especially grass since it rains in the area but the land cover remains fallow.	• Steam released into the atmosphere from the wells in the Caldera does not affect vegetation. Further investigation is required to establish the cause.
		• Fear of acid rain corroding roofing as some cases have been reported in Naivasha.	• Complaints have been raised in Olkaria Naivasha on the rusting of iron sheet roofing on house being associated with the geothermal steam but this has not been proven.
		• Request to the Client to assist in constructing Ndunguri polytechnic administration block, ladies' hostel and provide training machinery and equipment.	• The Client noted the requested.
		• Brine from the wells to be supplied to the community to be used for household and irrigation.	• Brine has high levels of toxicants which are harmful and therefore brine cannot be used for consumption, household use and irrigation of crops.
		• Bad odour from the Caldera affecting breathing especially at night.	• Hydrogen Sulphide present in geothermal steam is the cause of bad odour.
		• Creation of scholarships to aid needy student and hosting sports events in the area to promote local talent among the youth.	• The suggestion was noted.
		• GDC and KFS to assist in environmental education in the area and provision of tree seedlings to increase ground cover.	• GDC and KFS to be consulted and informed on the matter.
		• Disease affecting maize crop in the area is caused by geothermal steam from the Caldera	• The disease affecting maize crop in the area is a viral disease and not associated with geothermal steam or activities.
		• The area is experiencing erratic weather conditions and most people attribute it to the geothermal project and emissions released.	Erratic weather conditions are being experienced worldwide. This has been linked to global warming and climate change.

SN	Sub Location	Issues and Concern	Response from the consultant team
4.	**Ol Banita**	• The relationship between ground shaking and exploration drilling. • Clarification as to whether steam from wells resulted into rust on house roofing. • Will negative environmental impacts result into halting of the project? • Clarification as to whether work on the construction of the power plant had commenced. • Provision of social amenities by Sosian Geothermal Power Plants Ltd	• Nature of some geothermal exploration activities such as drilling of wells and release of geothermal steam from underground reservoir may result in ground shaking. • There have complaints in other areas such as Olkaria Naivasha of Iron sheet roofing rusting due to H2S but there is no evidence to link H2S to rusting. • Mitigation measures in the ESIA study report will be implemented to eradicate and minimize negative impacts thus allowing the project implementation. • Construction works had not yet commenced. Work will commence in 2015. • No social amenities will be provided by Sosian Geothermal Power Plants Ltd.
5.	**Wanyororo**	• Benefits from the project to the local community. • It was suggested that Sosian Geothermal Power Plants Ltd have a Memorandum of Understanding with the local community on employment of persons from the area so that in case the issues in the M.O.U are not fulfilled they can hold Sosian Geothermal Power Plants Ltd responsible • Long term effects from the project and mitigation measures.	Benefits to the local community will include: • Employment opportunities for skilled, semi-skilled and unskilled labour from the project area; • Sourcing construction materials such as sand and building stones from local suppliers; • Reliable power source; • Reduced cost of electricity. • Point was noted and acknowledged. Some of the long-term impacts from the geothermal power plant are: • Air emissions (CO2 and H2S); • Noise; • Reduction in the cost of electricity. Mitigation measure will include: • Sitting and design changes; • Air quality monitoring; • Continuous noise measurement; • Building barriers around the power plant to contain noise.

SN	Sub Location	Issues and Concern	Response from the consultant team
		• Public disclosure of the ESIA study report to educate the local community on the impacts and mitigation measures. • The use of brine after power generation for irrigation in greenhouses • Prioritize employment of locals especially women and youth. Hiring should not to be undertaken through SACCOs as there is no equity when hiring. • On job trainings for non-skilled labour to build their technical capacity and issuance of long-term contract. • Commencement of construction of power plant. • A big portion of land in the Caldera belonged to Wanyororo yet the community had not been compensated for their private land. It was suggested that the community be part of any agreement between GDC and IPPs and given shareholding in the projects.	• Public disclosure workshop will be organized in Nakuru after the approval of the report where all stakeholders will be invited. Impacts and mitigation measures from the ESIA study report will be communicated. • Brine cannot be used for household use and irrigation because it contains high levels of pollutants. It can only be used to treat skin infections. • Priority will be given to persons from the project neighbouring communities when hiring semi-skilled and unskilled labour. Available vacancies will be advertised through the area Chief and not through SACCOs. • Qualified persons with job specific skills will be hired for the duration of the work • Construction of the power plant will commence in January 2015 and will last for a period of 15 to 17 months. • Where private land is acquired for geothermal energy development, land owners should be compensated.
6.	**Menengai**	• Benefits to the community from the project • Access to electricity from the project. • Menengai Sub location experiences severe water scarcity and depends mainly on rain water harvested during the rainy season. The	Benefits to the community from the project include: • Employment opportunities; • Geothermal power plants can be a tourist draw when students, scientists, or interested individuals visit the site, thereby bringing business to the local community. • Electricity from the project will be injected into the national grid and accessed by application to Kenya Power. • Point noted and will be forward to the project proponent for consideration.

SN	Sub Location	Issues and Concern	Response from the consultant team
		community requested that in case the project proponent would consider doing something for them water project to be priority. • Promises to Menengai Sub location community by GDC have not been realized. Project proponent urged to do something for the community. • A request was made to the project proponent to support entrepreneurs and community self-help groups. • A consensus was reached that any employment presented to the community should be advertised through the area Chief.	• Point noted and will be forward to the project proponent for consideration. • Point noted and will be forward to the project proponent for consideration. • Point noted and will be forward to the project proponent for consideration.
7.	**Mwaki Mugi**	• Priority to be given to the youth as far job vacancies for the project is concerned. • Compensation for power transmission lines passing through private land. • Involvement of the County Government in the project. • Benefits from the project to the local community. • Inquiry as to whether grading has been done on the access to the Caldera through Mwaki Mugi y GDC and IPPs. • Assistance to be provided to the community to generate revenue and employment from the Menengai Crater through promotion of tourism. • Increased incidences of human-wildlife conflict ever since geothermal exploration started in Menengai. • Recommendation to GDC in the construction of an operation theatre and providing an ambulance to Bahati district hospital. They asked if they could be assisted in renovating and building a school administration block in one of the local schools as well as a police station to enhance security in the area.	• Job vacancies for the local youth would be considered during the construction and operation phases of the project. • Power transmission is a separate project undertaken by Kenya Electricity Transmission Company (KETRACO). • County Government involved during key project stakeholders' consultations. Benefits to local community are: • Employment opportunities for both skilled and unskilled labour; • Sourcing of building materials such as building stones from quarries around the project area. • The designated access road through Wanyororo will be used by the IPPs. • Point noted and will be forward to the project proponent for consideration. • ESIA study report will recommend to the stakeholders involved measures to minimize human-wildlife conflict. • Point noted and will be forward to the project proponent for consideration.

SN	Sub Location	Issues and Concern	Response from the consultant team
		• Talent promotion through sports targeting local youth such as cross-country athletic race to promote environmental conservation in Menengai. • Tree seedlings for tree planting by the community around the project area to be provided to the local community by GDC in order to promote environmental conservation and water catchment. • Creation of a data bank of all qualified but unemployed person as well as a committee for handling the recruitment of locals in the event of available job opportunities. • Proposal that local business and companies be contracted to provide materials such building stones which are abundant in the area. • Involvement of the community throughout the project cycle in order to inform the community on the progress and challenges. • Measures of involving the community in conservation of environment in the Caldera since exploration activities were degrading the natural environment.	• Point noted and will be forward to the project proponent for consideration. • Consultation to be done with GDC on the tree planting programme. • Point noted and will be forward to the project proponent for consideration. • Point noted and will be forward to the project proponent for consideration. • The local community will be involved throughout the project life cycle updating them on progress and challenges. Public meetings and local administrative leaders would be used to pass information. • Consultation would be made with Kenya Forest Service on the issue.
8.	**Mutukania/ Landi Mawe/Karonga**	• Consultation and sensitization of the project neighbouring communities was important and commended the Consultant for undertaking it prior to commencement of the project. • Prioritization of youth for semi-skilled and skilled labour. • Request for assistance of community health workers with First Aid kits; rent for office space; identification of materials and stipend for members. • Sport evangelism to be initiated in collaboration with NACADA to curb alcoholism among the youth.	• It is a requirement by law for community involvement prior to commencement of any project of such magnitude. • The Consultant in the ESIA report will recommend that people from the project area be prioritized when hiring semi-skilled and unskilled labour during construction of the power plants. • Point noted and will be forward to the project proponent for consideration. • Point noted and will be forward to the project proponent for consideration. Benefits from the geothermal power plant project include: • Creation of employment opportunities during the construction and operation phases of the project;

SN	Sub Location	Issues and Concern	Response from the consultant team
		• Benefits from the power plant project to the community.	• Electricity cost reduction making it affordable to majority of the people in the area.
		• The area experiences scarcity of water and a request for drilling of boreholes was raised in order to avert the problem.	• Point noted and will be forward to the project proponent for consideration.
		• The area around Ahero where the meeting was being held lacked public toilets for use by the inhabitants therefore a request for assistance to the project proponent to construct one for the community to run and generate revenue. These would be a sustainable source of revenue for a youth group in the area.	• Point noted and will be forwarded to the project proponent for consideration.
		• Request was made to the project proponent to sub contract local businesses to supply locally available materials such as sand and building stones.	• Point noted and will be forward to the project proponent for consideration.
		• GDC had previously assured the community that carbon credit fund would be made available thus they wanted to know when it will be available.	• Consultation would be raised with GDC on the matter.
		• Clarification was sought as to whether Corporate Social Responsibility would be part of the project.	• CSR program would be recommended to the project proponent.
		• In recognition that Water supply from NAWASCO was available in the area at the water kiosks, a request was made on the possibility of provision of water mains to be directly connected to individual homes.	• Point noted and will be forward to the project proponent for consideration.
		• Persons living next to the Caldera were inhaling bad odour and being affected by the high noise levels and vibrations. Consequently, clarification was sought on appropriate intervention measures.	• The ESIA study report will recommend mitigation measure will be implemented by the project proponent to minimize impacts on air quality and noise and vibrations.

6.6 Future Consultations

Further to consultations conducted by the consultant for ESIA update in 2014, GDC has continuously engaged the various stakeholders in the project area. However, records of these consultations had not been shared at the time of completing this report.

As part of continuous stakeholder engagement, GDC has constituted committees that shall be engaged from time to time to assist during the Menengai projects' activities. Separate committees have been constituted for tackling thematic issues and are proposed as follows:

- Youth committees;
- Wanyororo B community project water committee; and
- St. John Dispensary/Bahati hospital committee.

GDC has in place a Terms of Reference for the roles and responsibilities that the constituted committees will perform in the project. See Appendix IX.

While most of the documented concerns above have been addressed in the ESMP proposed in this report, it is necessary to have a clearly defined plan for subsequent and continuous engagement with the stakeholders at various stages and on the various issues of interest. Therefore, it will be necessary Sosian in close collaboration with GDC, develop a structured stakeholders engagement plan (SEP) inclusive of provisions for community grievance redress mechanisms. The SEP should cover the remaining project planning stages, construction and operation phases. In addition, the means, nature and contents of engagement records should be well defined. Given the presence of other IPPs in the same area, broader liaison among the IPPs will be necessary as well.

7 IMPACT ASSESSMENT AND MITIGATION MEASURES

7.1 General

Actual and potential environmental and social impacts associated with geothermal power plant in Menengai are presented in this chapter. Impacts have been divided into positive and negative environmental, social, health and safety during the construction and operation phases of the project.

Cumulative impacts of the project are also assessed by considering effects of various planned activities of the project.

7.2 Methodology for Impact Assessment

An environmental impact is any change to the existing condition of the environment caused by human activity or an external influence. Impacts may be:

- Positive (beneficial) or negative (adverse);
- Direct or indirect, long-term or short-term in duration, and wide-spread or local in the extent of their effect.

Impacts are termed cumulative when they add incrementally to existing impacts. In the case of the project, potential environmental impacts would arise during the construction and the operations phases of the project and at both stages positive and negative impacts would occur.

7.2.1 Impact Identification

The study has predicted and evaluated anticipated impacts using internationally acceptable standard methods of impact prediction and evaluation. Constant reference to a checklist of project activities was made and scores were assigned in an assessment table in order to make an objective assessment of how each of the project activities would impact on a particular environmental and social medium. The significance of impacts is subjective, but the value judgments required were best arrived at by consensus.

The study team used several approaches such as brainstorming and use of checklists and matrices, to identify the main sources and establish the potential impacts from the proposed main project activities. Public participation and consultation were also conducted to reduce uncertainty.

7.2.2 Impact significance

The purpose of this ESIA study report is to identify the significant impacts related to the project or activity under consideration and then to determine the appropriate means to enhance those which are positive, and avoid or mitigate those which are negative.

Significant impacts are defined, not necessarily in order of importance, as being those which:

a) Are subject to legislative control;
b) Relate to protected areas or to historically and culturally important areas;
c) Are of public concern and importance;
d) Are determined as such by technically competent specialists;
e) Trigger subsequent secondary impacts;
f) Elevate the risk to life threatening circumstances; and
g) Affect sensitive environmental factors and parameters.

7.2.3 Impact Assessment Scoring

To systematically identify, predict, evaluate and determine the significance of impacts resulting from the project construction and operation, a generic criterion developed by Haug *et al* (1984) was adopted as presented in Table 7-1. Precautionary principle was used to establish the significance of impacts and their management and mitigation i.e. where there is uncertainty or insufficient information, the Environmentalist erred on the side of caution.

Table 7-1: Criteria for assessing significance

SEVERITY OF IMPACT	***RATING***	***CONSEQUENCE***
Insignificant / non-harmful / less beneficial	**-1/ +1**	
Small/ Potentially harmful / Potentially beneficial	**-2/ +2**	
Significant / slightly harmful / Significantly beneficial	**-3/ +3**	
Great/ harmful / beneficial	**-4/ +4**	
Disastrous/ extremely harmful / extremely beneficial	**-5/+5**	
SPATIAL SCOPE OF IMPACT	**RATING**	
Activity specific	**-1/ +1**	
Right – of – way specific (within right – way)	**-2/ +2**	
Local area (within 5km of the project)	**-3/ +3**	
Regional	**-4/ +4**	
National	**-5/+5**	
DURATION OF IMPACT	**RATING**	
One day to one month	**-1/ +1**	
One month to one year	**-2/ +2**	
One year to ten years	**-3/ +3**	
Life of operation	**-4/ +4**	
Post closure	**-5/+5**	
FREQUENCY OF ACTIVITY / DURATION OF ACTIVITY	***RATING***	***LIKELIHOOD***
Annually or less / low	**-1/ +1**	
6monthly / temporary	**-2/ +2**	
Monthly / infrequent	**-3/ +3**	
Weekly/ life operation/ regularly / likely	**-4/ +4**	
Daily / permanent / high	**-5/+5**	
FREQUENCY OF IMPACT	**RATING**	
Almost never/ almost impossible	**-1/ +1**	
Very seldom / highly unlikely	**-2/ +2**	
Infrequent / unlikely/seldom	**-3/ +3**	
Often / regularly/ likely/ possible	**-4/ +4**	
Daily / highly likely/ definitely	**-5/+5**	

Table 7-2: Significance rating matrix

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

Table 7-3: Negative mitigation ratings

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

7.3 Positive Impacts during construction

7.3.1 Creation of Employment Opportunities

The construction phase of the project will be characterised by recruitment of significant numbers of skilled and unskilled people to work with the contractor. Some skilled persons likely to be recruited include engineers, project managers, masons, carpenters, mechanics etc. There will also be an influx of new people into the project area.

The projected number of construction staff is estimated to be between 100 - 200 persons for both skilled and non-skilled personnel. However, these persons will not be employed through-out the construction period, as the demand for particular staff will be based on the construction program at any one point in time. The PISSA encourages Sosian to prioritize local/Kenyan suppliers as well as recruitment of local casual labour, provided that these will not jeopardize any of her obligations in undertaking the project.

An increase in population of this magnitude will create a corresponding increase in demand for goods and services such as food for construction workers, housing, healthcare and need for transport. These needs will be satisfied by people living within the project area where local women will provide food vending services, homes will rent out spaces for the new population and shops will also benefit from increase of sales. All these avenues are bound to create new employment opportunities.

From public meetings feedback, there is an expectation that the employment opportunities provided by the project will significantly reduce the unemployment rates in the immediate project area. This expectation will need to be managed to avoid complaints and likely lack of satisfaction by the local community members.

Considering the geographical location of Nakuru County and peri-urban nature of plant site, the risk of immigrant labour from outside the county is deemed to be low. However, considering that the northern corridor passes through Nakuru town, some level of monitoring on use of immigrant labour by the project is required.

Impact Analysis Matrix

Impact without Mitigation	
Severity of impact	*+5*
Spatial scope of impact	*+5*
Duration of impact	*+3*
Frequency of activity / duration of activity	*+5*
Frequency of impact	*+5*
Result	***+130 Very High***

Enhancement measures

In order to improve direct employment opportunities by Sosian and its contractors/sub-contractors and make the project attractive to the people living in the area, the following are vital:

- All Sosian workers should be employed and remunerated in accordance with the provisions of Kenyan labour laws including the Employment act, WIBA, Labour Relations Act and the Occupational Safety and Health Act and best international practices as contained in ILO, AfDB Operational safeguard 5: Labour conditions, Health and Safety and IFC Performance Standard 2: Labour and Working Conditions;
- Capacity building and training of men, women and youth on specialised labour that will be required during construction. It should be noted that due to the nature of the construction works no persons under the age of 18 years should be employed during this phase. Therefore, it should be mandatory that the workers provide Identification Cards before they are employed;
- The appointed EPC contractor shall be required to have a human resource policy and related human resource management procedures in compliance with the local labour laws, applicable ILO standards that will include but not be limited to the following aspects:
  - ✓ Local Labour Recruitment Strategy with an equitable spread among the surrounding Rongai and Nakuru North sub-counties;
  - ✓ Gender mainstreaming strategies with an action plan for affirmative action and target quotas as required for men, women and persons with disability (PWDs);
  - ✓ Gender segregated protection strategies for workers against sexual harassment, sexual exploitation and gender-based violence in the work place;
  - ✓ Facilities, procedures and records to demonstrate application of non-discrimination principles;
  - ✓ Program for capacity building and training of men, women and youth to facilitate them to access semi-skilled and skilled labour opportunities during the project construction phase. The program will include targets for training and absorption of trained beneficiaries into the construction program;
  - ✓ Staff Code of Conduct and related Management Response Procedures as required;
  - ✓ Mechanisms for updating staff wages to at least meet the amounts set in the latest gazetted minimum wage orders;
  - ✓ Staff Grievance Mechanisms;
  - ✓ Mechanisms for reporting to Sosian and GDC on grievances regarding employment of local community members;
  - ✓ Mechanisms for allocation of time and resources for staff training on all the elements required under the project ESMP. All trainings will be supported by review mechanisms to check the impact / improvement of staff knowledge and skills.
  - ✓ Gender segregated monthly and quarterly HR reporting to Sosian on all the above listed aspects. The reporting will also indicate the nationality of the staff (as supported by legally recognised documents) as a tag to facilitate monitoring of the working terms for immigrant labourers;
- The appointed EPC Contractor will integrate disclosure of information on employment opportunities available to the local community, mechanisms to access these opportunities and periodic reporting to the local community on actual employment awarded into his quarterly stakeholder engagement schedule;
- Sosian will include the above requirements into the EPC Contract for the Contractor to customise to his operations at the Sosian Menengai Power Plant;
- Sosian will monitor the implementation of the labour related programs, as well as the performance and improvement strategies applied by the EPC Contractor and record the lessons learnt;
- Sosian will establish a grievance mechanism that takes into consideration the various actors and their roles at the geothermal field;
- Sosian will require the EPC contractor will develop a retrenchment strategy in good time, in the event of down-sizing due to technological or financial changes, organisational structuring or mergers and acquisition in accordance with the

requirements of Kenyan law and relevant requirements / policies as guided by the parent companies and other applicable stakeholders.

- Spreading administrative units to areas that are not going to benefit directly from the construction works so as to facilitate distribution of economic activities and;
- Establishment of a strong quota system of allocation of jobs for persons living in the neighbouring locations both in Rongai and Nakuru North sub counties even after relocation to a new place to facilitate equal spread of opportunities.

The above requirements will also apply to the appointed O&M Contractor and Sosian for the operation life of the project.

7.3.2 Income Generating Opportunities for local community

During construction phase the neighbouring local community (particularly the women) to the project sites will get an opportunity to start small income generating activities such as:

- Sale of food to the construction staff; and
- Opening up shops to sell basic necessities to the construction staff.

This will increase and diversify income streams for the communities hosting the project and improve socio-economic status of their families.

Impact Analysis Matrix

Impact without Mitigation	
Severity of impact	*+4*
Spatial scope of impact	*+3*
Duration of impact	*+3*
Frequency of activity / duration of activity	*+5*
Frequency of impact	*+5*
Result	***+100 High***

Enhancement

- It is proposed that water should be provided at the catering area through a water tank or stand pipe to improve hygienic conditions; and
- Women who want to participate be advised to get clearance from local Public Health offices in Rongai and Nakuru North sub counties.

7.3.3 Improved Local Economy

With project increased earnings of both the local population and the new population coming in search for labour, the amount of money in circulation will increase. With the increased earnings, purchases of local goods and services by the construction labour force will positively impact the local economy. Similarly, increase in imports of construction and process equipment and in the supply of local construction materials will change economic dynamics of the entire Nakuru County. This will therefore have a positive impact in terms of economic development. Improvement of the quality of life of the local community during construction is anticipated to arise from improved local socio-economy.

Impact Analysis Matrix

Impact without Mitigation	
Severity of impact	*+4*
Spatial scope of impact	*+4*
Duration of impact	*+3*
Frequency of activity / duration of activity	*+4*
Frequency of impact	*+4*
Result	***+88 Medium - High***

7.3.4 Local Market Opportunities

This is an advantage to the sellers of construction materials who will get contracts to supply the materials and services during construction phase. In addition, the local people will be selling food and other merchandise to the construction workforce. This means therefore that there will be an increase in revenue opportunities for the local population due to the presence of non-resident workers.

Impact Analysis Matrix

Impact without Mitigation	
Severity of impact	*+4*
Spatial scope of impact	*+3*
Duration of impact	*+3*
Frequency of activity / duration of activity	*+5*
Frequency of impact	*+4*
Result	***+90 Medium - High***

7.3.5 Improved infrastructure and Social Services

The development of access roads for use during the geothermal exploration and production wells development by GDC has already improved access across villages and open up areas that have been lacking efficient access such as the Wanyororo. This is a development attested by the consultees contacted during the study.

The projected increase in population and subsequent revenue growth from power plant construction is also likely to lead to development of social amenities such as improved water supply, development of social halls within established town centres and improvement of standards and number of medical facilities.

Impact Analysis Matrix

Impact without Mitigation	
Severity of impact	*+3*
Spatial scope of impact	*+3*
Duration of impact	*+4*
Frequency of activity / duration of activity	*+5*
Frequency of impact	*+4*
Result	**+ 90 *Medium - High***

7.3.6 Information, Education and Communication

With the implementation of the power plant, there will be development of additional skills for those taking advantage of new opportunities. There will also be diffusion of know-how from the more qualified personnel to the local personnel who participate in the construction activities.

Impact Analysis Matrix

Impact without Mitigation	
Severity of impact	*+3*
Spatial scope of impact	*+4*
Duration of impact	*+3*
Frequency of activity / duration of activity	*+2*
Frequency of impact	*+3*
Result	**+ 50 *Low***

Enhancement measures

- Sosian can intentionally include local training during the construction and equipment installation as part of scope of the selected contractor and sub-contractors

7.4 Negative Impacts during construction

7.4.1 Impact on Flora (Loss of vegetation cover)

Vegetation has already been cleared from the proposed plant site, locations of associated substation and access roads. However, this impact is short-term and considered not significant because the spatial extent will be limited to the small plant area (140m by 180m) and can be readily minimised by ensuring that vegetation disturbance is confined to construct sites. Further, the project sites can be re-vegetated with the same species after construction. The proposed plant area is covered by mainly by bushes and the presence of the endangered East African sandalwood (*Osyris lanceolata*) at this site was not established. However, constructions workers shall require sensitization on how to handle sandalwood that can be found within the caldera.

Clearing and disposal of unwanted materials from the plant area and introduction of foundation construction/fill materials from outside the caldera can encourage sprouting of invasive/alien species both at the construction site and in locations where the disposal of cleared materials is done off-site. Such invasive species like *Nicotiana glauca, Ricinus communis* and *Lantana camara* are however widely distributed in the region and the associated significance is deemed low. Nonetheless, there establishment at the project site or spread by the project activities should be prevented.

Impact Analysis Matrix

Impact without Mitigation	
Severity of impact	*-2*
Spatial scope of impact	*-2*
Duration of impact	*-2*
Frequency of activity / duration of activity	*-2*
Frequency of impact	*-4*
Result	***-36 Low***

Mitigation measures

- Any sandal wood identified on site should be marked out and made known to the engineers and contractor;
- Ensure that construction site is clearly demarcated and there is selective clearing of the vegetation to allow future re-growth and regeneration. This will ensure minimal disruption of wild fauna's natural movement, territoriality, and other ecological processes;
- It is desirable to re-vegetate disturbed areas along access roads, pipelines and steam lines and other construction sites. While the invasive *Datura stramonium* will rapidly colonize the disturbed bare grounds and still act as surrogate habitat for some fauna species, it is still desirable to minimize/discourage its dominance by planting native trees such as *Croton megalocarpus*-. Additionally, *Digitaria sp,* a native grass commonly growing at the site can be very used in checking soil erosion especially on loose soil dumps or bare slopes created during construction.
- There is need to create awareness among the local communities and discourage them from engaging in charcoal burning which was reportedly on the increase within the caldera. GDC can lead the IPPs and KFS in this;
- Project personnel accessing the caldera should be sensitized against collection of wild plants of conservation interest, particularly species protected under the CITES listing (see section 3.2 of this Report); and
- Sosian in liaison with GDC's Environmental and community liaison section should monitor regeneration of natural vegetation as well as the appearance/spread of invasive or opportunistic species within the disturbed areas. Monitoring should include spotting and uprooting of unwanted germinating plants.

7.4.2 Impact on Fauna

The project area is part of a gazetted forest land inhabited by wildlife such as monkeys, leopards, several bird species and reptiles. The most significant effect of geothermal power plant operation on the environment is noise, power transmission cables and air pollution. These may disturb the habitat, interfere with breeding and displace the animals and thus increase animal-human conflicts. However, given the relatively low presence of fauna in the project area the impacts are not expected to be very significant.

(a) Impacts on Macro fauna (mainly Mammals)

The major impacts on mammals like monkeys, baboons and leopards during the construction phase include (but not limited to) the following:

- Loss and disturbance of habitat/vegetation may lead to disappearance from the area of some rare wildlife such as leopards known to occur in the caldera;
- Scaring mammals from the caldera into nearby farming communities thereby increasing human-wildlife conflicts;
- Increased vehicle and human traffic in this area may result in many resident species leaving the area. Many forms of human-wildlife conflicts may occur e.g. poaching and accidents due to the high human and vehicle traffic in the area Docile species such as Olive Baboon, honey badger that are protected species under CITES;
- Construction area may attract scavenging or predators (in dire search of food or water), skulking/straying into water points, material piles or waste collection areas. Wildlife poisoning may occur as they sniff or leak substances in the containers or bags. Ground contamination may incidentally occur as fluids flow away from the exposed sources. Scavenging rodents and vermin may attract snakes (higher in the food chain) to the construction area where they may fall victim of human persecution. Snake bites may also increase with frequent human encounters; and
- Dust during the construction phase may cause poor visibility which may result to wild animals being knocked by vehicles.

Impact Analysis Matrix

Impact without Mitigation	
Severity of impact	*-2*
Spatial scope of impact	*-2*
Duration of impact	*-2*
Frequency of activity / duration of activity	*-2*
Frequency of impact	*-4*
Result	***-36 Low***

Mitigation measures

- Sosian to liaise with GDC and KWS to regularly monitor wildlife abundance, distribution and movement in relation to power infrastructural development during construction and operation stages to aid in decision making;
- Limit speed of construction traffic within the caldera e.g. through erection and maintenance of bumps and traffic signages within the caldera;
- Vehicular disturbances such as hooting should be discouraged accordingly;
- Incident records (of poaching, accidents and other human wildlife conflicts etc) should be kept by monitoring and taking of corrective measures;
- Roads into/out of the Caldera area should be maintained in good conditions to discourage unnecessary detours and as routes for tourist's activities and wildlife management;
- Access for earthmoving machines should be regulated;
- Areas set aside for stockpiling/storage (lubricants, oil cans, acids, water, food reserves) at the project site should be secured (fenced off) and where practicable covered from stray wildlife;

- Eating areas to be provided with in-house lidded bins for depositing food waste prior to collection and disposal, offsite. Wildlife (such as baboons with opposable limbs) may tamper with out-door lidded bins;
- Sensitize construction workers against persecution of docile wildlife; As part of wildlife emergency preparedness, the contractors and/Sosian should maintain contacts of KWS (Warden Office in Nakuru) for relaying wildlife emergencies and safe relocation as necessary;
- Proper hygiene and sanitation standards should be maintained at construction sites to rid-of rodents and vermin;
- Liaison with Menengai forest office and GDC to ensure that forest rules are enforced within the caldera throughout; and
- Sosian liaise with GDC to ensure that brine ponds are located close to the source. Distant flow should be piped to prevent animal or vegetation contact

(b) Impact on Avifauna

The impacts on birds during the construction phase include (but not limited to) the following:

- Fugitive dust from roads settling on perching and nesting sites may push some birds from the site;
- As a result of vegetation clearing habitat for birds that occur in thickets will be lost. The loss may create habitats for species associated with more open areas especially along the steam pipelines and roads;
- Migrating bird's species within the general rift valley area may be affected by transmission lines erected across their fly ways where they are either electrocuted or collides with transmission lines.

Impact Analysis Matrix

Impact without Mitigation	
Severity of impact	*-2*
Spatial scope of impact	*-2*
Duration of impact	*-2*
Frequency of activity / duration of activity	*-2*
Frequency of impact	*-4*
Result	***-36 Low***

Mitigation measures

- The project site has gorges, valleys and hillsides which form some of the keystone habitat features for raptors (Vultures and Eagles) as they enable them to soar high using thermal currents while in search of prey. These should therefore be retained as intact as possible;
- High voltage transmission lines should be fitted with wire markers and flappers to alert birds on flight; and
- High heat points and emission vents within the project area should be sheltered or fitted with inhibitors to deter birds which may get killed as a result of using such areas

(c) Impacts on Herpetofauna

The major impacts on reptiles during the construction phase include (but not limited to) the following:

- Clearing of vegetation on higher grounds may lead to excessive run off at lower elevations which may lead to washing out and/or filling the breeding burrows of reptiles (and other animals);
- Site clearing may result to movement and relocation of surface materials such as rocks, which are ideal keystone habitat features used by cold blooded

reptiles for sun basking e.g. by the endangered African rock python noted in the area; and
- Ground vibrations during the construction phase are also bound to negatively affect reptiles.

Impact Analysis Matrix

Impact without Mitigation	
Severity of impact	*-3*
Spatial scope of impact	*-2*
Duration of impact	*-2*
Frequency of activity / duration of activity	*-5*
Frequency of impact	*-3*
Result	***-56 Low - Medium***

Mitigation measures

- Sosian and GDC should liaise with KWS to capture any reptile encountered hiding under rocks and sheltered terrains such as *Python sebae* and safely release them in suitable habitats; and
- Limit movement heavy earth machinery only to necessary areas within the plant site

(d) Impacts on Invertebrates

The major foreseen impacts on invertebrates are not limited to the following:

- Vegetation clearing may in turn lead to increased run off, which may wash away important invertebrate groups;
- Affected insects may interfere with vital ecosystem functions and processes such as pollination hence vegetation regeneration.

Impact Analysis Matrix

Impact without Mitigation	
Severity of impact	*-3*
Spatial scope of impact	*-2*
Duration of impact	*-2*
Frequency of activity / duration of activity	*-5*
Frequency of impact	*-2*
Result	***-49 Low***

Mitigation measures

- Re-vegetation of the cleared vegetation.

(e) Impact on Livestock

From observations, it was noted that livestock grazing by the communities adjoining the Menengai caldera is a common place. From consultations, it was reported that the development of access road by GDC during the preceding stages of geothermal wells exploration and development have enhanced access to the caldera by herders. If animals graze at any contaminated sites, the chemical might accumulate in the animal body and cause side effects such as mineral imbalances leading to anaemia. However, geothermal effluents from the proposed project will be re-injected and sites will be fenced off. Ultimately animals' access to any contaminated sites should not be encouraged and therefore potential impacts are unlikely to occur.

Impact Analysis Matrix

Impact without Mitigation	
Severity of impact	*-3*
Spatial scope of impact	*-3*
Duration of impact	*-5*
Frequency of activity / duration of activity	*-1*
Frequency of impact	*-3*
Result	***-44 Low***

Mitigation measures

- Ensure all brine ponds and any waste water holdings are fenced off;
- Liaise with GDC and KFS in controlling access of herders into the caldera; and
- As part of community engagement, the community should be sensitized on the danger of exposure of livestock to brine ponds.

7.4.3 Landscape Character Impacts

During the construction process vegetation and other natural elements shall be cleared from the project area resulting in a change of the landscape character. Creation of new ground levels during construction shall also result in a minor change in the area topography.

This landscape character area has been identified as having medium landscape sensitivity. It forms part of tourist attraction with an established crater view point. Overall, the predicted magnitude of change in landscape resource is medium. Therefore, the predicted significance of landscape impact is moderate.

(a) Visual Impacts

The assessment of the existing visual environment and the impact of the proposed development and its various components on visual receptors have established that there will be potential visual impacts during construction and operation. It is notable that the caldera has a view point at the eastern rim from which tourists enjoy its scenic features. The elements that shall intrude the scenic view are;

- Above-ground steam pipes above the ground from the storm wells to the power station;
- Power Station Structures;
- Site Lighting – During construction and operation; and
- Construction Equipment – Temporary during construction.

Visual sensitivity for the area can be described as medium as activities already undertaken by GDC have had visual intrusion and the total plant area is relatively small in size (140x180m). Overall, the predicted magnitude of change in visual resource is low.

Impact Analysis Matrix

Impact without Mitigation	
Severity of impact	*-3*
Spatial scope of impact	*-1*
Duration of impact	*-2*
Frequency of activity / duration of activity	*-4*
Frequency of impact	*-4*
Result	***-48 Low***

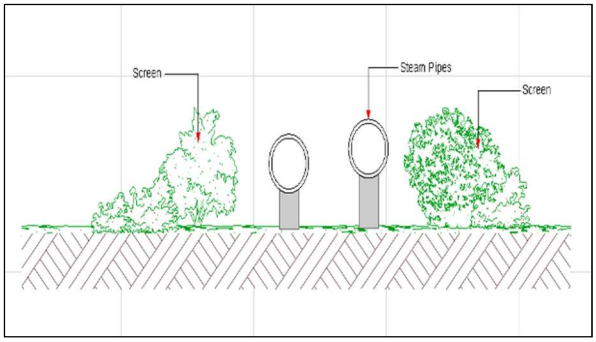
Mitigation measures

The mitigation measures proposed to deal with the anticipated impacts are shown in the table below:

Impact	Mitigation
Loss of Vegetation Cover	• Limiting vegetation clearing to defined construction areas only; • Preparation of a landscape planting plan for the entire project area. Planting plan to be comprised of 75% indigenous species and to be rid of any invasive species
Topography Change	• Limitation of earthworks to construction areas only
Soil disturbance	• Stripped topsoil to be preserved and used during landscaping. • All embankments to be vegetated or stone pitched to prevent soil erosion.

(b) Visual Environment

Visual impacts shall be mitigated by physical and visual integration of the proposed development and associated features into surrounding landscape. This mitigation measures shall include the following:

Impact	Mitigation
Typical visual intrusion by steam pipes from wells to a power station 	• Planting appropriate vegetation screen along the steam pipes to reduce visual intrusion across the landscape. • Pipeline colouring should be greened or given appropriate colour 
View intrusion by the power station structures	• The colour of structures within the project area should be carefully selected to reduce visual impact. Neutral, non-reflective colours blend well with the surrounding landscape.
Lighting	• Lighting to be switched off when not required; • Lighting of temporary working areas and site compounds during periods of darkness to be minimised where possible.

(c) Residual Impacts

If a proper post construction planting plan is developed, implemented fully and new vegetation establishes well, there shall be minimum residual impact on the landscape character. Likewise, if the visual impact mitigation measures are implemented, the visual impact shall be significantly reduced ensuring there are minimal residual effects.

Mitigation measures

- Sosian and GDC together with the other IPPs should undertake holistic studies on cumulative visual impacts to the entire caldera, in this coherent mitigation measures should be proposed.

7.4.4 Soil Erosion

This Project will involve earthworks and truck movements on unpaved surfaces which are bound to result in significant amounts of loose soil materials prone to erosion through surface runoff, especially during rainy seasons and by wind. However, with implementation of appropriate and timely erosion control measures, this can be arrested and associated soil loss and siltation minimized.

Impact Analysis Matrix

Impact without Mitigation	
Severity of impact	*-2*
Spatial scope of impact	*-2*
Duration of impact	*-3*
Frequency of activity / duration of activity	*-4*
Frequency of impact	*-3*
Result	***-49 Low***

Mitigation measures

(a) Site Soil Conservation Measures

Site clearing or disturbance of the natural vegetation will be planned and approved as part of project management process. Among the areas that require immediate restoration, the Contractor will allow minimal vegetation clearing and disturbance on the slopes to avoid difficulties during restoration.

Areas inevitably disturbed, cleared, excavated, or/and exposed during construction will be re-vegetated using native grass species, preferably of species growing in the immediate pristine environment like *Digitaria sp* to allow harmony with the surrounding and minimize duration for watering and care. The restoration period will require monitoring of the re-vegetated sites to assess impacts of heavy foraging, patch growth as well as gulley formation. For instance, tussock grass becomes dominant mid slope up to the valley bottoms hence preferred as the grass cover restoration for such an area.

Isolated sites with installations and frequent human presence that require re-vegetation will be surrounded by less palatable native species to act as plant screens and reduce pressure from wildlife and livestock foraging. Presence of well rooted vegetation will act as soil stabilization for the areas. *Croton sp* is recommended among the woody species.

(b) Other Mitigation Measures during Construction

- No grey water runoff or uncontrolled discharges from the site/working areas (including wash down areas) to adjacent watercourses and/or water bodies shall be permitted;
- Water containing pollutants such as cements, concrete, lime, chemicals and fuels shall be discharged into a conservancy tank for removal from site;
- Runoff loaded with sediment and other suspended materials from the site/working areas should be prevented from discharging to adjacent watercourses and/or water bodies must be prevented;
- Potential pollutants of any kind and in any form shall be kept, stored and used in such a manner that any escape can be contained and the water table not endangered;
- Wash areas shall be placed and constructed in such a manner so as to ensure that the surrounding areas (including groundwater) are not polluted.

7.4.5 Impact on natural sources of raw materials

No materials sites (quarry and other borrow areas) have been identified/confirmed for the project. Some materials may be sourced within the existing GDC quarries within the caldera

while others from outside. If such sites are not reinstated and rehabilitated after project completion, cause landscape scarring, dangers of overhanging cliffs and falling rocks which creates environmental, health and safety hazards.

From consultations, it was established that some of the quarries already existing in the site neighbourhoods immediately outside the crater e.g. in Maili Sita, have been associated with public safety concerns and structural integrity of nearby buildings. If the contractor sources materials from such quarries, the locals will develop resentment towards the project as this will be seen as promoting risky activities.

The quantities of earthwork and materials for power foundation However, given the size of area to be developed, the volumes of materials envisaged to be involved is very minimal and this impact is deemed to be of low significance.

Impact Analysis Matrix

Impact without Mitigation	
Severity of impact	*-3*
Spatial scope of impact	*-3*
Duration of impact	*-3*
Frequency of activity / duration of activity	*-2*
Frequency of impact	*-3*
Result	***-45 Low***

Mitigation measures

- Appropriate authorisation including from NEMA and Mines and Geology department to do or use any new borrows pits and quarries will be obtained before commencing activities;
- Any new borrow pits and quarries shall be located more than 100 meters from watercourses in a position that will facilitate the prevention of storm-water runoff from the site from entering the watercourse;
- Notice will be given 14 days to nearby communities of intention to excavate in the borrow pits or quarries;
- Borrow rehabilitation plans, will be prepared prior to use and approved by the local authorities;
- Storm-water and groundwater controls through appropriate drainage shall be implemented to prevent runoff entering streams and the slumping of soil from hillside above;
- The use of borrow pits or quarries for material spoil sites must be approved by the local authorities (and/or with the appropriate consent of the “landowner”). Where this occurs, the materials spoiled in the borrow pit shall be profiled to fit into the surrounding landscape covered with topsoil and re-vegetated.

In the event that blasting for rock will be done the following mitigation measures are proposed:

- A current and valid authorisation from the Department of Mines prior to any blasting activity shall be obtained;
- A qualified and registered blaster by the Department of Mines and Geology shall supervise all blasting and rock-splitting operations at all times;
- The Contractor shall ensure that appropriate pre blast monitoring records are in place (i.e. photographic and inspection records of structures in close proximity to the blast area);
- Sosian Geothermal Power Plants Ltd and the Contractor shall ensure that emergency services are notified, in writing, a minimum of 24 hours prior to any blasting activities commencing on Site;
- Sosian Geothermal Power Plants Ltd and the Contractor shall take necessary precautions to prevent damage to special features and the general environment, which includes the removal of fly-rock. Environmental damage caused by blasting/drilling shall be repaired at the Contractor’s expense;

- The Contractor shall ensure that staff involved in blasting be issued with the correct personal protective equipment (PPE) and adequate notification is provided to the local communities immediately prior to all blasting. It is preferable that warning / informative signage and billboards be erected at the site indicating operation hours as well as commencement and end of operations. All signals shall also be clearly given;
- Sosian Geothermal Power Plants Ltd and the Contractor shall use blast mats for cover material during blasting. Topsoil shall not be used as blast cover.
- Precautionary and corrective measures will be taken to avert defacing and deformation of the land features.

7.4.6 Water Resources

The major water supplies in the project area are from underground abstractions developed by GDC and supplemented by NAWASCO. The underground water developed by GDC is used for construction and related activities while NAWASCO supplies are for domestic needs. Currently there are no supply constraints. The project will require water during the construction and operation stage. The construction water requirements have been estimated in Table 4-3 and is not expected to negatively affect the existing supplies. Construction activities may however result to misuse of water resources if conservation measures are not adopted.

Impact Analysis Matrix

Impact without Mitigation	
Severity of impact	*-1*
Spatial scope of impact	*-3*
Duration of impact	*-2*
Frequency of activity / duration of activity	*-4*
Frequency of impact	*-3*
Result	***-42 Low***

Mitigation measures

For good practice the following mitigation measures are proposed, which the same are as proposed for the construction of the Menengai power plant:

- Continued monitoring of underground water levels by GDC;
- Accidental leakages and bursts of water supply pipelines should be reported and repaired immediately;
- Recycle water as much as possible should be encouraged for example water used for curing of concrete can be used for spraying dusty roads;
- Control of the water flows and the water consumption records must be kept and availed to the supervising and Sosian Geothermal Power Plants Ltd Resident Engineers at the end of working day;
- All employees should be sensitized on water usage practices like discouraging unnecessary opening of taps;
- Monitoring of taps and their efficiency should be done regularly;
- Curing of concrete should be done in conservancy tank to avoid wastage;
- Harvest water from surface runoff during rainfall times;
- GDC and the Contractor shall ensure that necessary approvals/permits from the water authorities for the abstraction of water is adhered to;
- The Contractor will be required to comply with the water quality regulations;
- No grey water runoff or uncontrolled discharges from the site/working areas (including wash-down areas) to adjacent watercourses and/or water bodies shall be permitted;
- Water containing pollutants such as cements, concrete, lime, chemicals and fuels shall be discharged into a conservancy tank for removal from site;
- The Contractor shall instruct their staff and sub-contractors that they must use toilet provided and not the bush or watercourses; and
- Reduction of baseline water quality through construction actions/activities shall be prevented (for example coffer dams, silt traps or plastic lining).

7.4.7 Air Quality and Dust

During construction the main emission sources include dust from earthworks and batching plants and tail gases from construction equipment and vehicles. The dust will settle on flora, and can cause increased incidence of respiratory problems (currently the leading illness in the general project area) and nuisance for local residents. However, given that the caldera is isolated and not densely settled (with exception of few temporary settlements by herders), the key dust impacts will mainly be realized in limited settlements along haulage routes outside the caldera which include the routes through Wanyororo sub location (via Wanyororo/Bahati gate) and Mercy Njeri sub location (Via the Kabarak gate). Given the unpaved nature of the roads, dust impact could be of medium to high significance depending on the dry or wet weather periods.

Impact Analysis Matrix

Impact without Mitigation	
Severity of impact	*-2*
Spatial scope of impact	*-3*
Duration of impact	*-2*
Frequency of activity / duration of activity	*-4*
Frequency of impact	*-3*
Result	***-49 Low***

Mitigation measures

The following mitigation measures will be implemented to minimize or reduce impact on air quality for proposed projects:

- Mobile machinery or vehicle maintenance and services should be undertaken away from project site in a yard set aside for this or by an approved garage or service station to prevent any incident of oil and fuel spills that could contaminate soils and possibly ground water quality.
- Daily monitoring of air quality standards;
- All construction machinery shall be maintained and serviced in accordance with the manufacture's specifications;
- Workers shall be trained / sensitized on dust minimization techniques and management of air pollution from vehicles and machinery;
- The removal of vegetation shall be avoided until such time as clearance is required and exposed surfaces shall be re-vegetated or stabilized as soon as practically feasible;
- Frequent watering of exposed surfaces, haulage routes through settled areas and piles of soil to prevent airborne dust emissions;
- All vehicles accessing the site shall observe low speed limits;
- Minimize idling time for construction vehicles;
- Incorporate dust/fumes arrestors in the batching plant e.g. use of dust nets
- Provision of appropriate protective personal equipment including respirators and aprons to affected personnel

7.4.8 Noise and vibration

There are several sources of noise during construction and operation. Noise may not only be a nuisance but can also be detrimental to the health of exposed persons depending on the magnitude and exposure period. In addition, excessive vibrations may be detrimental to structural integrity of nearby/affected installations.

Construction related activities that will impact on environmental noise and vibration levels typically include bulk earthworks, metal works, concrete works, traffic-generated noise and electrical works associated with the establishment of production wells, plant infrastructure, office buildings and support infrastructure. Noise levels have been monitored in connection to the existing activities as well as the Menengai geothermal wells' drilling in the recent past as indicated in section 3.1.7. Existing noise levels are already beyond the NEMA limits. However, any construction noises will be intermittent and mainly affect people working within the caldera

and occasionally those settled along the haulage routes. With appropriate mitigation measures for occupational exposure, the net impacts of noise and vibration are anticipated to be low - medium in magnitude.

Impact Analysis Matrix

Impact without Mitigation	
Severity of impact	*-3*
Spatial scope of impact	*-3*
Duration of impact	*-2*
Frequency of activity / duration of activity	*-5*
Frequency of impact	*-4*
Result	***-72 Low - Medium***

Mitigations

- Encourage the adoption of low noise technology and practice for construction machines;
- All diesel-powered construction equipment and plant vehicles must be kept at a high level of maintenance. This must particularly include the regular inspection and, if necessary, replacement of intake and exhaust silencers. Any change in the noise emission characteristics of equipment must serve as trigger for withdrawing it for maintenance;
- Limit construction activities to the day time only (indicated in NEMA license conditions to be between 0800 Hrs and 1700 Hrs) since noise impacts are most significant during the night; and
- Provide appropriate Personal Protective Equipment (PPEs) to all workers exposed to elevated noise levels and enforces usage.

7.4.9 Solid wastes

The construction phase will generate two types of solid wastes: spoils and household refuse. Construction spoils will consist of building materials, concrete, paper and plastic (for example from packaging materials and lagging), timber, scrap metal, etc at the lay down area. Disposal of the same solid wastes off-site could also be a social inconvenience if done in the wrong places. The off-site effects could be aesthetic, pest breeding, pollution of physical environment, invasion of scavengers and informal recycling communities.

During construction the contractor will setup various facilities for temporary use at the lay down area, which have to be removed and dismantled on completion of the works. Adopt recycle and reuse measures for some of the spoils generated such as woody spoils generated from construction work will be stock piled to manageable size on regular intervals, valued and given to surrounding community as fuel wood as a cost-effective measure. This will require a strategic and mutual understanding between the involved parties that is the local community, Sosian Geothermal Power Plants Ltd, GDC and the Contractor. All waste shall be removed from the site for appropriate disposal through licensed waste handlers.

Impact Analysis Matrix

Impact without Mitigation	
Severity of impact	*-2*
Spatial scope of impact	*-3*
Duration of impact	*-3*
Frequency of activity / duration of activity	*-2*
Frequency of impact	*-4*
Result	***-48 Low***

Mitigation

Identifying environmentally acceptable spoil sites for spoil materials and approval by GDC taking into consideration the following:

- Preferably to be located on land already cleared wherever possible.

- Diligence on the part of the Contractors during construction activities will minimise the amount of debris, and also will ensure that debris is disposed of in a sensible manner, at a specified and approved dump site.
- The tender documents should specify the proper disposal of waste during construction.
- The tender documents should also ensure that the Contractors leaves the site in a clean condition on completion of works. The Contractors should be required to restore and landscape all areas to the satisfaction of the GDC and Sosian Geothermal Power Plants Ltd.;
- All solid waste generated during construction and operation should be carefully monitored, collected, stored, and taken out of the park for disposal.
- Waste generated during the operation of the plant must be segregated at source, inventoried and appropriate methods of disposal determined.
- The development and rehabilitation of spoil areas shall include the following activities:

    - Stripping and stockpiling of topsoil;
    - Removal (to a nominal depth of 500mm) and stockpiling of subsoil;
    - Placement of spoil material;
    - Contouring of spoil site to approximate natural topography and drainage and/or reduce erosion impacts on the site;
    - Placement of excavated subsoil and then topsoil over spoil material;
    - Contouring and re-vegetation;
    - The Contractor shall ensure that the placement of spoil is done in such a manner to minimise the spread of materials and the impact on surrounding vegetation and that no materials 'creep' into 'no-go' areas.

7.4.10 Spread of communicable diseases

During the construction phase there is a risk of spread of communicable diseases such as tuberculosis, diarrhoea, Upper respiratory tract infections and pulmonary infections. Aspects of the physical environment that promote transmission of diseases include: inadequate housing, disposal of wastes, increased interactions between locals and construction workers, dusty environment and ventilation which are likely to occur during the construction phase of the project especially at the contractor's camp. Diarrhoea for instance is already a common public health problem within the project area.

Due to the protection status of the Forest Reserve and the controls at the formal access points into the geothermal field, the risk of mushrooming small businesses or hawkers seeking to provide food and snacks / refreshments to workers at the construction site is not foreseen. However, this also means that the project staff will have to either bring in their own food or rely on a service provider approved/commissioned by the EPC Contractor. Unhygienic handling of worker's food and domestic water supplies can be a source of public health concern.

Increased dust emissions from daily movement of staff and construction materials on non-bituminised access roads can exacerbate upper respiratory tract infections for community members present in their homes during work hours.

Workers active at excavation areas and other work sites with high concentrations of fugitive dust and fossil fuel emissions coupled with low ventilation may result in increased URTIs in workers that can spread to the community through staff-community interactions.

Impact Analysis Matrix

Impact without Mitigation	
Severity of impact	*-3*
Spatial scope of impact	*-3*
Duration of impact	*-2*
Frequency of activity / duration of activity	*-3*
Frequency of impact	*-3*
Result	***-48 Low***

Recommendations

- The Community Liaison Office should organize for community and workers training and sensitization programs in conjunction with the Sub-County Public Health Officer. This will facilitate development of more sanitation facilities within the community and also increase usage;
- Covering and / rehabilitation of borrow pits to prevent breeding of mosquitoes that spread malaria;
- Dust proofing of earth roads within the construction site through three (3) times watering a day. This can be done in the Morning, Noon and Afternoon or through spreading of grave/ballast or temporary tarmacking
- Formation of peer groups from among the project staff to ensure continuity in training and awareness raising;
- The contractor should ensure that the project workers are sensitised on the local culture.
- Sosian Geothermal Power Plant Ltd will monitor the implementation of the EPC Contractor's worker's accommodation strategy. Should the contractor provide centralised accommodation for staff in the project area,
- Sosian Geothermal Power Plants Ltd will instruct the contractor to update his social management programs to include the protections for worker's accommodation as provided in the labour laws, ILO Standards and PS 2;
- The EPC Contractor will provide workers sanitation, water and health related facilities as indicated in the project ESMP and in compliance with the Public Health Act, the Health Act, 2017, the labour laws and the Building Code;
- The Sosian Geothermal Power Plants Ltd Officer in charge of Community Relations, in collaboration with the EPC Contractor, GDC and the other IPPs will organize for periodic sensitisation of project staff on water, sanitation and hygiene (WASH) in the work place; in order to promote improvement of hygiene practices by workers, their families and immediate neighbours. Where necessary, support will be sought from the Rongai and Nakuru North Public Health Offices;
- To monitor the impact of point source pollutants and wastes on public health, Sosian Geothermal Power Plants Ltd will collaborate with the EPC Contractor, GDC and the other IPPs to check compliance on dust suppression, speed control, waste management and pollution control and abatement measures provided under the project ESMP;
- Sosian Geothermal Power Plants Ltd will collaborate with the EPC Contractor, GDC, the local public health office and the other IPPs to monitor data on increased incidences of diseases known to be exacerbated by dust, excessive noise and H2S to inform the grievance management process should such complaints arise; and
- Sosian Geothermal Power Plants Ltd will monitor complaints from the local community on dust emissions at the access routes and follow up with the resolution process through the GDC Community Liaison Office.

7.4.11 Increase in Amount and Tonnage of Traffic

The traffic to and from the caldera is currently limited to vehicles used by GDC and various contractors in geothermal exploration and drilling. Construction traffic for the power plant within the caldera is bound to increase from the commencement to completion of construction phase of power plant. This traffic will vary from fast, light vehicles used for transport of supervisors,

minibuses transporting workers to site, pickups, tracked excavators, fuel tankers, and tipping trucks (dump trucks).

All the roads used for access to and within the caldera are of murram or of gravel type off the existing public highways. The roads also have a number of blind meanders. These are likely to result in dusty environment and noise pollution within the area as a result of the anticipated heavy traffic along the roads during construction phase. The negative health and aesthetic effects will be on residents along these roads and the natural environment respectively.

The impact of increased traffic will be felt past the project site level to the neighbouring communities in Mercy Njeri and Wanyororo villages. This will be through increase in the number of fast-moving small construction vehicles in these areas. These can also lead to increased accidents involving vehicles, people and animals. However, the traffic is not anticipated to have significant impacts on the main Nakuru-Nairobi-Bahati and Nakuru-Kabarak-Kampi Ya Moto roads which are some of the busiest roads in close proximity to the project area.

As part of its security and traffic plan, GDC already controls vehicular traffic into/out of the geothermal area at the two existing access points (Wanyororo and Mercy Njeri/Kabarak access routes). Apart from GDC fleet, all other vehicles/visitors to the area require prior clearance from the GDC office. This existing system will make construction traffic easy to monitor and together with GDC traffic guidelines contained in the HSE policy document, will partly contribute to reducing traffic impacts especially within the caldera.

Impact Analysis Matrix

Impact without Mitigation	
Severity of impact	*-2*
Spatial scope of impact	*-2*
Duration of impact	*-2*
Frequency of activity / duration of activity	*-5*
Frequency of impact	*-4*
Result	***-54 Low - Medium***

Mitigation measures

- The contractor should develop a Traffic Management Plan to be followed by his staff within and outside the project area. Project traffic management plan should be jointly reviewed and approved by Sosian Geothermal Power Plants Ltd and GDC;
- Liaison with GDC to ensure timely maintenance and upgrading of existing roads where necessary to take care of the new traffic;
- Erection of proper signage along all roads selected for the construction process and at approaches to junctions with the main roads;
- Construction and maintenance of bumps along speed bumps along Bahati/Wanyororo access road and the roads within the caldera; more so near learning institutions, local centres and sharp corners along the access road;
- Sensitization and training of construction drivers;
- Monitoring, enforcement and disciplinary action of offenders;
- Use of escort and chase vehicles for abnormally sized loads;
- Consider transporting imported bulky equipment by rail between Mombasa and Nairobi;
- Publicly notify general road users of planned haulage timetable in advance; and
- Plan traffic movement, especially through the traversed urban centres, to occur during off peak hours.

7.4.12 Occupation and general public health and safety

(a) Occupational Health and Safety

The construction process is estimated to take 2 years. The construction activities may involve employment of numerous workers on site performing different activities including operation of powered and mobile equipment, increasing chances of workplace accidents, injuries and illnesses. Such accident and injuries could result from:

- Accidents involving construction machinery;
- Falls and slips from elevated work positions and or deep excavations;
- Electrical and welding equipment;
- Exposure to abnormally high amounts of Hydrogen sulphide, dust, excessive noise and vibrations etc.;
- Knocks by objects falling from heights;
- Encounter with and possible bites from poisonous reptiles/snakes;
- Working in confined spaces during equipment installation etc.

Health and safety of workers at the work place is a sure motivator to enhance productivity. It will thus be paramount that the contractor adheres to best practices in occupational health and safety and undertake through hazard and risk assessment to inform adequate safety plan before commencement of works.

(b) Public Health and Safety

Direct interaction between the local communities and the power plant construction site is not envisaged due to the controlled access to the caldera for vehicular traffic. Similarly, such access to pedestrians is also limited by the natural terrain barrier provided by the caldera rim. However, occasional instances of herders accessing the plant area may arise. In addition, residents from settlements along the access roads or those using the access roads (see Figure 3-17) and those near materials borrow sites exploited for the project will be exposed to accidents involving construction traffic and quarry activities respectively.

However, with appropriate management policies and implementation of safe working systems, these impacts area readily manageable reducing them to insignificant levels.

Impact Analysis Matrix

Impact without Mitigation	
Severity of impact	*-5*
Spatial scope of impact	*-3*
Duration of impact	*-3*
Frequency of activity / duration of activity	*-3*
Frequency of impact	*-3*
Result	***-66 Low - Medium***

Recommendation / Mitigation

- Contractor must develop Construction Safety and Health Policy in compliance with OSHA, IFCs Environmental, Health and Safety Guidelines among other international best practices;
- Undertake comprehensive assessment for PPE requirements, provide and enforce usage of all ranges of required PPEs;
- Contractors to establish a comprehensive Health and Safety Policy which should be in compliance with GDC's Occupation Health and Safety Policies and be approved by Environment, Health and Occupation Manager from GDC and Nakuru DOSH office;
- Ensure compliance with all standards and legally required Safety and Health regulations in line with OSHA;
- Sosian to include standard best practice health and safety provisions in the construction contract. The provisions should include insurance to enable the contractor to pay for any and all treatments required by his workers including those of all sub-contractors, together with any subsequent lifelong disability payments in line with WIBA;
- Employ a full-time qualified Safety and Health advisor;
- Include a specific and independent task in the supervision contract concerning H&S supervision and compliance, together with the staff resources to carry this out;
- Establish and enforce a strict code of conduct for all project drivers including outside suppliers delivering materials. The code should focus on safety, especially speed, and

loading, especially banning all carriage of staff, workers and passengers except in seats;

- Ensure the plant construction site is fenced to keep away animals and ensure restricted access;
- Require the contractor to source construction materials from duly licensed source areas by undertaking due diligence on the selected suppliers;
- Implement the specified H&S programme throughout the construction period. This should incorporate but not limited to:
    - An emergency response procedure and display at conspicuous sites in all work areas. This is likely to require one vehicle on site equipped as an ambulance and a paramedic on site at all times during construction activities;
    - Provision of a standard first aid kit at the site office at all times;
    - Provision of fire-fighting equipment available at the workers camp;
    - Provision of medical facilities for staff;
    - Installation of appropriate safety signage for all work sites;
    - Registration of the work place;
    - Maintain an accident register;
    - Carry out accident and incidents investigations and implement corrective actions;
    - Establishment of Occupational Health and Safety Committee;
    - Staff and visitor induction;
    - Toolbox and monthly safety meetings;
    - Routine inspections.

7.4.13 HIV / AIDs and Sexually Transmitted Infections

While the actual residential areas of the project staff are unknown at this point, the increase in money circulating in the project area from wages as well as supply of goods and services increases the instances of interaction between project staff and the local community in their leisure (after work) activities.

In addition to this, consumption of alcohol and the occurrence of casual sexual relations as part of the leisure activities by project staff is likely to increase during those periods that project staff have been paid their wages. This leads to an increased risk of spread of Sexually Transmitted Infections (STIs) and HIV/AIDS.

Commercial sex workers as well as financially challenged men, women and children may also be attracted to relaxation and leisure facilities in the vicinity of the project area due to the increased cash-based incomes as a result of the project. These interactions would further increase the chances of exchange of sex for money or other favours, thus increasing the risk of spread of STIs and HIV/AIDS.

Impact Analysis Matrix

Impact without Mitigation	
Severity of impact	*-4*
Spatial scope of impact	*-3*
Duration of impact	*-3*
Frequency of activity / duration of activity	*-5*
Frequency of impact	*-4*
Result	***-90 Medium-High***

Recommendation / Mitigation

The Contractor should ensure that prevention and management of sexually transmitted diseases as a result of social interaction between immigrant workers and local populations is conducted through:

- Education and sensitisation of workers and the local communities on HIV/AIDs and STIs in conjunction with Rongai and Nakuru North Sub-County Public Health Officers;

- Provision of condoms to the construction workers, project team and the public. This should be kept in places that are not locked and are accessible to the above persons;
- Where possible conduct regular sensitisation campaigns and monitoring and evaluation of the modes used during course of the project;
- Formation of peer groups from among the project staff to ensure continuity in training and awareness raising;
- The contractor has to institute HIV/AIDS awareness and prevention campaign amongst workers for the duration of the contract e.g. erect and maintain HIV/AIDS information posters at prominent locations as specified by the Resident Engineer in consultation with the GDC Community Liaison Office;
- The contractor has to ensure that staff are made aware of the risks of contracting or spreading sexually transmitted diseases;
- The contractor should ensure that the project workers are sensitised on the local culture;
- Contracting of a service provider to provide free testing and counselling facilities to project staff. This will be done through support of an identified existing VCT Facility (government or private sector) or facilitation of periodic mobile VCT clinics at the construction site. Participation by project staff in the counselling and testing activities will be voluntary;
- Monthly reporting to Sosian Geothermal Power Plants Ltd on implementation of the STI and HIV/AIDS Management Program;
- Periodic reporting to Sosian Geothermal Power Plants Ltd on the impact and outcome of implementation of the program, through a pre-program (baseline), mid-program and post-program Knowledge Attitude Practice (KAP) Survey;
- Participate in the GDC driven activities for the larger Menengai Geothermal Field stakeholders such as the national commemorative World AIDS Day;
- Where necessary, the EPC Contractor will through GDC, seek support from the regional (Nakuru) National AIDS Control Council (NACC) Co-ordinator as well as the Rongai and Nakuru North Sub-County Public Health Officers;
- All project staff will be periodically sensitised through tool box talks on how to identify and avoid sexual exploitation;
- All project staff will be periodically sensitised on the legal implications of any forms of sexual relations with children (statutory rape). Where necessary, the EPC Contractor will, through GDC invite the sub-county Child Protection Officers to participate in some of the tool box talks; and
- Sosian Geothermal Power Plants Ltd will track and review the implementation of the STI and HIV/AIDS Management Program through spot checks as well as ESMP monitoring and quarterly audit activities.

7.4.14 Contractors' worker accommodation

Contractor's workforce will be drawn from both local (especially the unskilled labour) and non-locals (especially for skilled labour). The accommodation plan for non-local staff and workforce transport arrangements are currently unknown. However, the EPC Contractor is prohibited from establishing a residential camp within the Forest Reserve For the non-local staff, the project contractor can either establish own workers' camp for accommodation or workers can be accommodated in various rental houses/hotels in Nakuru town and its outskirts (Mercy Njeri in particular and the neighbourhoods along the Kabarak Road was observed to have a considerable number of flats and storeyed residential apartments.) and shuttle daily to and from the site. Hotel or rental accommodation will see increased demand for these services. However, given the number of non-local staff (assuming up to 70% of the estimated 200 construction work force), this is not anticipated to have a significant impact on rental houses supply or tourist accommodation in Nakuru town over the estimated 21 months construction period.

Workers are entrenched within the community can have some impacts like local inflation due to their enhanced earning relative to the general community members, diversion of certain resources to meet their demand, waste management, effect on health services etc. However, given the number of workers likely to be engaged in the power plant project relative to the population in the area, the Impacts of such embedded workers on the community is not anticipated to be significant.

Where adopted, a typical contractor's camp has facilities including site offices, workshops, stores, vehicle parking, and staff accommodation. If adopted, the camp site is bound to have high human activity, material storage facilities, sanitary facilities, waste generation and disposal. All these are potential pollution agents that need adequate management. At worst, waste from the camp may be disposed of into the natural bush land or streams. Such a temporary camp is considered low-risk under EMCA and requires a separate environmental assessment culminating in an EIA project report.

Daily transportation of workers to and from site will also add to traffic impacts as discussed in section 7.4.11.

Impact Analysis Matrix

Impact without Mitigation	
Severity of impact	*-4*
Spatial scope of impact	*-3*
Duration of impact	*-3*
Frequency of activity / duration of activity	*-2*
Frequency of impact	*-4*
Result	***-60 Low - Medium***

Recommendation / Mitigation

To mitigate on the above, it is therefore proposed that:

- Workers transport to and from site shall be incorporated in the contractor's traffic management plan with the aim of optimizing trips to and from site;
- Where a worker's camp is to be used, a separate EIA shall be prepared by the contractor in line with EMCA and the IFC performance standards;
- The contractor's camp should have a comprehensive waste management and sanitation plan and facilities commensurate with population of workers and activities in the camps;
- Any storage tanks and equipment should have correct labels and Material Safety Data Sheets;
- Adequate Emergency Response Plan should be in place in the camps;
- The contractor should employ best practice management "housekeeping" (site cleanliness, waste disposal etc.) at all times;
- The contractor's facilities should be completely removed from site after use and the land restored to its previous condition or better; and
- All fuel storage and dispensing areas must be laid on hard standing.

7.4.15 Risks of wildfires

Consultations established that the vegetation within the caldera is prone to natural wildfires. Activities of power plant construction staff including improper disposal of any cleared vegetation and of cigarette buts and careless handling of inflammable material are likely to increase incidences of wildfires within the caldera especially during dry spells. This will negatively affect forage available for both wildlife and livestock.

Impact Analysis Matrix

Impact without Mitigation	
Severity of impact	*-4*
Spatial scope of impact	*-3*
Duration of impact	*-1*
Frequency of activity / duration of activity	*-1*
Frequency of impact	*-3*
Result	***-32 Low***

Mitigation

- Include an adequate fire buffer zone around the proposed power plant construction site. This could be open bare ground/un-vegetated areas and planting fire resistant trees e.g. Mexican green ash (*Fraxinus sp*) around the plant should be maintained throughout during the construction and the operation period;
- Liaise with the Menengai KFS office to sensitize construction and operation staff on wildfires and train on emergency responses; and
- Where temporary contractor's camp is adopted, additional fire hazard management measures shall be instituted including installation and maintenance of appropriate portable and automatic fires extinguishers as necessary.

7.4.16 Impacts of fuel and chemical storage on site

During the construction period for the Menengai Power Plant, oil spills may occur from the various equipment using petroleum-based fuels and lubricants. Spilled chemicals can contaminate soil as well as pollute water resources within the caldera and hazardous and flammable substances (e.g. diesel oil, paints, thinner, solvents, etc.) when improperly stored and handled on the site become potential health hazards. It is anticipated that refuelling and maintenance of large vehicles will take place on the construction site and that, correspondingly, there will be storage of fuel and lubricants on the site.

However, chances of surface water pollution are low due to improper fuel and chemical handling given that there is no permanent surface water body within the caldera while the seasonal stream available is located approximately 7.5km away from the proposed plant site with no direct drainage connectivity. In addition, given the radially inward drainage pattern of the caldera, surface activities within the caldera are not likely to directly interact with surface water bodies found outside the caldera.

Impact Analysis Matrix

Impact without Mitigation	
Severity of impact	*-4*
Spatial scope of impact	*-2*
Duration of impact	*-3*
Frequency of activity / duration of activity	*-2*
Frequency of impact	*-3*
Result	***-45 Low***

Mitigation measures

- Ensure that all chemicals delivered to site have a material safety data sheet (MSDS) with proper/correct instructions on how to handle the material;
- Ensure that the employees on site are aware of the company procedures for dealing with spills and leaks from oil storage tanks for the construction machinery though induction and safety training;
- In case of spillage, isolate the source of oil spill and contain the spillage using sandbags, sawdust, absorbent material and/or other materials approved by NEMA;
- Ensure that there is always a supply of absorbent material such as saw dust on site during construction, readily available to absorb/breakdown spill from machinery or oil storage;
- All vehicles and equipment should be kept in good working order, serviced regularly and stored in an area approved site by GDC and Sosian Geothermal Power Plants Ltd;
- Ensure that filling areas, Oil storage drums / products storage areas have a smooth impermeable (concrete or thick plastic covered in gravel) floor. The floor should be bunded and sloped towards a sump to contain any spillages of substances in accordance with *The Kenya Bureau of Standards (KEBS) KS 1969: 2006 The Petroleum Industry -The installation of underground storage tanks, pumps/dispensers and pipe work at service stations and consumer installations - Code of Practice.*

7.4.17 Potential Impacts on archaeological features

No archaeological sites have been recorded and no surface artefacts were seen on the proposed development site. However, since the absence of artefacts on the surface does not exclude the possibility existence of artefacts or features buried in the ground, there is a chance of encountering buried artefacts during excavation and other earthwork construction activities. Without proper planning in place to manage such encounters, any artefacts encountered by chance may be interfered with. The anticipated impacts are therefore rated insignificant.

Impact Analysis Matrix

Impact without Mitigation	
Severity of impact	*-2*
Spatial scope of impact	*-2*
Duration of impact	*-2*
Frequency of activity / duration of activity	*-4*
Frequency of impact	*-2*
Result	***-36 Low***

Mitigation measures

- The developer (Sosian Power Plant ltd) shall notify NMK if any artefacts or bones are uncovered in the course of excavations. This is in accordance with the National Museums of Kenya Chance Finds Procedure which aims to minimize damage to objects accidentally uncovered during the construction phase;
- If something is discovered in the course of excavation, the exercise must be stopped to determine whether a rescue operation needs to be carried out. This requires a pause in the construction and removal of the objects in question and only then can the construction continue. Any questionable objects must be shown to the archaeologist on duty in order to determine its value, and any of the management options outlined in the procedure applied;
- The EPC contractor should have a chance find procedure on site which should be used in case of an encounter with any archaeological feature; and
- Decisions regarding cultural heritage must be consistent with the requirements of IFC Performance Standard 8 and the UNESCO 1972 World Heritage Convention.

7.4.18 Land take and displacement

The proposed power plant will be located in Menengai caldera which is a gazetted government forest reserve under the management of KFS. As such, there will be no displacement of any settlements to pave way for the power plant construction. Further, geothermal development in the area was sanctioned by the government. No change of user will be necessary for the proposed project.

From both noise and air quality modelling outcomes, no adverse public health impacts are anticipated on the nearest sensitive receptors (settlements) hence no resettlement is anticipated based on community health concerns.

It is, however, notable that 30m wide way leave was required for a section of the 15km transmission of power generated from the plant to the national grid. KETRACO undertook ARAP studies for the transmission line. The line did not necessitate any physical displacement of individuals but affected 25 parcels of land, 6 parcels belonging to the government and the rest to private individuals. According to the latest status update received from KETRACO, all the private individuals have been paid their compensation packages apart from 2 absentee land owners and 1 parcel over which land succession has delayed the compensation process. Compensation was done before ahead of the line construction.

Finally, land take for the Wanyororo access road was undertaken in order to provide for a wider Right of Way (RoW) for the access road. From consultations with GDC, it was reported that compensation for all the land owners who ceded land fronting their properties to allow for the expanded RoW have all been compensated. At the time of this assessment, there were no

records of grievances concerning the compensation and payment process, all prior issues having being resolved by the time.

7.5 Positive Impacts during operation

7.5.1 Increased power supply to the national grid

The key positive operation impact will be meeting the development objective. The objective of Menengai geothermal power project is to construct a 35 MW geothermal power plant with associated infrastructure. This will then be connected to the national grid towards meeting the ever-increasing demand for electric power in the country. The project will partly contribute to realisation of vision 2030 through enhancing the country's energy security. Further, electricity generation via geothermal energy exploitation is regarded as environmentally-friendly and sustainable.

Impact Analysis Matrix

Impact without Mitigation	
Severity of impact	*+5*
Spatial scope of impact	*+5*
Duration of impact	*+4*
Frequency of activity / duration of activity	*+5*
Frequency of impact	*+5*
Result	***+140 Very High***

It also recommended that the proponent considers registering the project under the Clean Development Mechanism (CDM) to earn associated benefits both to the locals and the nation.

7.5.2 Creation of employment opportunities

The project will create direct and indirect employment opportunities in its operation phase. Direct employment opportunities will include operation and maintenance workers in the geothermal plant, labour force employed in supporting business such as transportation. It is estimated that a maximum of 15 operation staff will be stationed at the facility permanently. These opportunities will lead to local increases in trade and hence general economic development in the project area and reduced unemployment.

Impact Analysis Matrix

Impact without Mitigation	
Severity of impact	*+5*
Spatial scope of impact	*+5*
Duration of impact	*+4*
Frequency of activity / duration of activity	*+4*
Frequency of impact	*+5*
Result	***+126 Very High***

Sosian Geothermal Power Plants Ltd should emphasize the use of local labour in plant O&M as far as feasible to enhance benefits for the local population and develop national capacity.

7.5.3 Opportunities for enhanced tourism

The project is located within a caldera with existing tourist attraction being the scenic view of Menengai crater from the rim of the caldera and associated nature trails. Feedback from consultations with the local forest management office indicated that there are plants to enhance tourism activity at the area through establishment of a model ecotourism site at the rim of the caldera with KFS branding Menengai view point.

Operation of the project is likely to enhance tourist attractions with visitors taking opportunity to also tour the geothermal project i.e. see power generation activities within the Caldera.

Impact Analysis Matrix

Impact without Mitigation	
Severity of impact	*+4*
Spatial scope of impact	*+5*
Duration of impact	*+4*
Frequency of activity / duration of activity	*+4*
Frequency of impact	*+4*
Result	***+104 Very High***

This can be enhanced through coordinated management of the nature trail and the power plant visitor between the KFS, GDC and the IPPs.

In addition, educational expeditions could also be enhanced in conjunction with learning institutions.

7.5.4 Potential for Carbon Market

Geothermal power stations are eligible for CDM because they release lower greenhouse gases than thermal power plants. When the Menengai Power Station will be included as a CDM project, community projects around the area are likely to benefit from revenue generated from CDM through financing of community projects.

Impact Analysis Matrix

Impact without Mitigation	
Severity of impact	*+3*
Spatial scope of impact	*+4*
Duration of impact	*+3*
Frequency of activity / duration of activity	*+4*
Frequency of impact	*+3*
Result	**+ 70 *Low - Medium***

7.6 Negative Impacts during operation

7.6.1 Impact on Flora

The major impacts on flora during the operation phase include (but not limited to) the following:

- Invasive species such as *Ricinus communis, Nicotiana glauca and Lantana camara* may encroach on the cleared areas including road sides and areas near the plant. This may alter the physiognomy and the aesthetic appeal of the original area;
- Non-condensable Gases such as hydrogen sulphide (H_2S), sulphur dioxide (SO_2), ammonia (NH_3) and carbon dioxide (CO_2) released in escaping steam are known to have some impacts on the vegetation in the long term especially when produced in high concentrations (Thompson and Kats 1978) though some plants have been shown to be more tolerant (EPA, 1977; El-Hinnawi, 1981);
- High levels of H_2S, SO_2, NH_3 and CO_2 may result to the formation of acid rains although this has not been recorded in similar plants existing in Kenya like the Olkaria geothermal plants (Marani 1995);
- Brine may have deleterious effects on plants due to its chemical composition and the fact that it is usually at high temperature. Brine flows and ponds should be located close to the source. Distant flow should be piped to prevent animal or vegetation contact.

At worst, such adverse impacts may be very significant if the planted forest from the rim of the caldera is affected.

Impact Analysis Matrix

Impact without Mitigation	
Severity of impact	*-3*
Spatial scope of impact	*-3*
Duration of impact	*-4*
Frequency of activity / duration of activity	*-2*
Frequency of impact	*-2*
Result	***-40 Low***

Mitigation measures

- Monitor invasive plant species at the project area and uproot unwanted germinating plants;
- Assess concentration geothermal gaseous effluents such as H_2S, SO_2, NH_3 and CO_2 (e.g. by use of automatic sensors) and continually test for any evidence of acid rain
- Plant soil-erosion preventing grass species such as *Cynodon dactylon, Digitaria abyssinica, Pennisetum clandestinum* and *Hyparrhenia sp* at bare sloppy grounds or loose soil dumps;
- Steam pipe insulations should have a well camouflaged colours that are maintained so that animals don't perceive pipelines as barriers
- Brine flows and ponds should be located close to the source. Distant flow should be transmitted through closed pipes
- Rehabilitate disturbed areas along roads, pipelines and abandoned campsites etc by planting native plant species such as *Acacia mearnsii, Psidium guajava* and *A. melanoxylon*– this should be done as soon as practicable to avoid colonization by invasive and opportunistic pioneer species;
- Create awareness among the local communities on the importance of vegetation cover and discourage them from engaging in charcoal burning.

7.6.2 Impacts on Macrofauna

The major impacts on Macrofauna (Mammals) during the operation phase include (but not limited to) the following:

- Due to the high human and vehicle traffic in the area, there may be incidences of wildlife poaching;
- The noise from emission power plant installations will scare away many animal species;
- Brine in sumps or flowing into open surfaces may lead to contamination of the animal's drinking water;
- Strong flood lights if covering a large area may interfere with natural behaviour of both diurnal and nocturnal animals.

Given the relatively low density of mammals in the immediate project area and absence of any special habitat/range and migratory corridor, the anticipated impacts will not be very significant.

Impact Analysis Matrix

Impact without Mitigation	
Severity of impact	*-2*
Spatial scope of impact	*-3*
Duration of impact	*-4*
Frequency of activity / duration of activity	*-2*
Frequency of impact	*-2*
Result	***-36 Low***

Recommendation / Mitigation

- Sosian, GDC and KWS should monitor wildlife abundance, distribution and movement in relation to this infrastructural development during construction and operation stages to aid in decision making;

- Erect and maintain bumps and relevant warning signages to prevent traffic accidents involving wildlife within the caldera;
- Vehicular disturbances such as hooting should be discouraged accordingly;
- Incident records (of poaching, accidents and other human wildlife conflicts etc) should be kept by monitoring and taking of corrective measures;
- Forest rules should be enforced within the caldera;
- Brine ponds should be located close to the source. Distant flow should be piped to prevent animal or vegetation contact;

7.6.3 Impact on Avifauna

The major impacts on bird during the operation phase may include but not limited to the following:

- Powerful flood/security lights that are directed/shining upwards or covering a large area may interfere with birds that move by night;
- Also, when visible e.g. during the day, the swaying of the lines in the wind, their reflective properties and the humming sounds may probably scare away many birds – resulting in a huge area devoid of the flying creatures;
- As infrastructural and human footprint increase in the caldera, forest interior/specialist birds (Jackson's Widowbird, dusky turtle dove, African green pigeon, emerald spotted wood dove, Owls, hoopoe, red throated wryneck, shrikes) are likely to disappear giving to species that are habituated to human environments such as speckled mouse birds, feral pigeons, superb starlings, pied crows; and
- High-voltage transmission lines may cause death to birds through electrocution or as a result of direct collision.

Impact Analysis Matrix

Impact without Mitigation	
Severity of impact	*-2*
Spatial scope of impact	*-2*
Duration of impact	*-4*
Frequency of activity / duration of activity	*-2*
Frequency of impact	*-2*
Result	***-32 Low***

Recommendation / Mitigation

- High heat points and emission vents should be sheltered or fitted with inhibitors to deter birds from perching or hovering around.
- Sosian, GDC and KETRACO in liaison with KWS should develop and implement an avifauna monitoring scheme, assessing bird population trends and direct hazards relating to the project;
- The project site has gorges, valleys and hillsides which form some of the keystone habitat features for raptors (Vultures and Eagles) as they enable them to soar high using thermal currents while in search of prey. These should therefore be retained as intact as possible;
- High voltage transmission lines should be fitted with wire markers and flappers to alert any birds on flight;
- Domestic food remains should not be throne carefully within the site so as to prevent attraction of birds to site;
- Revegetation of degraded and disturbed project sites should be in harmony with immediate native forest cover. Forest cover and general habitat monitoring within the Caldera by GDC should ensure no-net-loss of habitats likely to trigger disappearance of forest interior / specialist species. and
- High heat points and emission vents within the project area should be sheltered or fitted with inhibitors to deter birds which may get killed as a result of using such areas;

7.6.4 Impacts on Herpetofauna

The major foreseen impacts of this project on herpetofauna during operation phase include:

- Brine flows should be piped to the brine ponds rather than being let to freely flow on open channels as this negatively affects herpetofauna in the area e.g. direct burning of slow-moving species or alteration of water quality;
- Brine ponds and cold re-injection sites should be monitored to ascertain their utilization as suitable habitat by amphibians like toads and frogs; and
- Conflicts between workers and reptiles that may find their way into the power plant compound.

Impact Analysis Matrix

Impact without Mitigation	
Severity of impact	*-2*
Spatial scope of impact	*-2*
Duration of impact	*-4*
Frequency of activity / duration of activity	*-2*
Frequency of impact	*-2*
Result	***-32 Low***

Recommendation / Mitigation

- Water and steam pipe lines should be laid across (perpendicular to) the valleys rather than running along them – as this will mean destroying large patch of this ecologically sensitive keystone habitat for many species;
- It is desirable to re-vegetate disturbed areas along roads, pipelines and steam lines and other construction sites;
- Create awareness among the local communities and discourage them from engaging in charcoal burning which is evidently on the increase in this area; and
- Sensitize operation and maintenance staff on handling encounters with reptiles who may find their way into the plant area, including liaison with local KWS office for relocation where necessary.

7.6.5 Operation wastes

Operation of the geothermal power plant is not anticipated to generate significant amount of wastes. Geothermal technologies do not generate significant volumes of solid waste. Typical wastes generated during the operational phase include:

- Maintenance wastes include:
  - Waste oils and lubricants
  - Scrap metal
  - Waste electrical and electronic components.
  - Batteries
  - Contaminated rags
  - (Potentially) Contaminated spill response equipment
  - Contaminated safety clothing, gloves, masks, and equipment
  - Waste wood
  - Waste paints and solvents
  - Contaminated plant and machinery, including filters
- Domestic and food wastes (from operation staff estimated to be a maximum of 15)
- Sewage wastes.
- Sludges (potentially contaminated with silica compounds, chlorides, arsenic, mercury, vanadium, nickel, and other heavy metals could be generated).
- Oily water and run-off.
- Elemental sulphur from the treatment of H_2S.
- Geothermal brine.

Since the surrounding area is an open veld, storm water will be allowed to flow on the ground as a sheet flow. Domestic waste generated by the operation staff estimated to be a maximum of 15. The proposed domestic waste water management system is presented in section 4.2 while solid wastes will be regularly collected for disposal by a contracted waste handler. The major industrial waste is brine (the wastewater from geothermal plants). Hydrocarbon-based wastes (e.g. spent lubricants, used oil etc.) generated through regular maintenance of the turbine and associated machines are hazardous.

Improper handling of these wastes could be very detrimental to the biophysical environment like:

- The chemical concentration of brine for instance has the potential to harm flora and fauna; thus, the disposal mechanism should allow reduce chances of harmful contact;
- The release of wastewater (from existing well drilling activities) via gullies and natural drainage lines has resulted in erosion effects.

With existing operations, there have been allegations by some consulted stakeholders that the materials used for lining brine ponds are of poor quality and are also regularly vandalised exposing receiving environments to brine pollution.

However, with proper implementation of proposed mitigation measures, the anticipated impacts will be insignificant. The proposed long-term method of wastewater disposal is by deep re-injection into a number of purposes drilled or unused production wells, which should have minimal surface impact as well as minimize contact with ground flora and fauna. The level of re-injection will be below aquifer levels used for water supply in the locality and there is little possibility of surface or groundwater pollution. One advantage of the fact that the brine will have been cooled is that the re-injection line can be buried. This is recommended so that the pipeline does not become a barrier to wildlife movement, particularly since the proposed re-injection wells lie some distance from the production field wells.

Impact Analysis Matrix

Impact without Mitigation	
Severity of impact	*-3*
Spatial scope of impact	*-2*
Duration of impact	*-4*
Frequency of activity / duration of activity	*-5*
Frequency of impact	*-3*
Result	***-72 Low-Medium***

Mitigation measures

- Brine ponds should be sited close to the source;
- Any brine ponds constructed should be lined with durable impervious materials of suitable quality and protected from any form of vandalism;
- Brine re-injection through re-injection wells into underground reservoir;
- Chemical composition and parameters of the brine should be regularly monitored. Monitoring of brine should be weekly and parameters to be measured include pH @ 25°C, TDS and SiO_2;
- Waste from catering services should be collected in lidded bins disposed offsite at landfills to avoid attraction scavengers to the project site;
- Waste such as oil, paints and lubricants should be designated a specific area within the site where they are placed/gathered before final off-disposal; this area should be constructed to prevent leakage which can lead to soil contamination as well as secured from scavenging wildlife; and
- Monitoring of waste should be continuous by tracking the volume of volume and type generated and establishing the treatment, storage, transport and disposal methods.

7.6.6 Fire Risk

With the installation of the power plant, related substations and transmission lines and associated control infrastructure, there is likely to be a fire risk during operation due to human error or faulty equipment. This may not only be detrimental to the development and energy supply to the national grid but also to the safety of operation staff. However, with implementation of best industry practice and the plant's in-built emergency fire suppression measures, the anticipated impact will be significantly reduced.

Impact Analysis Matrix

Impact without Mitigation	
Severity of impact	*-4*
Spatial scope of impact	*-2*
Duration of impact	*-1*
Frequency of activity / duration of activity	*-2*
Frequency of impact	*-2*
Result	***-28 Low***

Mitigation measures

- Ensure best international industry practice;
- Maintain and regularly inspect for serviceability of the installed fire protection system of fire water tanks, fire extinguishers, fire hydrants, hose reels, fire alarms and sprinklers;
- Formulate a fire emergency response plan for the operation phase. in liaison with GDC, this should be integrated with the overall Menengai geothermal field emergency response plan;
- Ensure that there are emergency contacts for the nearest fire respondents within the site;
- Train some staff to be fire marshals in line with OSHA 2007 requirements;
- Carry out fire drills -Inspect fire-fighting equipment; and
- Ensure regular safety audits by independent experts.

7.6.7 Accidental chemical spills

During plant operation, hydrocarbons and other chemicals such as solvents, coolants, acids, and, alkalis will be used. Accidental spillage or improper disposal of these hydrocarbons can be harmful to the receiving environments, mainly the soil and internal natural surface drainages. There is, however, no open surface water body within the immediate vicinity of the proposed plant and such impacts will mainly affect soils and plants.

Impact Analysis Matrix

Impact without Mitigation	
Severity of impact	*-4*
Spatial scope of impact	*-2*
Duration of impact	*-3*
Frequency of activity / duration of activity	*-2*
Frequency of impact	*-2*
Result	***-36 Low***

Mitigation measures

- Spill and drip trays used during servicing of machinery;
- Use septic tanks while ensuring doesn't flow to the surface;
- Response plans for accidental spills to be formulated and routinely tested by the O&M operator;
- Bunded storage areas and secondary containment for oil and chemicals;
- Use of an oil interceptor in the plant area where surface drainage is likely to be contaminated. Monitoring records for interceptors should include levels of oil and grease, total suspended solids and Total chromium, copper, iron and zinc;

- Place hazardous materials up to 2 kilometres away from the public water supply reservoirs such as in Ol Banita groundwater reservoirs. Also avoid placing within flood levels;
- Storage of fuel and other flammable materials shall comply with standard fire safety regulations;
- A secured compound shall be provided for storage tanks for chemicals and fuel. All chemicals and fuels shall be stored with manufacturer's instructions in mind as per the material safety data sheets;
- Storage areas or secondary containment shall be constructed of waterproof reinforced concrete or approved equivalent, which is not adversely affected by contact with chemicals captured within them;
- The minimum volume for secondary containment shall be 110% of the capacity of the largest tank system, plus 10% of the total capacity of all other separate tanks and containers within the bund wall with closed valves for controlled draining during rains;
- Pipe-work carrying product from the tank to facilities outside the containment shall be provided with secondary containment;
- Tank equipment such as dispensing hoses, valves, meters, pumps, and gauges shall be located within the containment or provided with own containment.

7.6.8 Occupation health and safety

Due to the fact that there are going to be staff working in different areas of the plant, accidents may likely to occur within the plant area. Some workers will also be likely exposed to high levels of noise, heat and H_2S which are detrimental to health. Noise and H2S exposure are the major occupational safety and health hazards identified so far.

Prior to connecting the completed plant to the steam gathering system, the PISSA has a requirement for a joint inspection to verify both the power plant and the steam gathering system protection equipment and mechanisms. This is toward ensuring that the associated safety measures are synchronised.

Impact Analysis Matrix

Impact without Mitigation	
Severity of impact	*-4*
Spatial scope of impact	*-1*
Duration of impact	*-4*
Frequency of activity / duration of activity	*-3*
Frequency of impact	*-4*
Result	***-63 Low - Medium***

Mitigation measures

- Formulate a plant occupational safety and health management plan. The plan as a minimum MUST have and require:
- Identification of all potential hazards;
- Compliance with GDC Health, Safety and Environment policy;
- Compliance with OSHA, 2007;
- Continuous H_2S monitoring within the plant premises;
- Equipping employees with necessary Personal Protective Equipment (PPE) including personal H_2S monitors for workers in exposed environments;
- Regular and induction training, of members of the safety committee and new staff respectively on First Aid;
- Ensure the plant and office blocks have adequate supply of First Aid Kits;
- Location of appropriate safety and warring signs around the plant;
- Inspections on conditions of machinery and equipment -Register the plant as a workplace with DOSHS;
- Medical examination of all employees before, during and after termination of employment;
- Emergency evacuation plan; and

- Regular independent Occupational Health and Safety audits.

7.6.9 Impacts on groundwater resources

Consultations with the regional office of Water Resources Management Authority and the existing bulk water service provider in the area, NAWASCO pointed out that since geothermal wells in the Menengai caldera were commissioned, the water temperature from the boreholes near the proposed power plant have been recording increased temperatures. This has impacted on operation and maintenance cost of the bulk water service providers and complaints from water consumers. It is notable that underground water is the main water supply to the locals and the nearby Nakuru town. If confirmed, such impacts would be significant in affecting the local waste supplies. It is notable that GDC has a policy of isolating steam producing sources from shallower hydrologic formations which may be used as sources of potable water through careful site selection and properly designed and installed well casing systems.

Impact Analysis Matrix

Impact without Mitigation	
Severity of impact	*-4*
Spatial scope of impact	*-4*
Duration of impact	*-4*
Frequency of activity / duration of activity	*-3*
Frequency of impact	*-4*
Result	***-84 Medium-High***

Mitigation

- Liaise with GDC to ensure that all well casing systems are properly designed and installed;
- GDC, NAWASCO and the water resources authority should undertake joint studies to investigate possibility of thermal contamination of underground water aquifers within the area with geothermal steam production and institute appropriate mitigations where necessary;
- Sosian and GDC should continually monitor water utilization in the plant's operation and enhance conservation efforts through water efficient fixtures;
- Formulate efficient water use practices for both domestic and plant water requirements; and
- Maintain and audit water use records.

7.6.10 Ground subsidence and seismic risks

In geothermal development, geothermal fluids withdrawal rate may surpass the natural rate of replenishment. Ultimately pressure drop in the reservoir as a result of fluid withdrawal could occur leading subsidence.

In general, subsidence is greater in liquid-dominated fields because of the geological characteristics typically associated with each type of field. Ground subsidence can affect the stability of pipelines, drains, and well casings. It can also cause the formation of ponds and cracks in the ground and, if the site is close to a populated area, it can lead to instability of buildings. The presence of numerous fault lines within the caldera may also contribute to increased seismic risks. Fluid re-injection at proper rates and pressures reduces subsidence potential significantly.

Impact Analysis Matrix

Impact without Mitigation	
Severity of impact	*-4*
Spatial scope of impact	*-4*
Duration of impact	*-3*
Frequency of activity / duration of activity	*-2*
Frequency of impact	*-2*
Result	***-44 Low***

Mitigation

- Continuous monitoring of seismic activity in the caldera and its surrounding by GDC; and
- GDC to formulate community risk management plan including trigger levels and communication strategy. The plan should incorporate all the IPPs, other relevant government agencies like mines and geology department, national disaster coordinating agency and the county government of Nakuru.

7.6.11 High socio-economic interest by communities

Public and stakeholders' consultations revealed that the local communities have high socioeconomic interests and a lot of expectations with the geothermal power development activities going on within the Menengai caldera. Some expectations and even false information are held by the communities. These include but are not limited to:

- Employment opportunities to benefit majority of the locals but never realised due to favouritism and nepotism;
- Political interest by different leaders; and
- Feeling that even basic contracts are awarded to non-locals.

Improper handling and misrepresentation of facts about the project area by the various players (GDC, Sosian and the other two IPPS) likely to hurt the good standing with the community and overall performance.

Impact Analysis Matrix

Impact without Mitigation	
Severity of impact	*-4*
Spatial scope of impact	*-4*
Duration of impact	*-3*
Frequency of activity / duration of activity	*-2*
Frequency of impact	*-2*
Result	***-44 Low***

Mitigation

Given the presence of other IPPs in the project area, the following measures should be undertaken both at Sosian level and in collaboration with GDC and the other IPPs as feasible:

- Develop and implement a community liaison strategy with proper communication and feedback mechanism. Any community social responsibility should be communicated through this strategy;
- Develop a clear and transparent employment policy for the local communities and ensure its fair implementation: and
- The expectation that many community members will be employed during the construction phase of the project needs to be managed. Community members should be informed of the limited employment opportunities. If at all possible, the project should notify community members of the number of jobs available, the skills required, employment period and the selection criteria of the project. In doing so community members would be well informed of the actual employment opportunities. This would reduce expectations and prevent

disappointment thereby instilling community trust in the project. This is essential if the project is to maintain healthy and cooperative relationships with the communities.

7.6.12 Impact on Air Quality

The most significant emissions from the Power Plant operation will potentially include the release of NCGs from steam vents and cooling towers/NCGs stacks. Although these can be considered 'natural' in the sense that they are already emitted from numerous existing fumaroles and vents, the power station will emit these in larger quantities than might be experienced naturally. Additionally, pipeline failures due to damage or corrosion could result in unplanned releases of steam and NCGs.

The composition of NCGs of the Menengai wells is shown in Table 4-2. H_2S and CO_2 are the predominant NCGs. H_2S is an odorous compound commonly found in geothermal areas and released through natural sources. It presents an unpleasant, typically "rotten eggs" odour at relatively low concentrations and is toxic in higher concentrations. CO_2 is not significant in terms of direct impact to human health but is a greenhouse gas. Studies on the effects of elevated CO_2 levels on vegetation around geothermal power plants in the US have shown that growth and productivity of commercial crops actually increased.

Combustion gas emissions during operation will be limited to emergency generators, firewater pumps, and service vehicles required for transporting any maintenance equipment and materials.

Air quality impact assessment study due to the proposed power plant established the following:

- The wind direction for the area is predominantly from the south and northeast. Long term air quality impacts are therefore expected to the north and southwest of the proposed operations;
- Ambient air quality monitoring conducted at the wells by the GDC, from 2016 to 2019 indicated ambient air pollutant levels that exceed the odour threshold as well as the American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Value (TLV) of 1 ppm.
- Several AQSRs are situated within the vicinity of the proposed power plant (several homesteads in the caldera, 3.5 km southwest of the plant, and areas outside of caldera 2 km northwest of the plant, Marigo, and 2.5 km north-north-east of the plant, Rigogo).

(a) Atmospheric Emissions

The establishment of a comprehensive emission inventory formed the basis for the assessment of the air quality impacts from the project's operations on the receiving environment.

(i) Sosian Geothermal Power Plant

A summary of emissions quantified for Sosian and source input parameters are provided in Table 7-4. Two scenarios were considered:

- Scenario A – emissions dispersed from single stack
- Scenario B – emissions dispersed from 40 vents situated above condenser fans

Table 7-4: Estimated stack parameters and emission rates for the Sosian power plant

Equipment and arrangement options	Stack parameters				Stack emissions		
	Height (m)	Diameter (m)	Velocity (m/s)	Temp (°C)	H_2S per stack (g/s)	H_2S total (g/s)	H_2S total (tpa)
Scenario A- Assuming single stack	25	0.35	23	52	117.1	117.1	3 693
Scenario B – Assuming multiple (40) vents	7	2.2	15.1	52	2.9	117.1	3693

(ii) Quantum Geothermal Power Plant

A summary of emissions quantified for Quantum was obtained from the study done in 2015 (Petzer & Bornman, 2015) and source input parameters are provided in Table 7-5.

Table 7-5: Estimated stack parameters and emission rates for the Quantum plant

Equipment and arrangement options	Stack parameters				Stack emissions		
	Height (m)	Diameter (m)	Velocity (m/s)	Temp (°C)	H_2S per stack (g/s)	H_2S total (g/s)	H_2S total (tpa)
Assuming single stack	30	0.4	13	33	76	76	2397
Assuming dispersal from 4 cooling tower fans	13.9	9.75	8.5	36.8	19 per cooling tower fan	76	2397

(iii) Orpower Twenty-two Limited (OTTL) Geothermal Power Plant

The complete stack parameters and emission rates are contained in the air quality impact assessment that was been completed for this Geothermal Power Plant (Petzer, 2019).

(b) Atmospheric Dispersion Modelling

The assessment of the impact of the project's operations on the environment is discussed in this section. To assess impact on human health and the environment the following important aspects need to be considered:

- The criteria against which impacts are assessed i.e. Emission standards and Air quality standards/guidelines;
- The potential of the atmosphere to disperse and dilute pollutants emitted by the project i.e. the Physical and meteorological mechanisms govern the dispersion, transformation, and eventual removal of pollutants from the atmosphere; and
- The methodology followed in determining ambient pollutant concentrations i.e. Atmospheric Dispersion Modelling System version 5 (ADMS 5).

The impact of operations on the atmospheric environment was determined through the simulation of ambient pollutant concentrations. Table 7-6 shows the scenarios included in the dispersion modelling results. Whereas OTTL have an idea of the arrangements they will be installing, it is unclear which option Quantum and Sosian is going to use (four scenarios were therefore assumed for the cumulative scenario).

Table 7-6: Scenarios considered for the three IPP

Scenario	Equipment and arrangement options	IPP and Emission Point		
		OTTL	Quantum	Sosian
1A	Assuming Quantum and Sosian single stack and OTTL dispersal from 4 cooling tower fans	Cooling tower fans	Single stack	Single stack
1B	Assuming Quantum single stack, Sosian 40 vents and OTTL dispersal from 4 cooling tower fans	Cooling tower fans	Single stack	Condenser fan vents
2A	Assuming Sosian single stack and Quantum and OTTL dispersal from 4 cooling tower fans	Cooling tower fans	Cooling tower fans	Single stack
2B	Assuming Sosian 40 vents and Quantum and OTTL dispersal from 4 cooling tower fans	Cooling tower fans	Cooling tower fans	Condenser fan vents
3A	Incremental impact from Sosian dispersal from single stack	-	-	Single stack
3B	Incremental impact from Sosian dispersal from 40 vents	-	-	Condenser fan vents

Dispersion models simulate ambient pollutant concentrations as a function of source configurations, emission strengths and meteorological characteristics, thus providing a useful tool to ascertain the spatial and temporal patterns in the ground level concentrations arising from the emissions of various sources. Increasing reliance has been placed on concentration estimates from models as the primary basis for environmental and health impact assessments, risk assessments and emission control requirements. It is therefore important to carefully select a dispersion model for the purpose.

(i) Dispersion Model Selection

Version 5 of ADMS was used in the study.

(ii) Meteorological Requirements

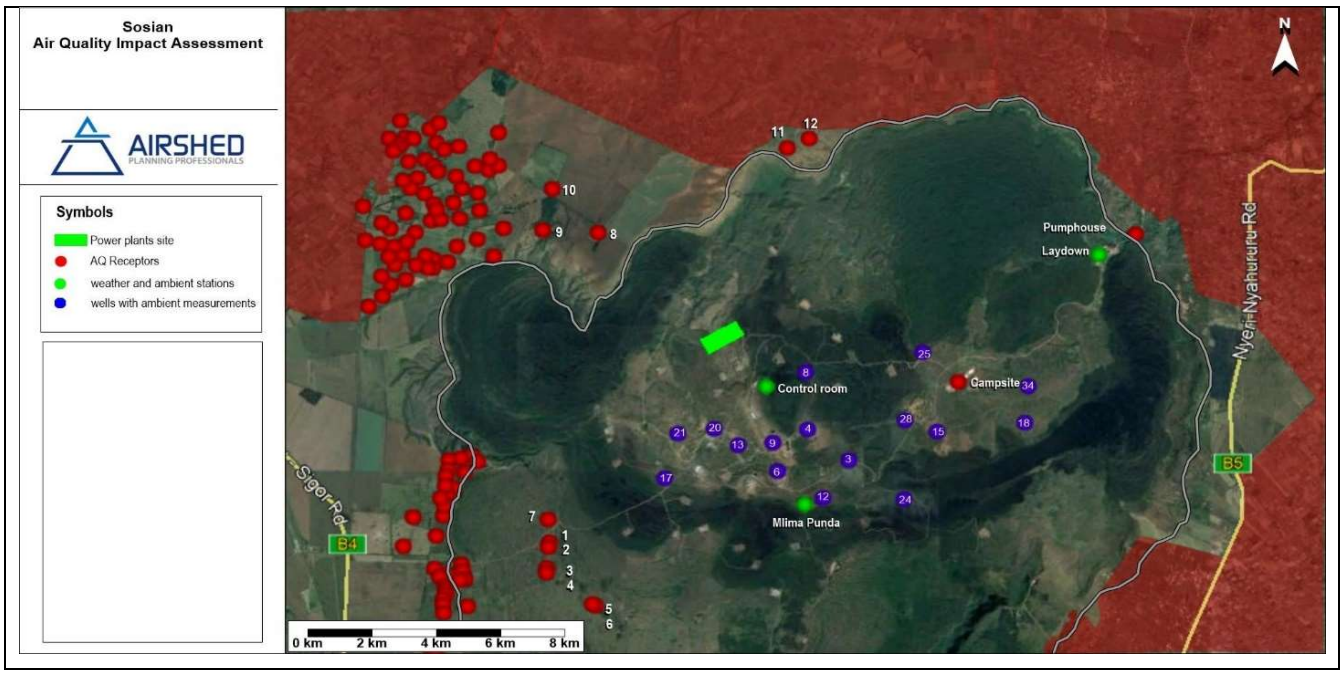
For the purpose of the current study use was made of hourly control room data for the period 2017.

(iii) Source Data Requirements

The ADMS model is able to model point, jet, area, line and volume sources. Stack and cooling tower fans were modelled as point sources.

(iv) Modelling Domain

The dispersion of pollutants expected to arise from proposed activities was modelled for an area covering 15 km (east-west) by 10 km (north-south). The area was divided into a grid matrix with a resolution of 200 m, with the geothermal power plants located centrally. The nearest settlements were included as AQSR (Figure 7-1). ADMS calculates ground-level (1.5 m above ground level) concentrations at each grid and discrete receptor point. Topography was included in dispersion simulations.



Source: Airshed Air Quality Impact Assessment Report

Figure 7-1: Study area, site layout and AQSRs

(v) Presentation of Results

Dispersion modelling was undertaken to determine highest hourly, 8 hourly, highest daily and annual average ground level concentrations. Averaging periods were selected to facilitate the comparison of simulated pollutant concentrations to relevant ambient air quality, inhalation health criteria and odour thresholds.

Results are primarily provided in tabular form as discrete values simulated at specific AQSR receptor locations. Selective use is also made of isopleths to present areas of exceedance of assessment criteria. Ground level concentration isopleths presented in this section depict interpolated values from the concentrations simulated by ADMS for each of the receptor grid points specified.

It should be noted that ambient air quality criteria apply to areas where the Occupational Health and Safety regulations do not apply, thus outside the property or lease area. Ambient air quality criteria are therefore not occupational health indicators but applicable to areas where the general public has access i.e. off-site.

The potential impact on human health as a result of H_2S emissions from proposed operations are discussed in Section (c), the occupational impact is discussed in Section (d) and the odour impact is discussed in Section (e) below.

(c) Screening of Simulated Human Health Impacts from H_2S

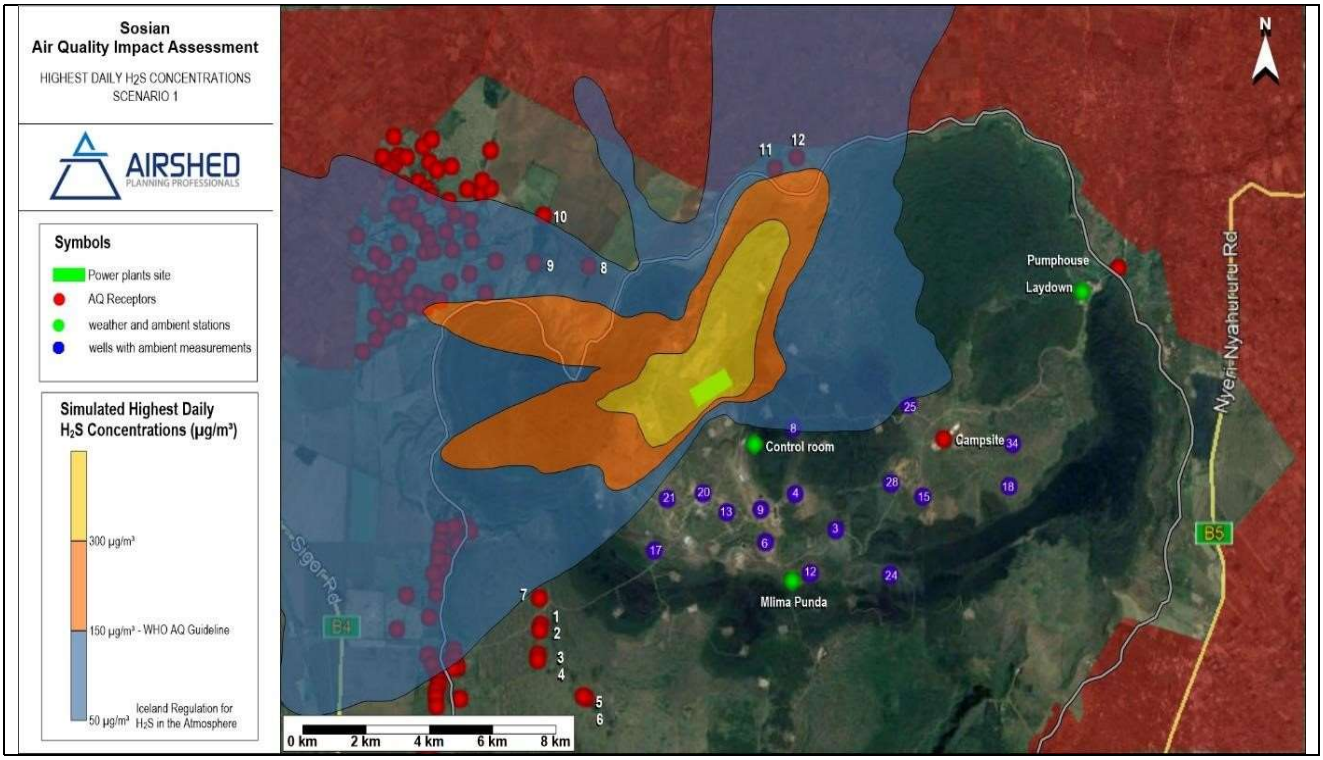
For Scenario 1A, with Quantum and Sosian emitting from a single stack and OrPower emitting from 4 cooling tower fans, simulated 24-hour ambient H_2S concentrations exceed the Iceland guideline of 50 µg/m³ at some of the AQSRs, but not the Kenyan Tolerance Limit of 150 µg/m³ with 3 allowable exceedances or WHO daily guideline

value of 150 µg/m³ (Table 7-7). Simulated annual average ambient H2S concentrations exceed the OEHHA screening level for chronic exposure (10 µg/m³) at some of the AQSRs. Isopleth plots for are shown in Figure 7-2 to Figure 7-4.

Table 7-7: Simulated ambient H2S concentrations during the operational phase for Scenario 1A

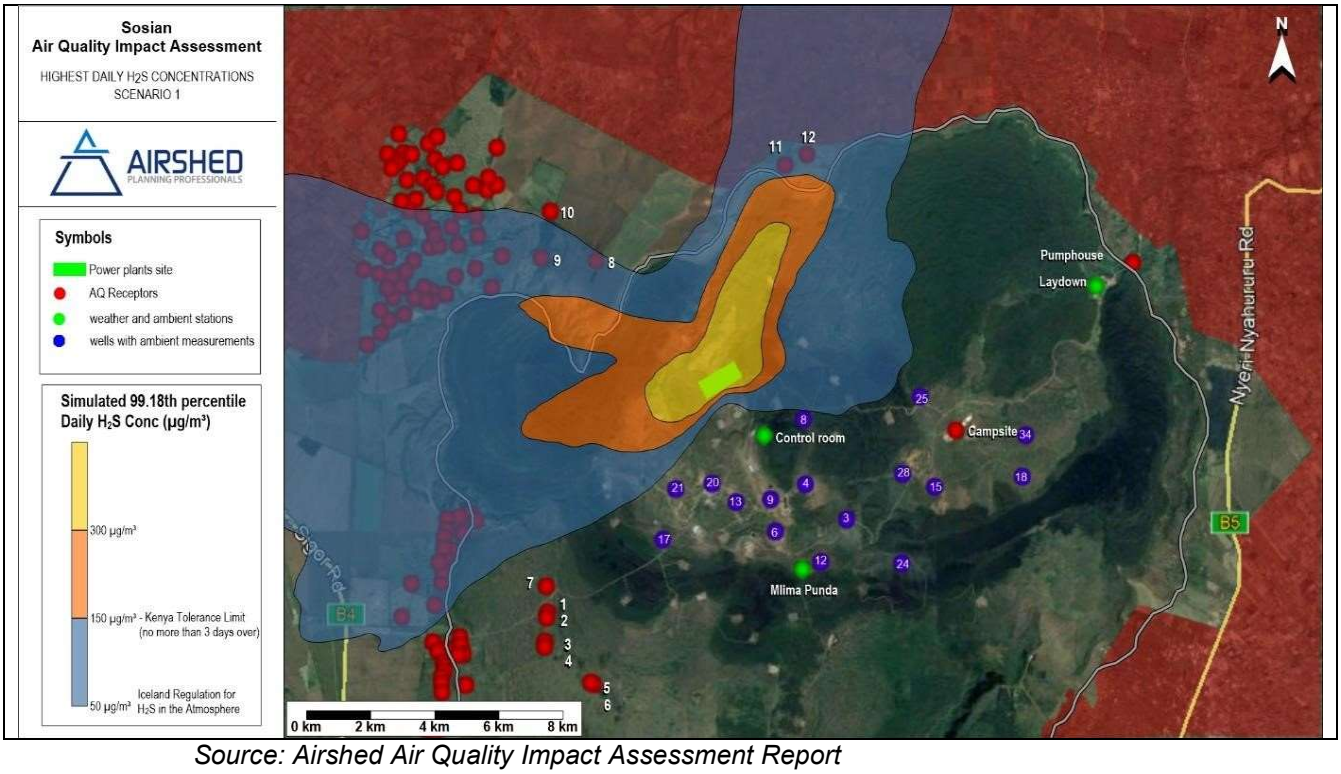
AQSRs		Simulated Ambient H_2S Concentrations During the Operational Phase (1)		
Number	**Description**	**4th Highest 24-hour Ground Level Conc. (µg/m³)**	**2nd Highest 24-hour Ground Level Conc. (µg/m³)**	**Annual Ave. Ground Level Conc. (µg/m³)**
1	Structure 1	23	31	3
2	Structure 2	22	29	2
3	Structure 3	16	22	2
4	Structure 4	15	21	1
5	Structure 5	2	5	0
6	Structure 6	2	5	0
7	Structure 7	29	44	4
8	Marigo area 1	68	71	12
9	Marigo area 2	86	97	15
10	Marigo area 3	42	49	8
11	Rigogo area 1	120	134	44
12	Rigogo area 2	111	125	42
	GDC Campsite	22	25	2
	Pumphouse and nursery	18	19	2
	Mlima Punda	1	3	0
	Laydown	19	20	3
	Control room	16	27	1
	Criteria	150 (Kenya) Kenya allows for 3 exceedances per year	50 (Iceland) 150 (WHO)	10 (OEHHA)

(1) Values in bold indicate exceedances of guidelines or standards



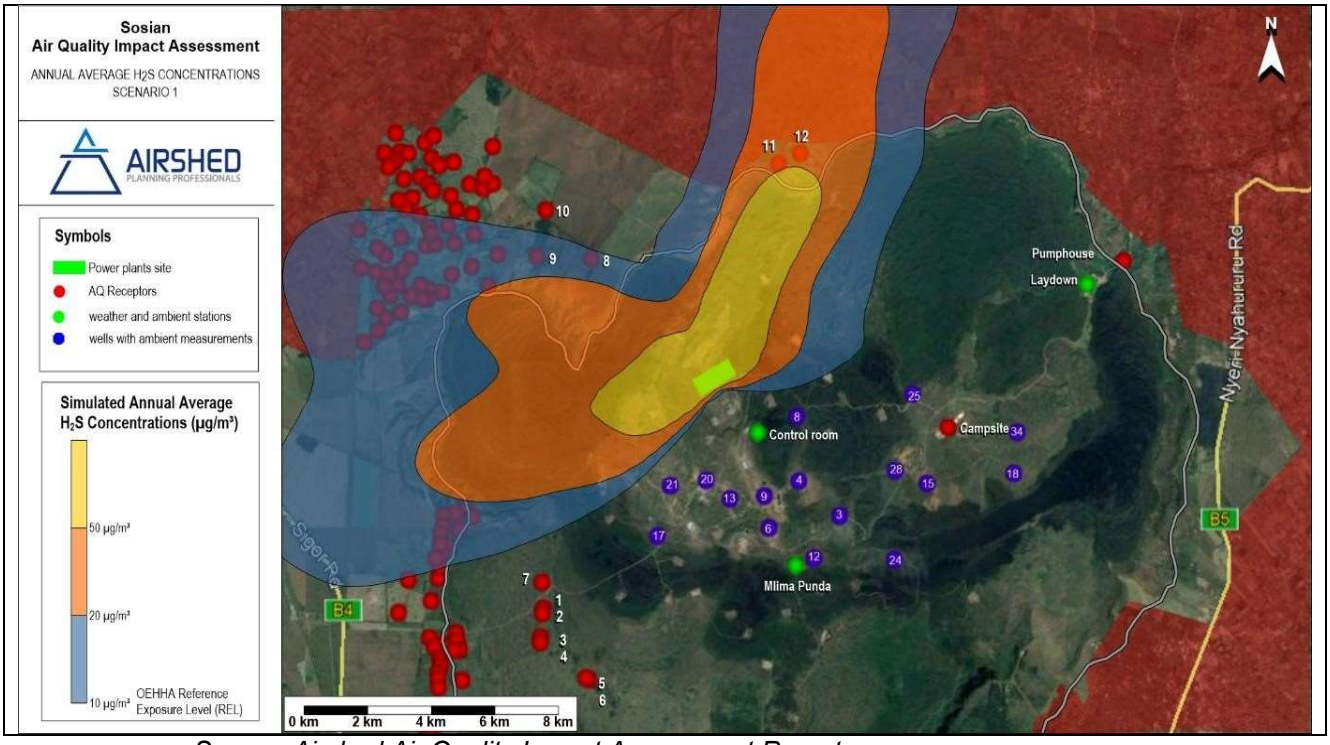
Source: Airshed Air Quality Impact Assessment Report

Figure 7-2: Highest daily ground level H_2S concentrations – Scenario 1A



Source: Airshed Air Quality Impact Assessment Report

Figure 7-3: 99.2th percentile of daily ground level H_2S concentrations – Scenario 1A



Source: Airshed Air Quality Impact Assessment Report

Figure 7-4: Annual average ground level H_2S concentrations – Scenario 1A

For Scenario 1B, with Quantum emitting from a single stack, Sosian emitting from 40 vents over the condenser fans and OrPower emitting from 4 cooling tower fans, simulated 24-hour ambient H_2S concentrations exceed the Iceland guideline of 50 µg/m³ at some of the AQSRs, but not the Kenyan Tolerance Limit of 150 µg/m³ with 3 allowable exceedances or the WHO daily guideline value of 150 µg/m³ (Table 7-8). Simulated annual average ambient H_2S concentrations exceed the OEHHA screening level for chronic exposure (10 µg/m³) at some of the AQSRs. Isopleth plots for are shown in Figure 7-5 to Figure 7-7. Results are very similar to Scenario 1A, with small reductions in impact seen.

Table 7-8: Simulated ambient H_2S concentrations during the operational phase for Scenario 1B

AQSRs		Simulated Ambient H_2S Concentrations During the Operational Phase (1)		
Number	Description	4th Highest 24-hour Ground Level Conc. (µg/m³)	2nd Highest 24-hour Ground Level Conc. (µg/m³)	Annual Ave. Ground Level Conc. (µg/m³)
1	Structure 1	23	32	3
2	Structure 2	22	30	2
3	Structure 3	16	25	2
4	Structure 4	15	24	1
5	Structure 5	3	7	0
6	Structure 6	2	6	0
7	Structure 7	31	44	4

8	Marigo area 1	35	46	9
9	Marigo area 2	62	65	**12**
10	Marigo area 3	27	29	6
11	Rigogo area 1	112	**120**	**41**
12	Rigogo area 2	107	**116**	**38**
	GDC Campsite	19	25	2
	Pumphouse and nursery	12	15	2
	Mlima Punda	1	3	0
	Laydown	13	18	2
	Control room	16	27	1
	Criteria	**150 (Kenya) Kenya allows for 3 exceedances per year**	**50 (Iceland) 150 (WHO)**	**10 (OEHHA)**

(1) Values in bold indicate exceedances of guidelines or standards

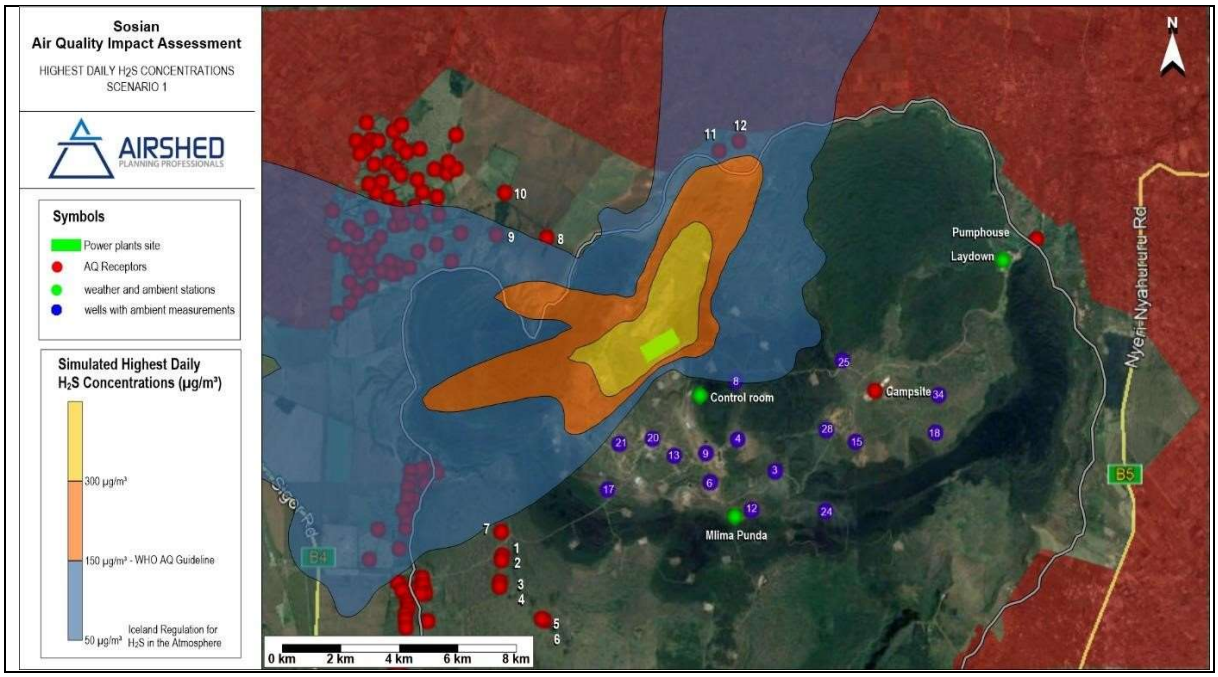


Figure 7-5: Highest daily ground level H_2S concentrations – Scenario 1B

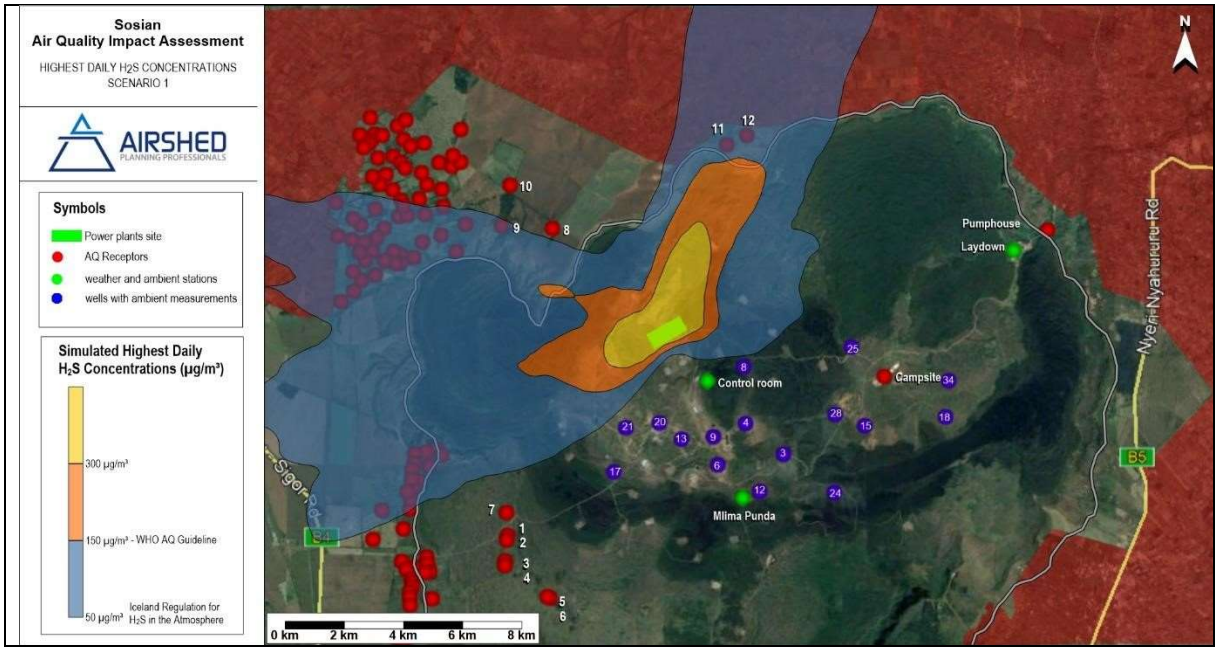


Figure 7-6: 99.2th percentile of daily ground level H_2S concentrations – Scenario 1B

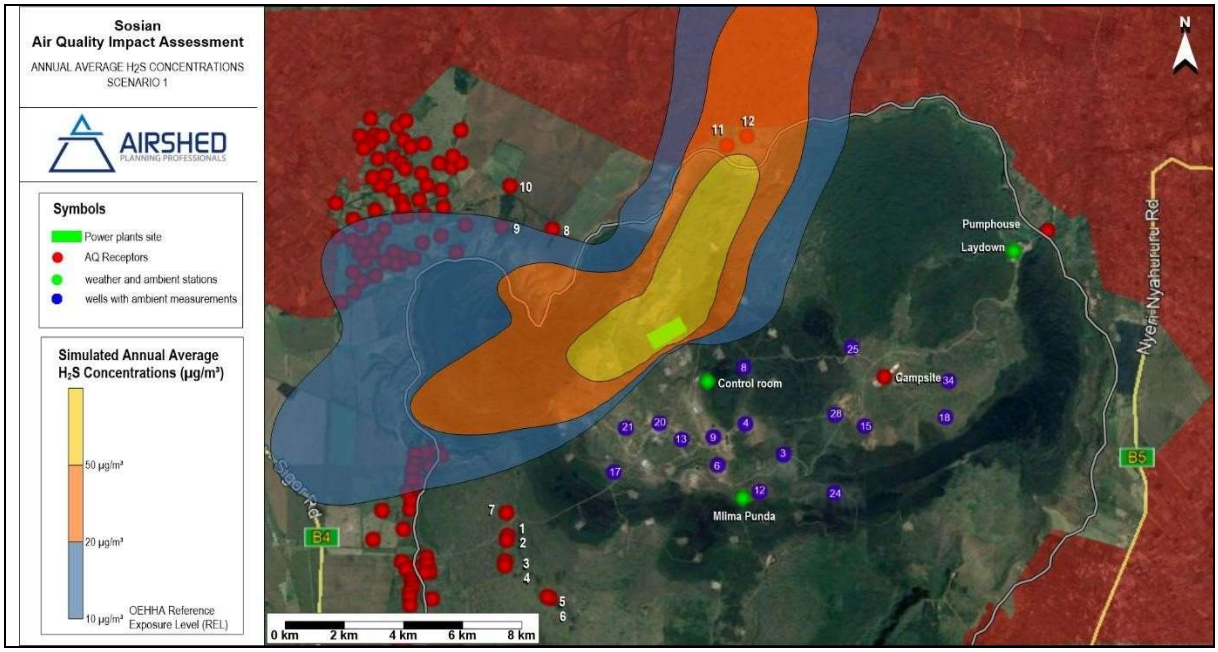


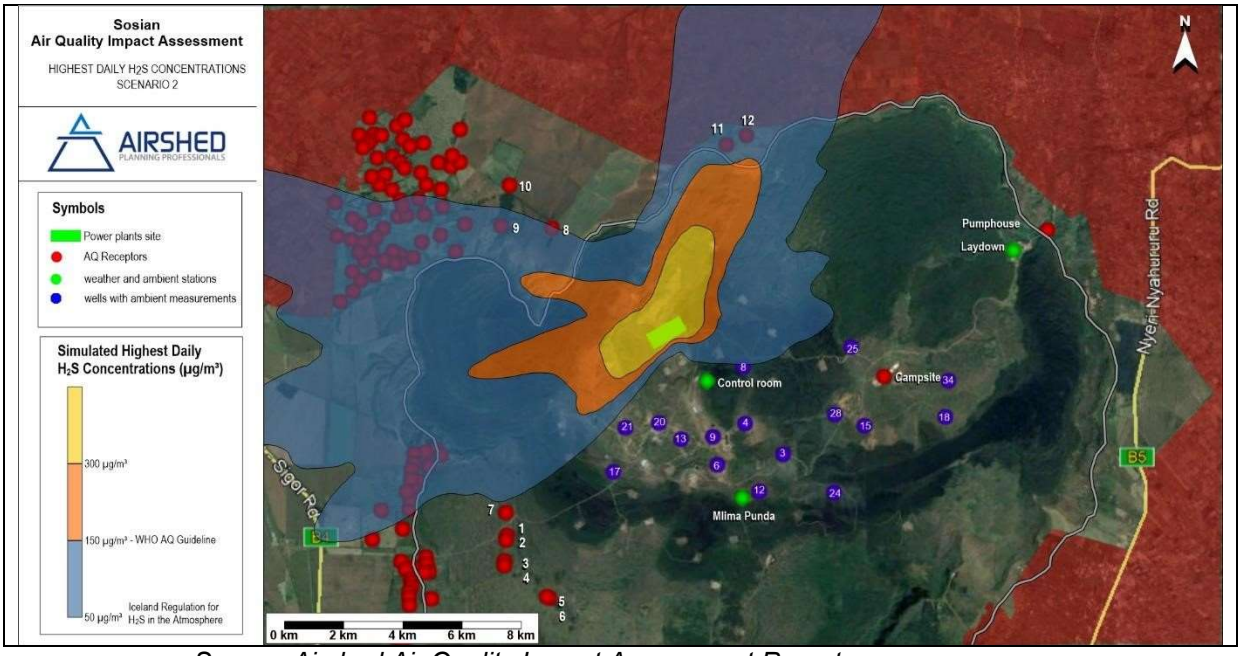
Figure 7-7: Annual average ground level H_2S concentrations – Scenario 1B

For Scenario 2A, with Sosian emitting from a single stack and Quantum and OrPower emitting from 4 cooling tower fans, simulated 24-hour ambient H2S concentrations exceed the Iceland guideline of 50 µg/m³ at some of the AQSRs (Table 7-9). The Kenyan Tolerance Limit of 150 µg/m³ with 3 allowable exceedances or WHO daily guideline value of 150 µg/m³ is not exceeded at any of the AQSR. Simulated annual average ambient H_2S concentrations exceed the OEHHA screening level for chronic exposure (10 µg/m³) at some of the AQSRs. Isopleth plots for are shown in Figure 7-8 to Figure 7-10.

Table 7-9: Simulated ambient H_2S concentrations during the operational phase for Scenario 2

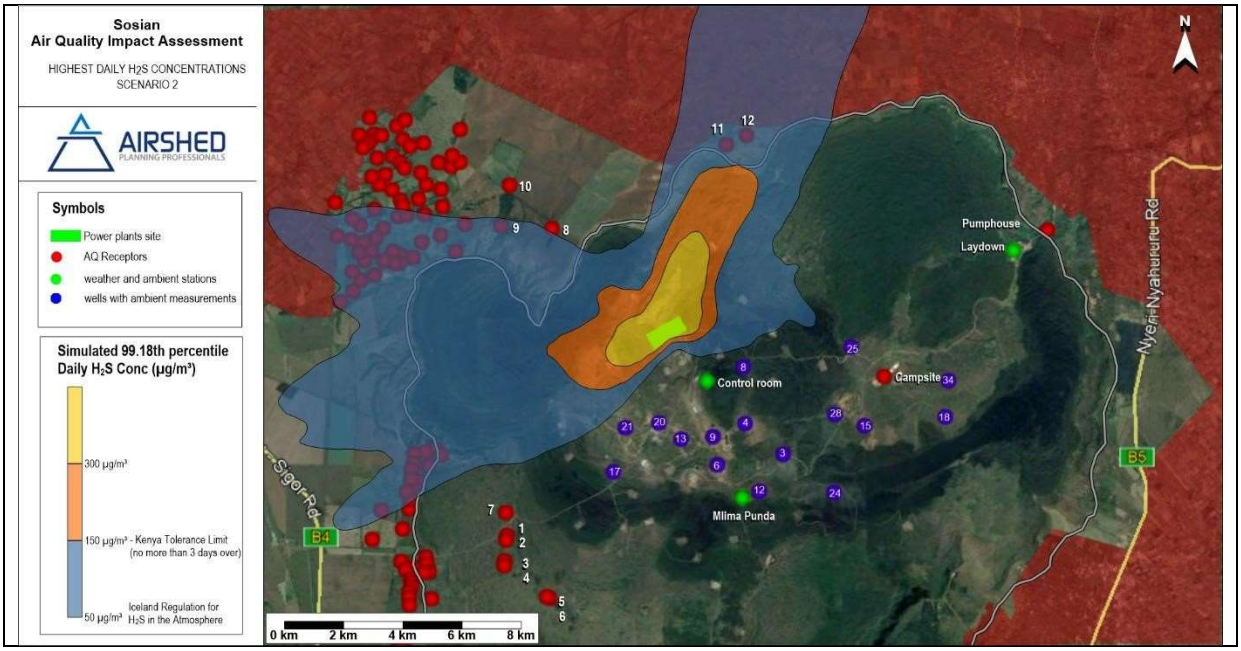
AQSRs		Simulated Ambient H_2S Concentrations During the Operational Phase (1)		
Number	Description	4th Highest 24-hour Ground Level Conc. (µg/m³)	2nd Highest 24-hour Ground Level Conc. (µg/m³)	Annual Ave. Ground Level Conc. (µg/m³)
1	Structure 1	22	31	2
2	Structure 2	20	29	2
3	Structure 3	15	20	1
4	Structure 4	14	18	1
5	Structure 5	2	4	0
6	Structure 6	2	4	0
7	Structure 7	29	43	4
8	Marigo area 1	49	**53**	**10**
9	Marigo area 2	60	**70**	**12**
10	Marigo area 3	28	35	6
11	Rigogo area 1	104	**108**	**39**
12	Rigogo area 2	98	**101**	**35**
	GDC Campsite	19	21	2
	Pumphouse and nursery	13	15	2
	Mlima Punda	1	3	0
	Laydown	14	16	2
	Control room	15	26	1
	Criteria	**150 (Kenya) Kenya allows for 3 exceedances per year**	**50 (Iceland) 150 (WHO)**	**10 (OEHHA)**

(1) Values in bold indicate exceedances of guidelines or standards



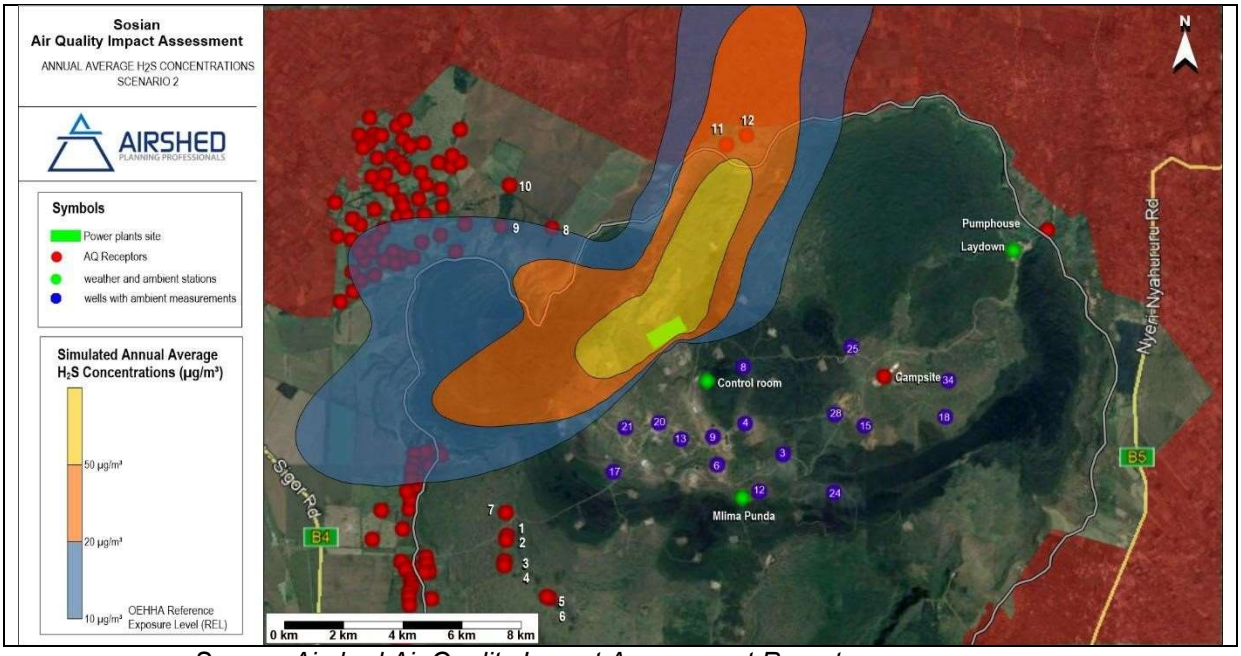
Source: Airshed Air Quality Impact Assessment Report

Figure 7-8: Highest daily ground level H_2S concentrations – Scenario 2



Source: Airshed Air Quality Impact Assessment Report

Figure 7-9: 99.2th percentile of daily ground level H_2S concentrations – Scenario 2



Source: Airshed Air Quality Impact Assessment Report

Figure 7-10: Annual average ground level H_2S concentrations – Scenario 2

For Scenario 2B, with Sosian emitting from 40 vents over condenser fans and Quantum and OrPower emitting from 4 cooling tower fans, simulated 24-hour ambient H2S concentrations exceed the Iceland guideline of 50 µg/m³ at some of the AQSRs (Table 7-10). The Kenyan Tolerance Limit of 150 µg/m³ with 3 allowable exceedances or WHO daily guideline value of 150 µg/m³ is not exceeded at any of the AQSR. Simulated annual average ambient H2S concentrations exceed the OEHHA screening level for chronic exposure (10 µg/m³) at some of the AQSRs. Isopleth plots for are shown in Figure 7-11 to Figure 7-13. Results are very similar to Scenario 2A, with small reductions in impact seen.

Table 7-10: Simulated ambient H_2S concentrations during the operational phase for Scenario 2B

AQSRs		Simulated Ambient H_2S Concentrations During the Operational Phase (1)		
Number	Description	4th Highest 24-hour Ground Level Conc. (µg/m³)	2nd Highest 24-hour Ground Level Conc. (µg/m³)	Annual Ave. Ground Level Conc. (µg/m³)
1	Structure 1	22	31	2
2	Structure 2	20	29	2
3	Structure 3	15	20	1
4	Structure 4	14	18	1
5	Structure 5	2	6	0
6	Structure 6	2	5	0
7	Structure 7	31	43	4
8	Marigo area 1	27	36	7

9	Marigo area 2	40	50	8
10	Marigo area 3	18	26	5
11	Rigogo area 1	98	**105**	**35**
12	Rigogo area 2	95	**96**	**32**
	GDC Campsite	15	21	2
	Pumphouse and nursery	8	11	1
	Mlima Punda	1	3	0
	Laydown	9	14	1
	Control room	15	26	1
	Criteria	**150 (Kenya) Kenya allows for 3 exceedances per year**	**50 (Iceland) 150 (WHO)**	**10 (OEHHA)**

(1) Values in bold indicate exceedances of guidelines or standards

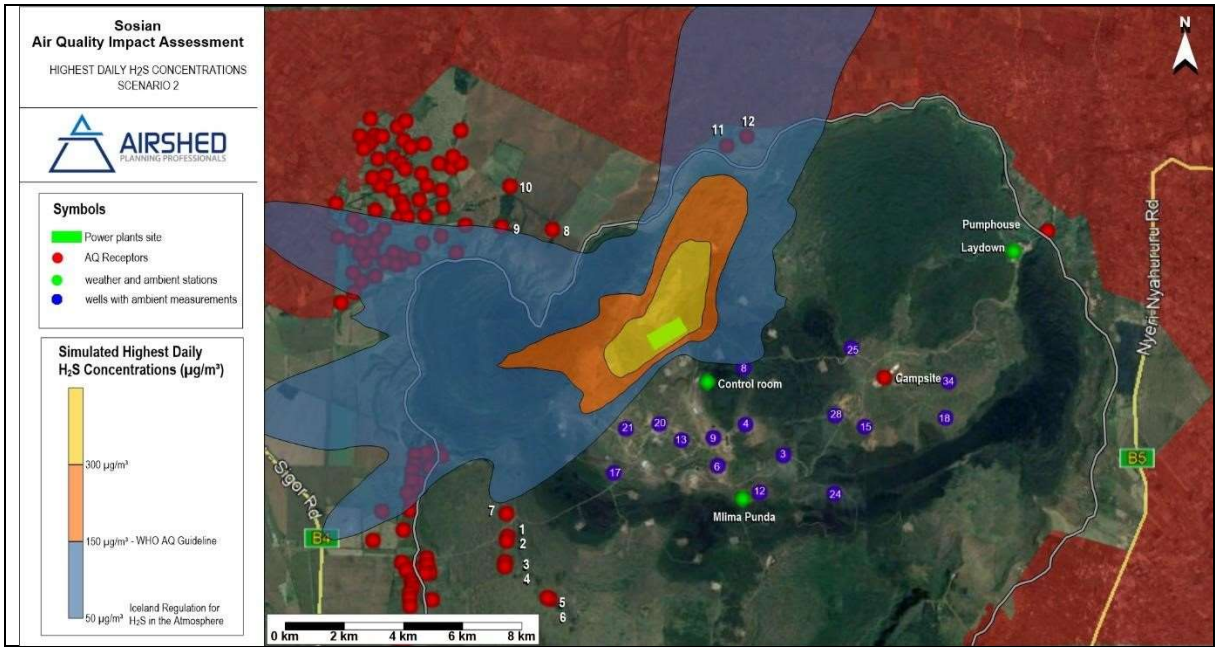


Figure 7-11: Highest daily ground level H_2S concentrations – Scenario 2B

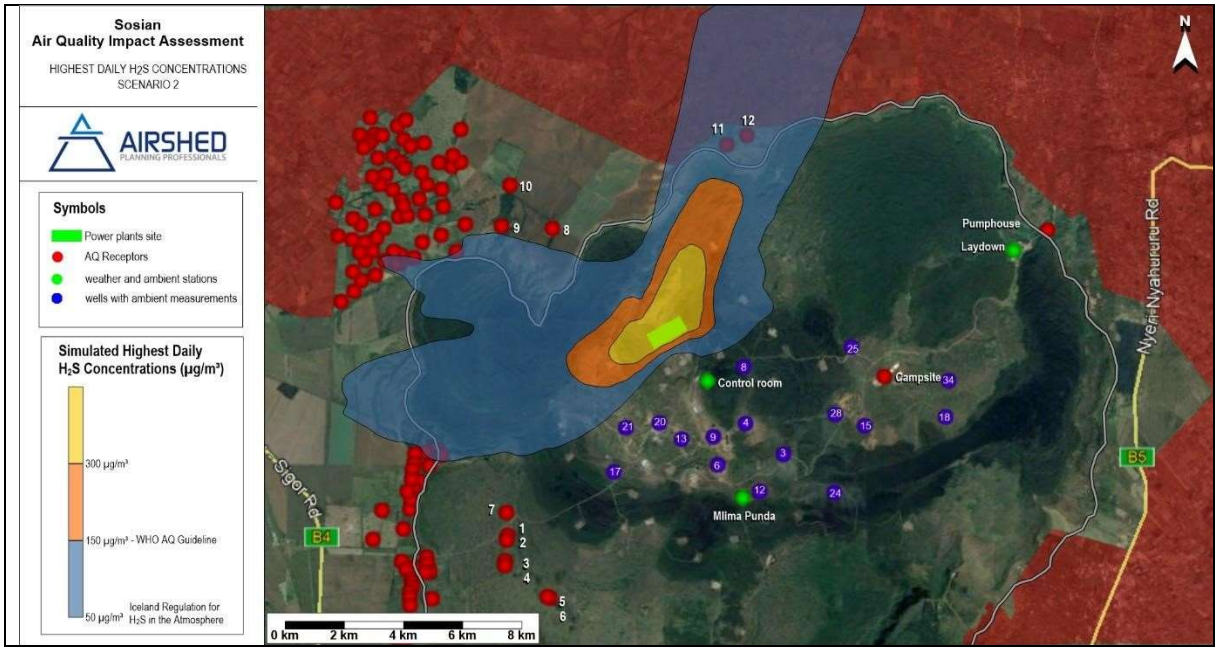


Figure 7-12: 99.2th percentile of daily ground level H_2S concentrations – Scenario 2B

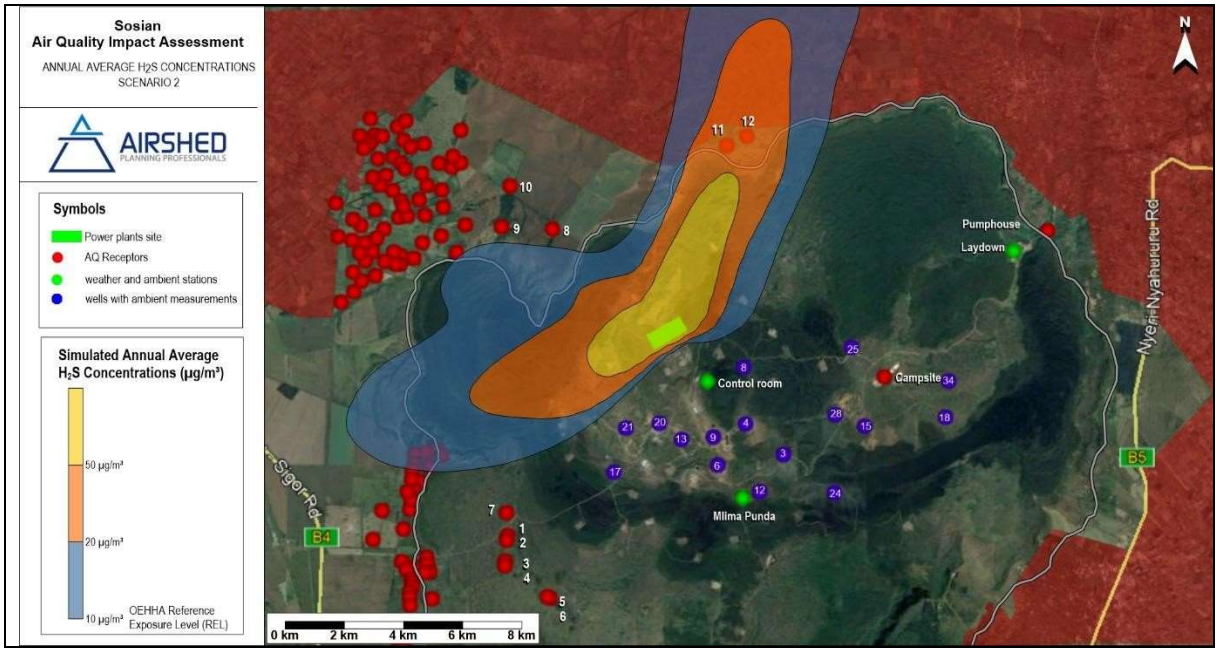


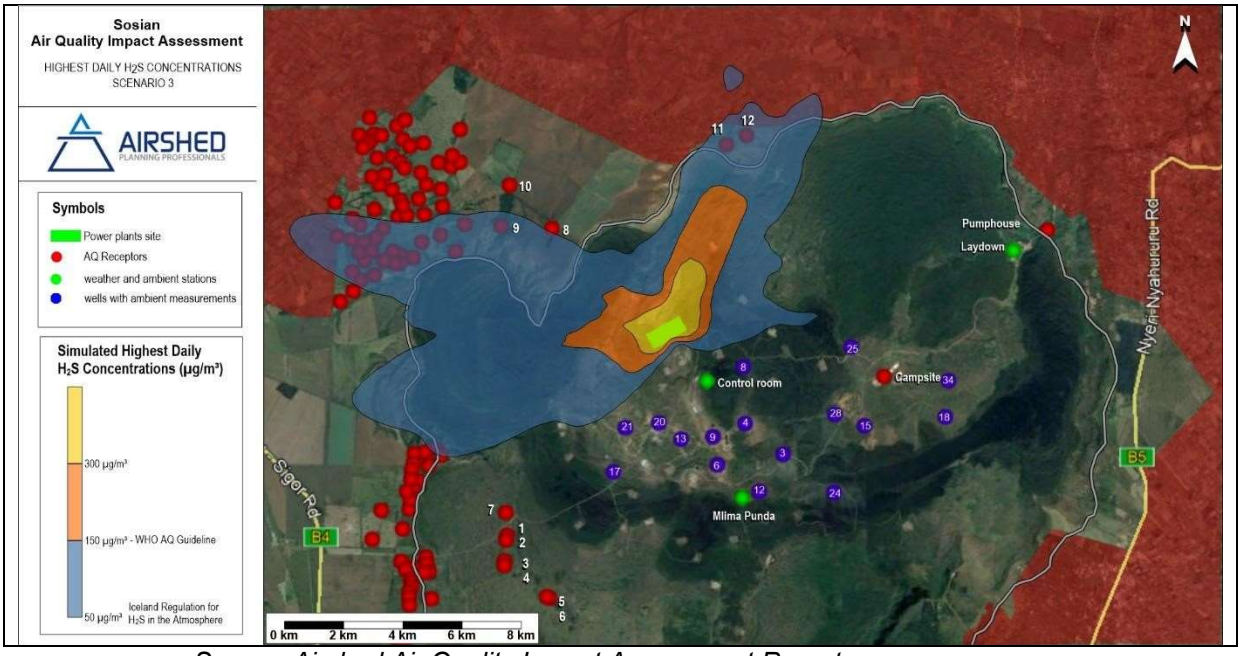
Figure 7-13: Annual average ground level H_2S concentrations – Scenario 2B

For Scenario 3A, showing Sosian's incremental impact from a single stack, simulated 24-hour ambient H_2S concentrations do not exceed the Kenyan Tolerance Limit of 150 µg/m³ with 3 allowable exceedances or the WHO daily guideline value of 150 µg/m³ at any of the AQSRs but do exceed the Iceland guideline of 50 µg/m³ at various receptors. Simulated annual average ambient H_2S concentrations exceed the OEHHA screening level for chronic exposure (10 µg/m³) at two of the AQSRs (Table 7-11). Isopleth plots for scenario 3 are shown in Figure 7-14 to Figure 7-16.

Table 7-11: Simulated ambient H_2S concentrations during the operational phase for Scenario 3A

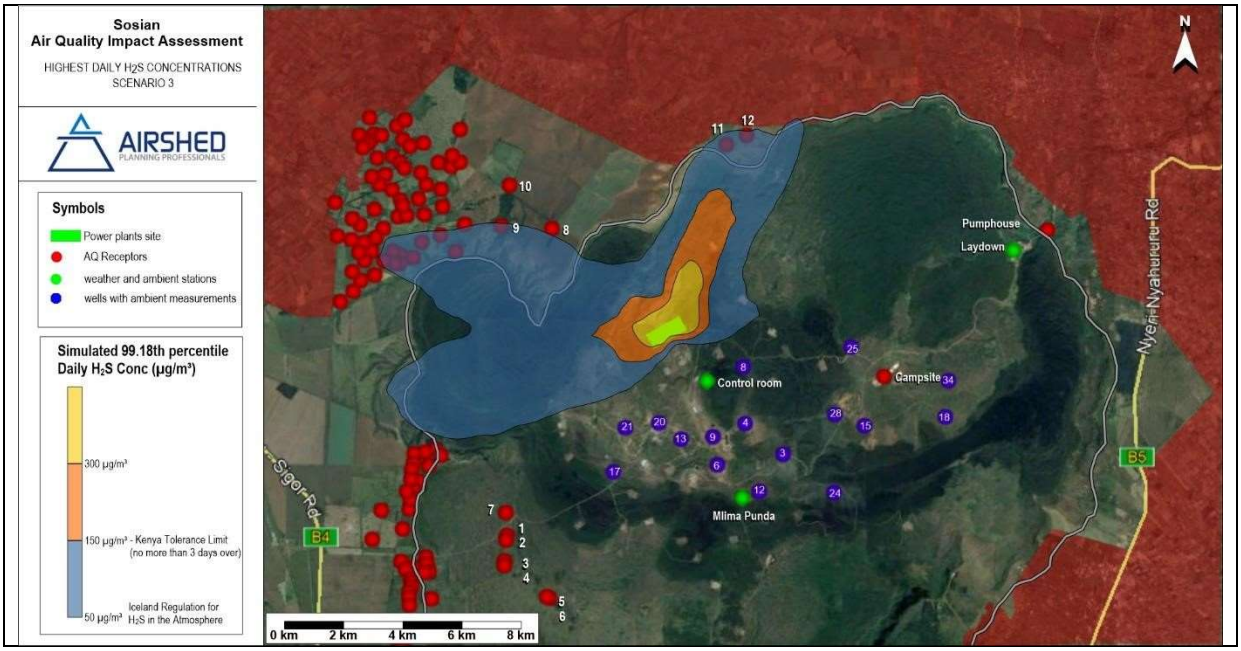
AQSRs		Simulated Ambient H_2S Concentrations During the Operational Phase (1)		
Number	Description	4th Highest 24-hour Ground Level Conc. (µg/m³)	2nd Highest 24-hour Ground Level Conc. (µg/m³)	Annual Ave. Ground Level Conc. (µg/m³)
1	Structure 1	9	14	1
2	Structure 2	9	14	1
3	Structure 3	7	11	1
4	Structure 4	6	10	1
5	Structure 5	1	3	0
6	Structure 6	1	2	0
7	Structure 7	13	20	2
8	Marigo area 1	42	47	7
9	Marigo area 2	56	**59**	8
10	Marigo area 3	25	31	4
11	Rigogo area 1	60	**68**	**19**
12	Rigogo area 2	49	**59**	**18**
	GDC Campsite	11	12	1
	Pumphouse and nursery	8	11	1
	Mlima Punda	0	1	0
	Laydown	9	10	1
	Control room	4	8	0
	Criteria	**150 (Kenya) Kenya allows for 3 exceedances per year**	**50 (Iceland) 150 (WHO)**	**10 (OEHHA)**

(1) Values in bold indicate exceedances of guidelines or standards



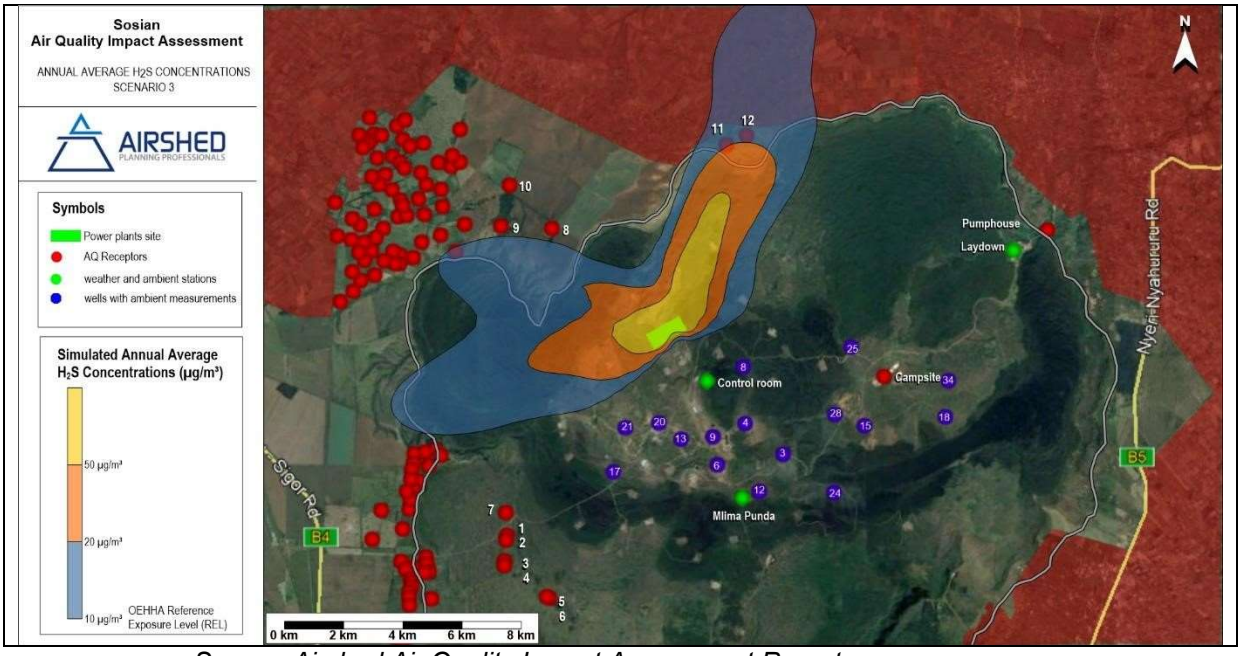
Source: Airshed Air Quality Impact Assessment Report

Figure 7-14: Highest daily ground level H_2S concentrations – Scenario 3A



Source: Airshed Air Quality Impact Assessment Report

Figure 7-15: 99.2th percentile of daily ground level H_2S concentrations – Scenario 3A



Source: Airshed Air Quality Impact Assessment Report

Figure 7-16: Annual average ground level H_2S concentrations – Scenario 3A

For Scenario 3B, showing Sosian's incremental impact if condenser fan vents are adopted, simulated 24-hour ambient H_2S concentrations do not exceed the Kenyan Tolerance Limit of 150 µg/m³ with 3 allowable exceedances or the WHO daily guideline value of 150 µg/m³ at any of the AQSRs but do exceed the Iceland guideline of 50 µg/m³ at one receptor. Simulated annual average ambient H_2S concentrations exceed the OEHHA screening level for chronic exposure (10 µg/m³) at two of the AQSRs (Table 7-12). Isopleth plots for are shown in Figure 7-17 to Figure 7-19. Results are very similar to Scenario 3A, with small reductions in impact seen.

Table 7-12: Simulated ambient H_2S concentrations during the operational phase for Scenario 3B

AQSRs		Simulated Ambient H_2S Concentrations During the Operational Phase (1)		
Number	Description	4th Highest 24-hour Ground Level Conc. (µg/m³)	2nd Highest 24-hour Ground Level Conc. (µg/m³)	Annual Ave. Ground Level Conc. (µg/m³)
1	Structure 1	12	17	1
2	Structure 2	11	16	1
3	Structure 3	9	14	1
4	Structure 4	8	13	1
5	Structure 5	2	4	0
6	Structure 6	2	4	0
7	Structure 7	15	21	2
8	Marigo area 1	17	22	4
9	Marigo area 2	29	38	5

10	Marigo area 3	12	14	2
11	Rigogo area 1	50	**53**	**15**
12	Rigogo area 2	42	50	**14**
	GDC Campsite	8	12	1
	Pumphouse and nursery	4	6	1
	Mlima Punda	0	1	0
	Laydown	4	7	1
	Control room	3	7	0
	Criteria	**150 (Kenya)** **Kenya allows for 3 exceedances per year**	**50 (Iceland)** **150 (WHO)**	**10 (OEHHA)**

(1) Values in bold indicate exceedances of guidelines or standards

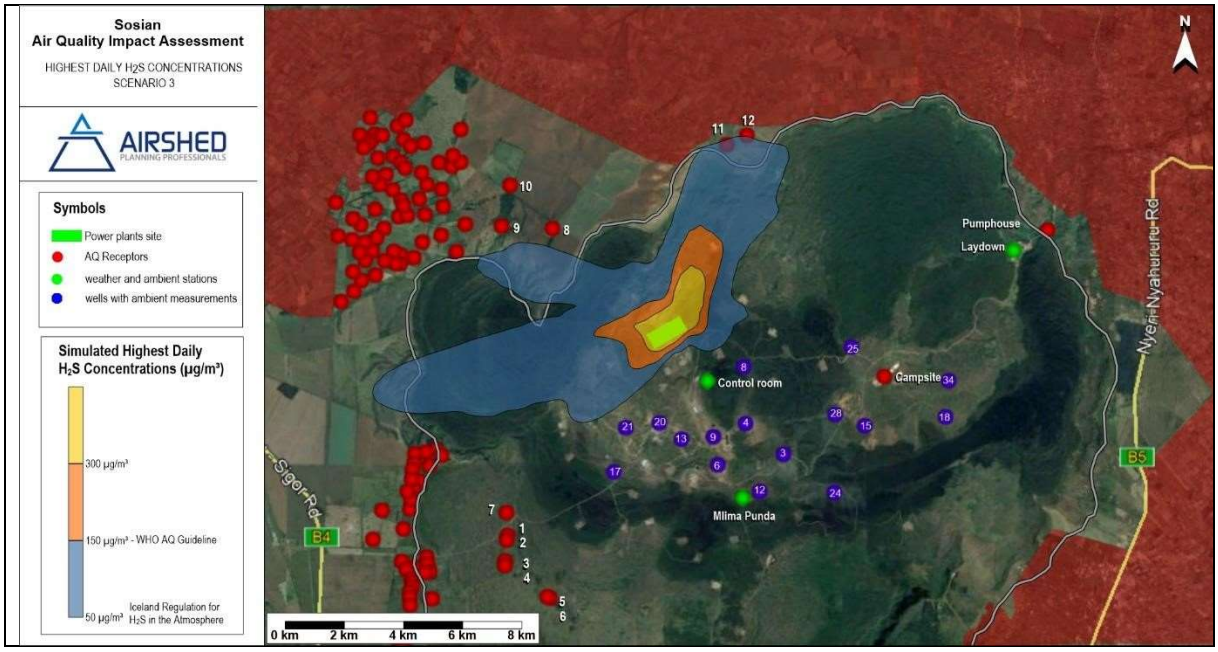


Figure 7-17: Highest daily ground level H_2S concentrations – Scenario 3B

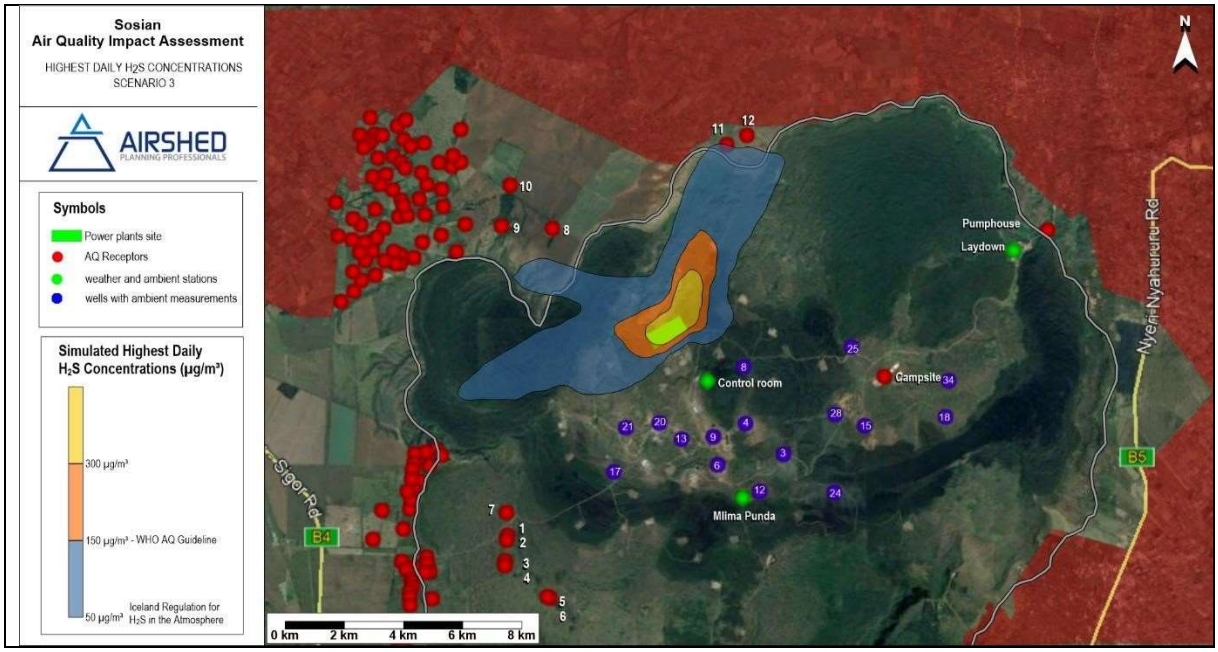


Figure 7-18: 99.2th percentile of daily ground level H_2S concentrations – Scenario 3B

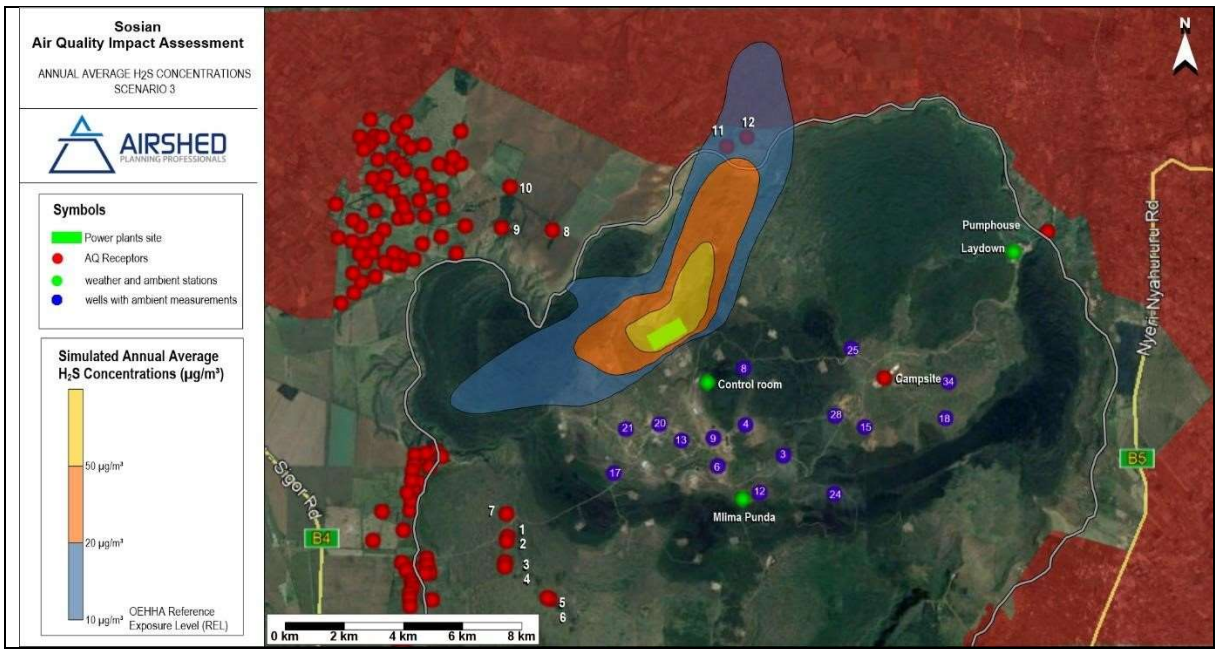
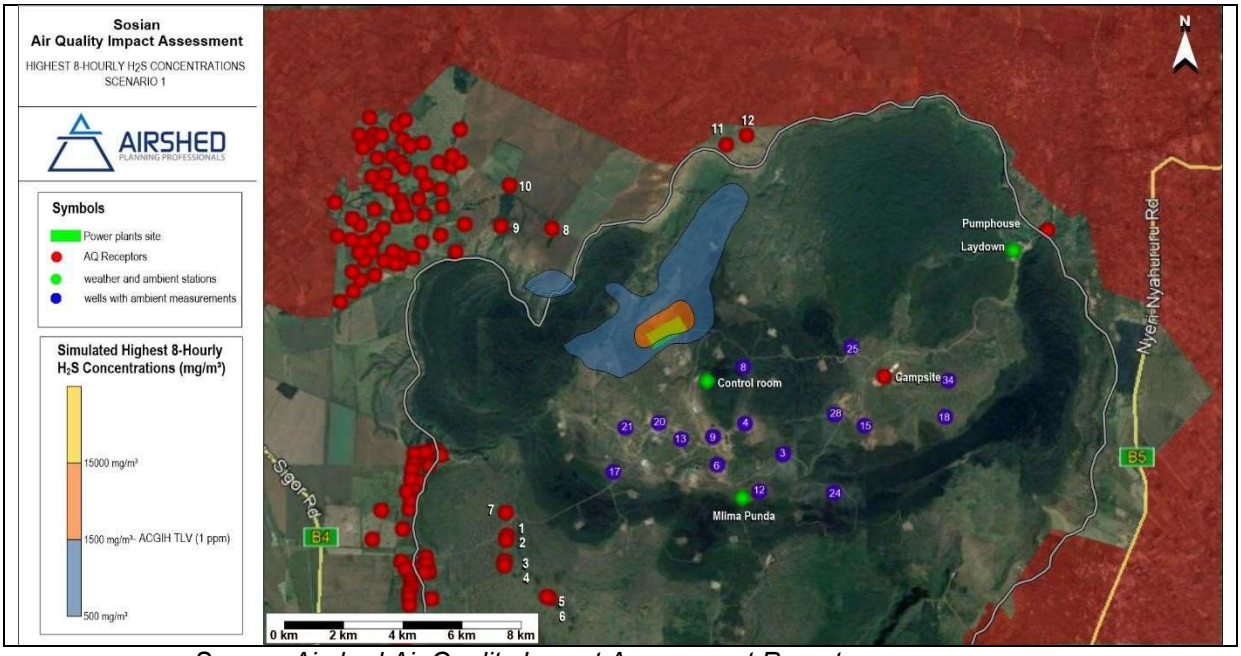


Figure 7-19: Annual average ground level H_2S concentrations – Scenario 3B

(d) Analysis of H_2S Emissions Occupational Impact

To assess occupational health only the plant boundary is considered. For Scenario 1, the ACGIH TLV of 1ppm (1500 µg/m³) is exceeded both on-site as well as ~ 200 m from the site boundary. For Scenario 2, the ACGIH TLV of 1ppm (1500 µg/m³) is exceeded in the vicinity of the three IPPs (~150 m). For Scenario 3, the TLV is exceeded just off-site for a small area (Figure 7-20, to, Figure 7-25). None of the scenarios exceed the WHO lowest observable adverse effect level (LOAEL) of 15 mg/m³ (15 000 µg/m³) or 10 ppm.



Source: Airshed Air Quality Impact Assessment Report

Figure 7-20: Highest 8-hr ground level H_2S concentrations – Scenario 1A

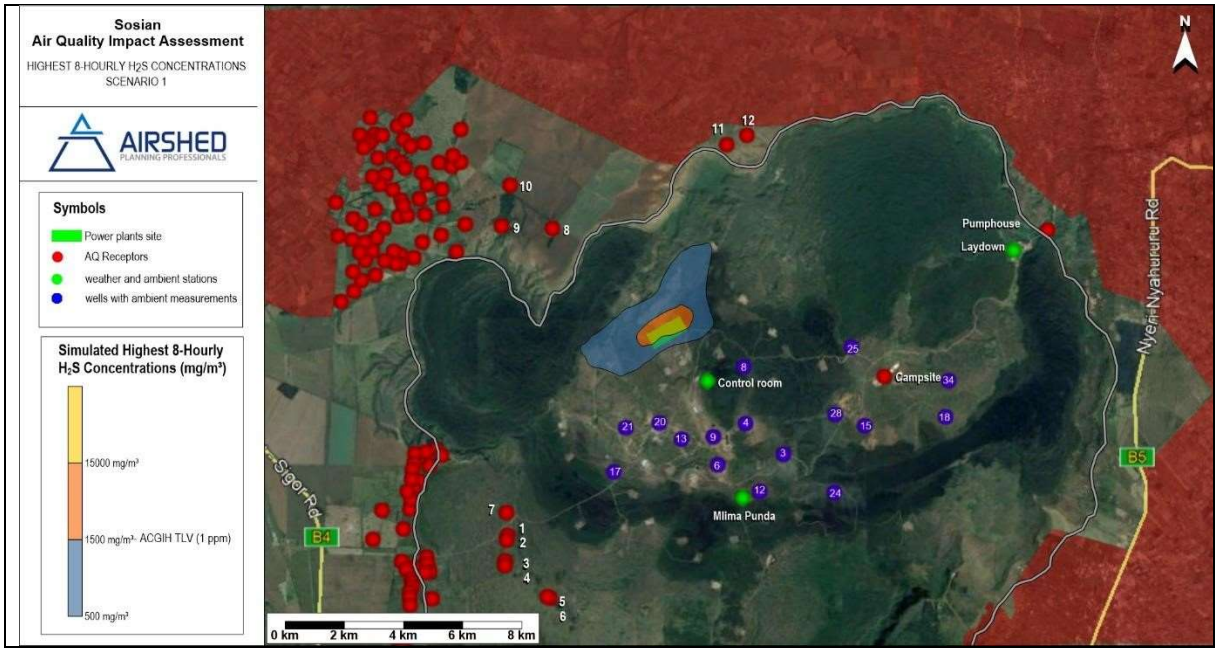
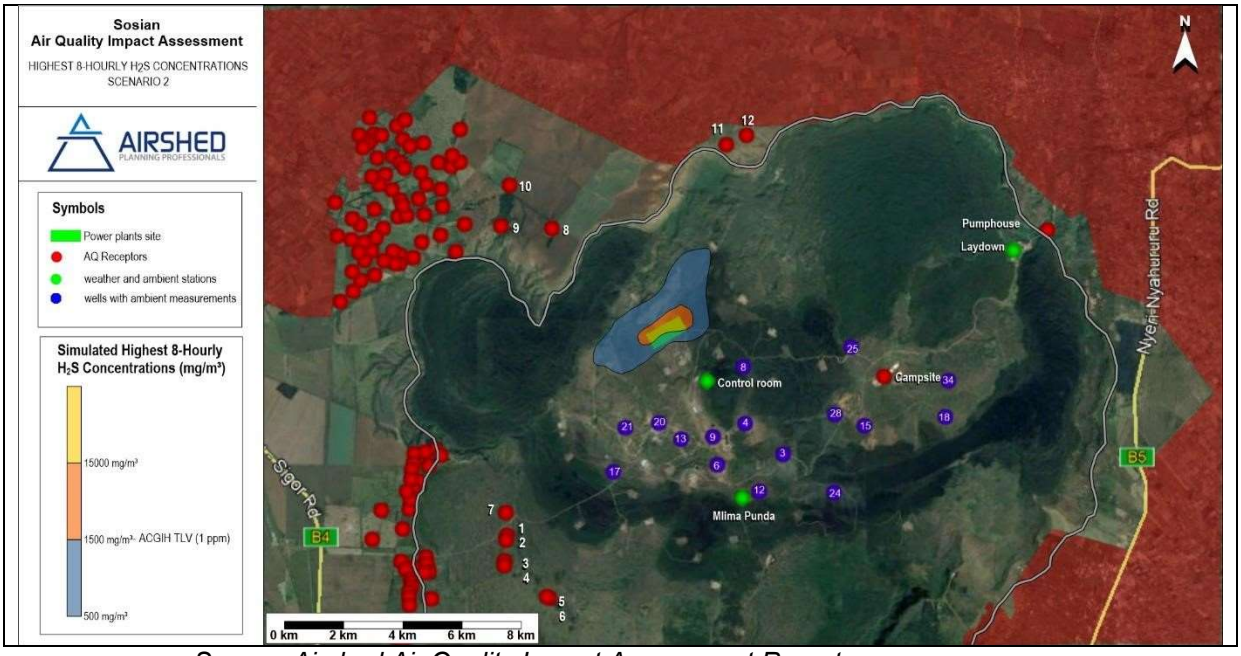


Figure 7-21: Highest 8-hr ground level H_2S concentrations – Scenario 1B



Source: Airshed Air Quality Impact Assessment Report

Figure 7-22: Highest 8-hr ground level H_2S concentrations – Scenario 2A

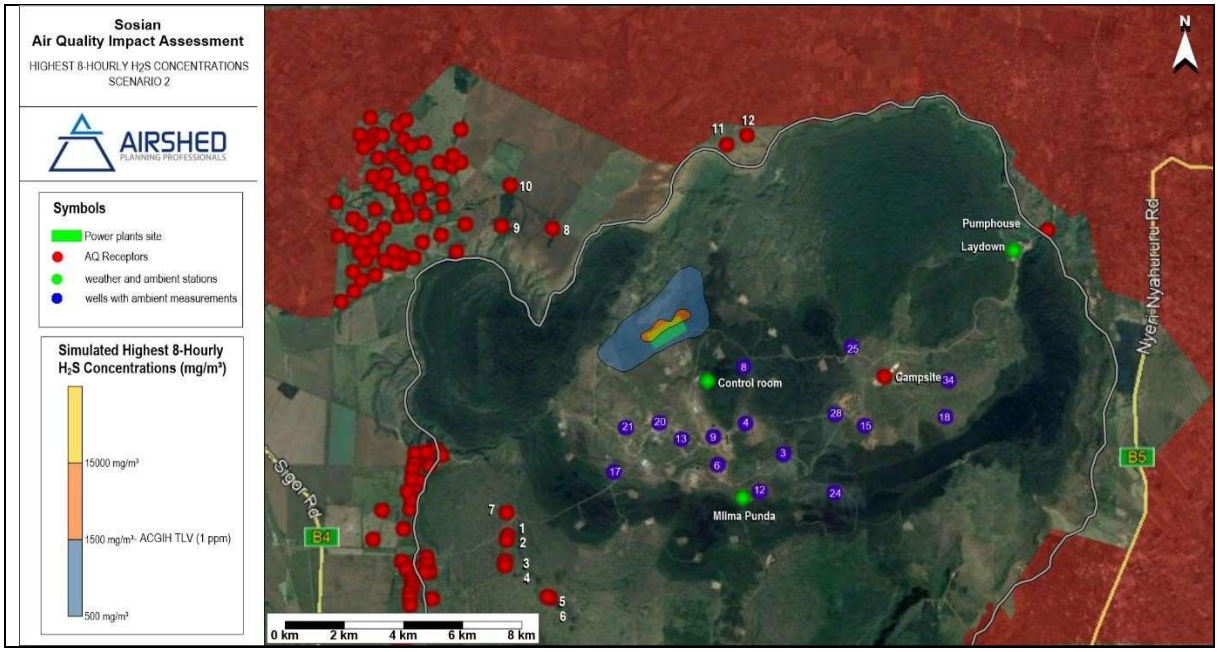
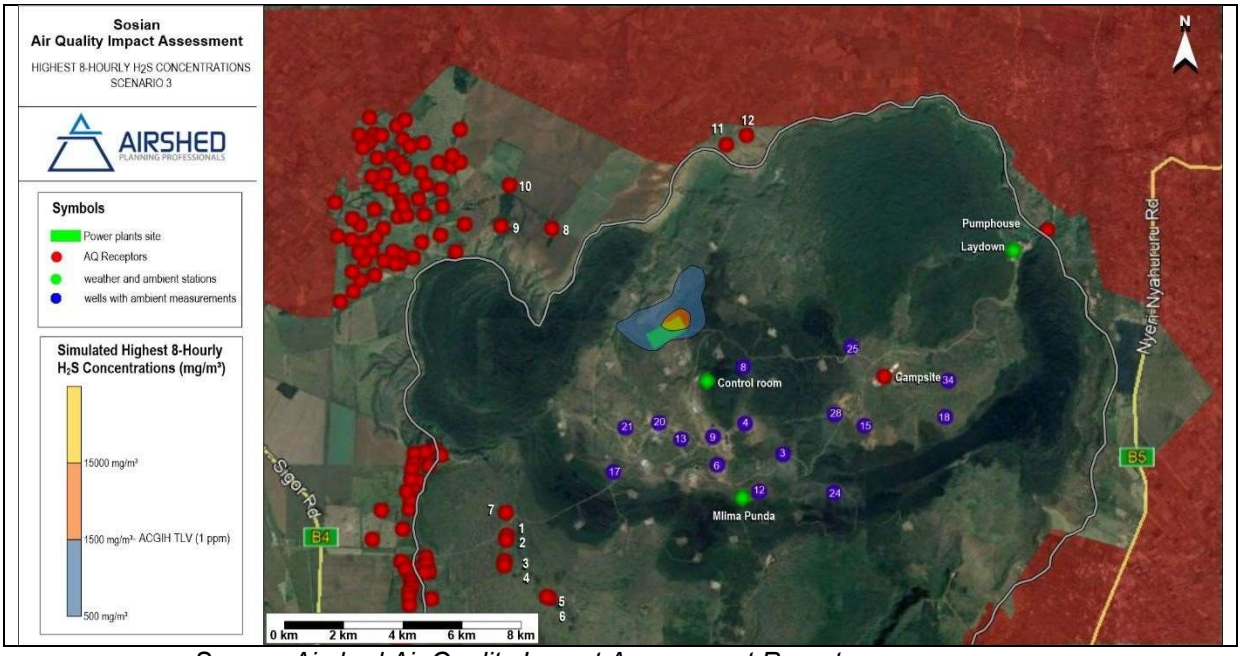


Figure 7-23: Highest 8-hr ground level H_2S concentrations – Scenario 2B



Source: Airshed Air Quality Impact Assessment Report

Figure 7-24: Highest 8-hr ground level H_2S concentrations – Scenario 3A

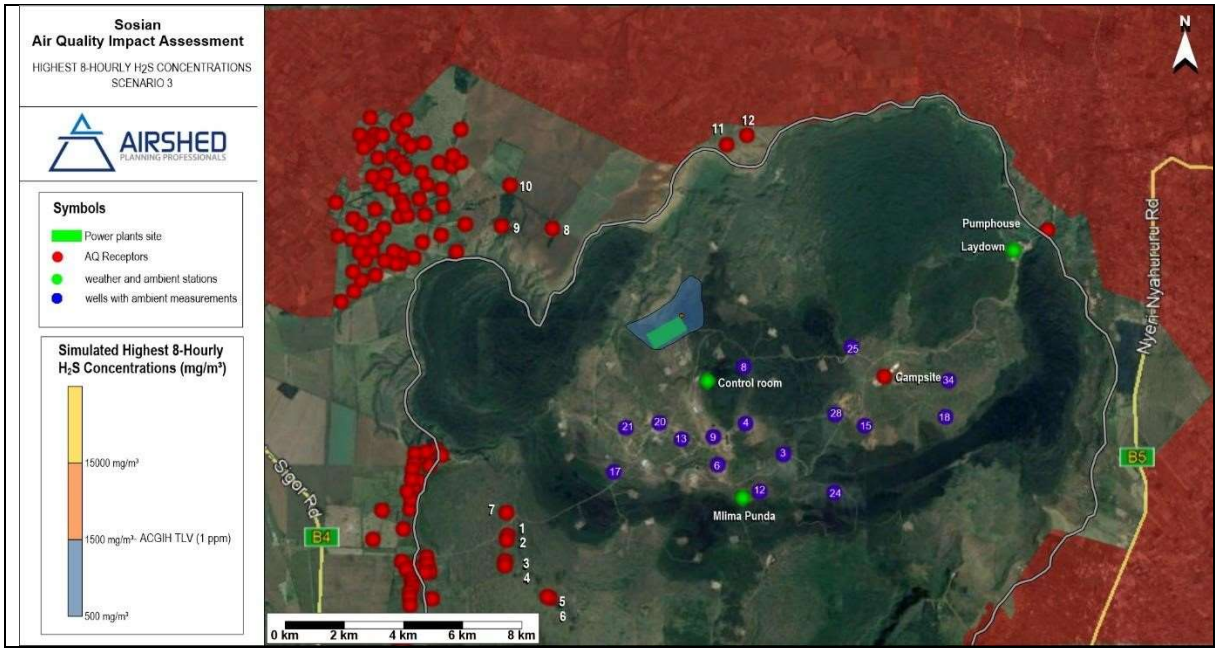


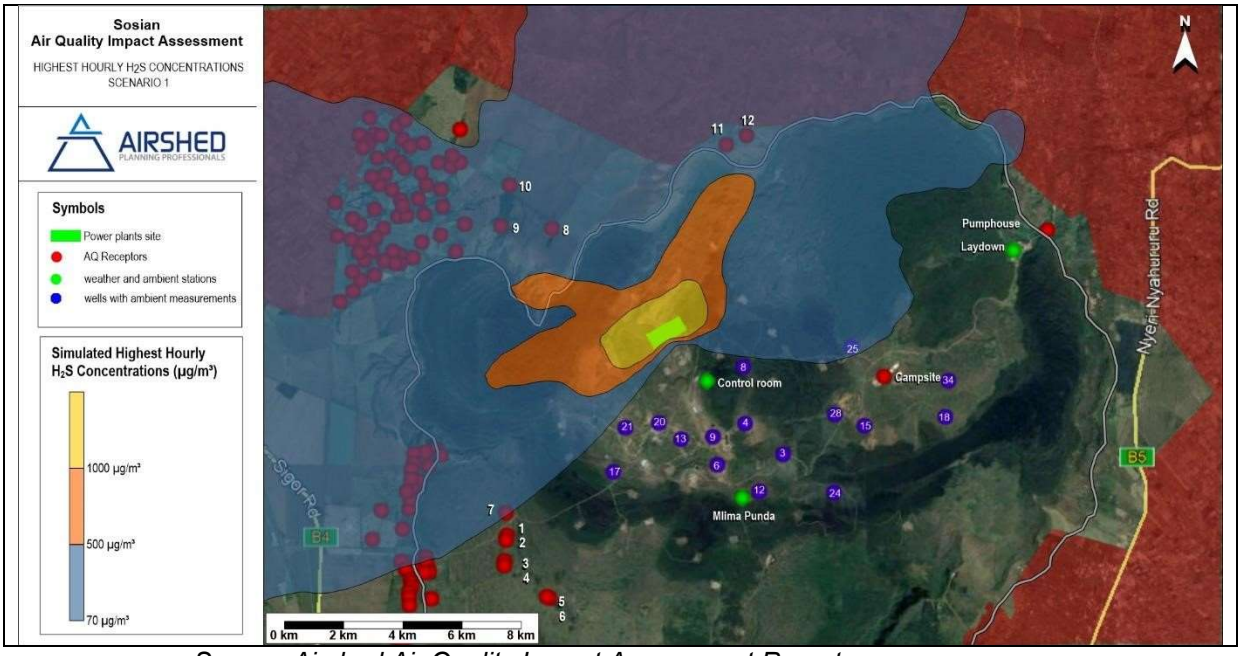
Figure 7-25: Highest 8-hr ground level H_2S concentrations – Scenario 3B

(e) Simulated Odour Impacts from H_2S

The results of the modelling suggest that a H_2S odour impact is possible and it has the potential under certain meteorological conditions to be regarded as a nuisance (offensive or objectionable) at some locations in Marigo and Rigogo (Figure 7-26, to Figure 7-31) (Table 7-13).

Table 7-13: Simulated 98th percentile hourly H_2S concentrations during the operational phase for Scenario 1, 2, 3

AQSRs		98th percentile 1-hour Ground Level Conc. (µg/m3)		
Number	Description	Scenario 1	Scenario 2	Scenario 3
1	Structure 1	46	43	19
2	Structure 2	42	39	18
3	Structure 3	28	25	12
4	Structure 4	25	22	11
5	Structure 5	1	1	1
6	Structure 6	1	1	0
7	Structure 7	**75**	69	30
8	Marigo area 1	**149**	**129**	**80**
9	Marigo area 2	**175**	**145**	**93**
10	Marigo area 3	**85**	**74**	43
11	Rigogo area 1	**251**	**212**	**141**
12	Rigogo area 2	**265**	**213**	**125**
	GDC Campsite	43	28	17
	Pumphouse and nursery	37	31	19
	Mlima Punda	0	0	0
	Laydown	39	31	18
	Control room	0	0	0
	Criteria	**70 (New Zealand)**		



Source: Airshed Air Quality Impact Assessment Report

Figure 7-26: Highest hourly ground level H_2S concentrations – Scenario 1A

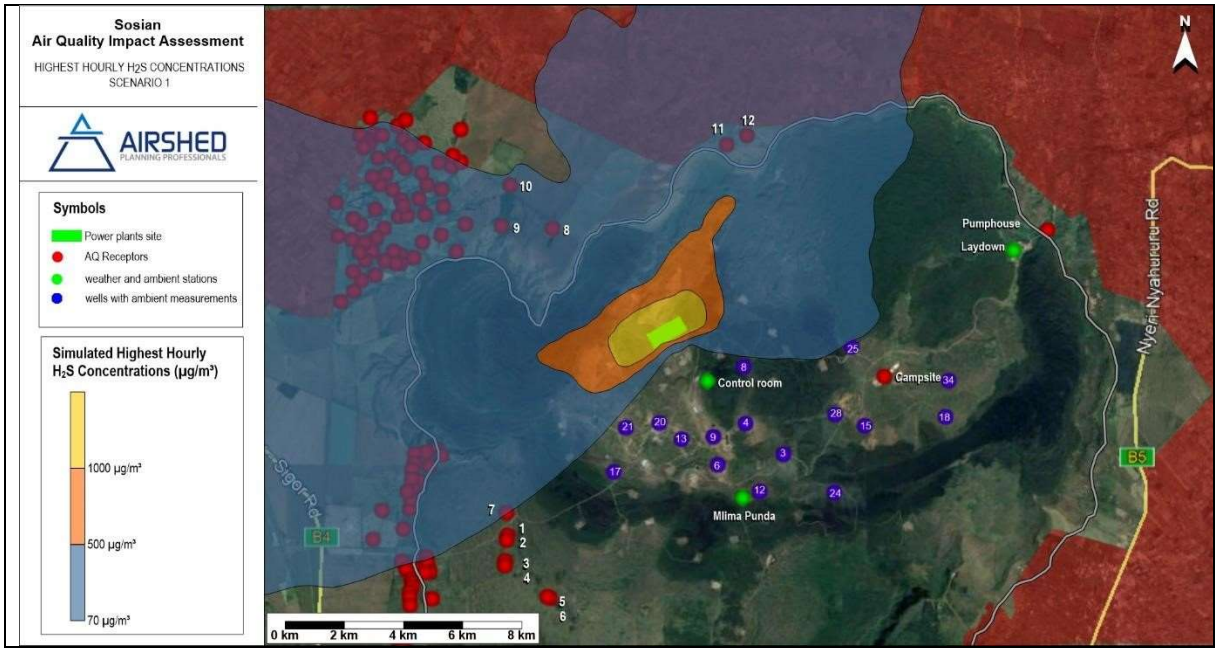
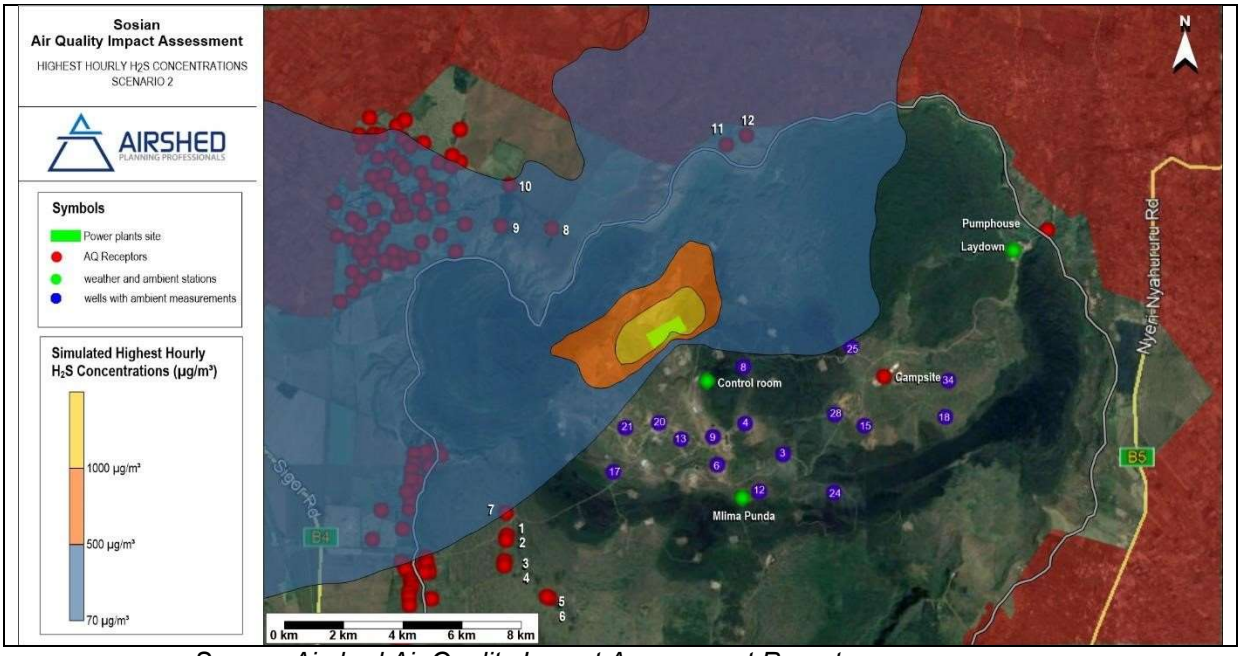


Figure 7-27: Highest hourly ground level H_2S concentrations – Scenario 1B



Source: Airshed Air Quality Impact Assessment Report

Figure 7-28: Highest hourly ground level H_2S concentrations – Scenario 2A

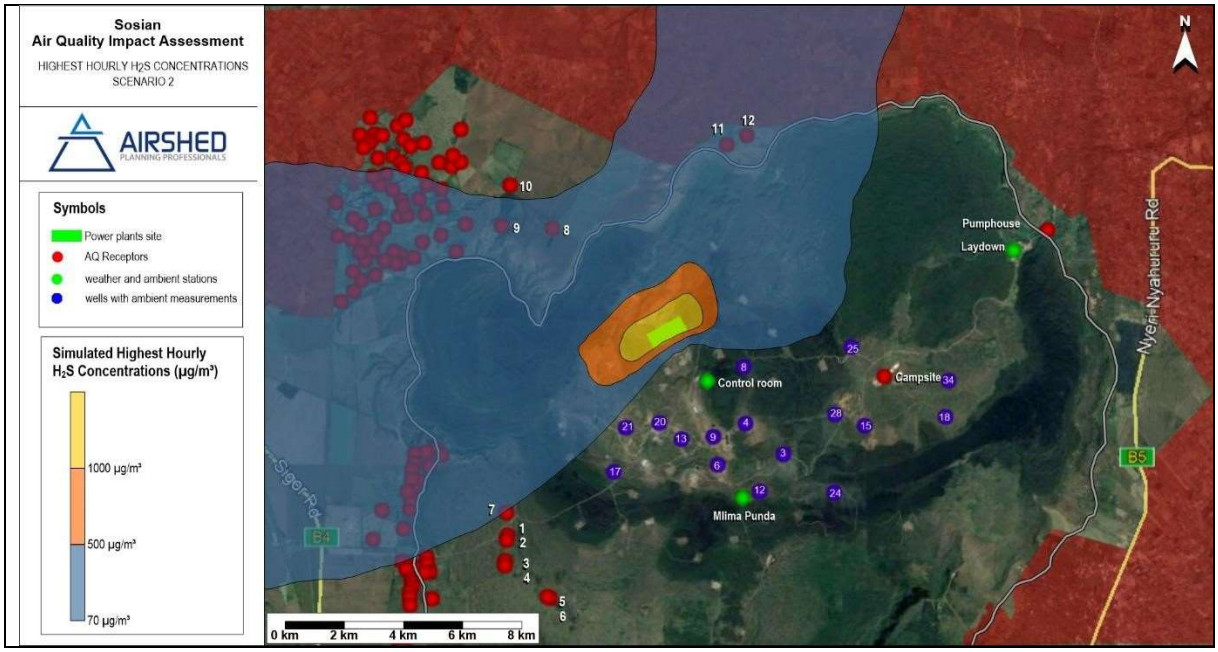
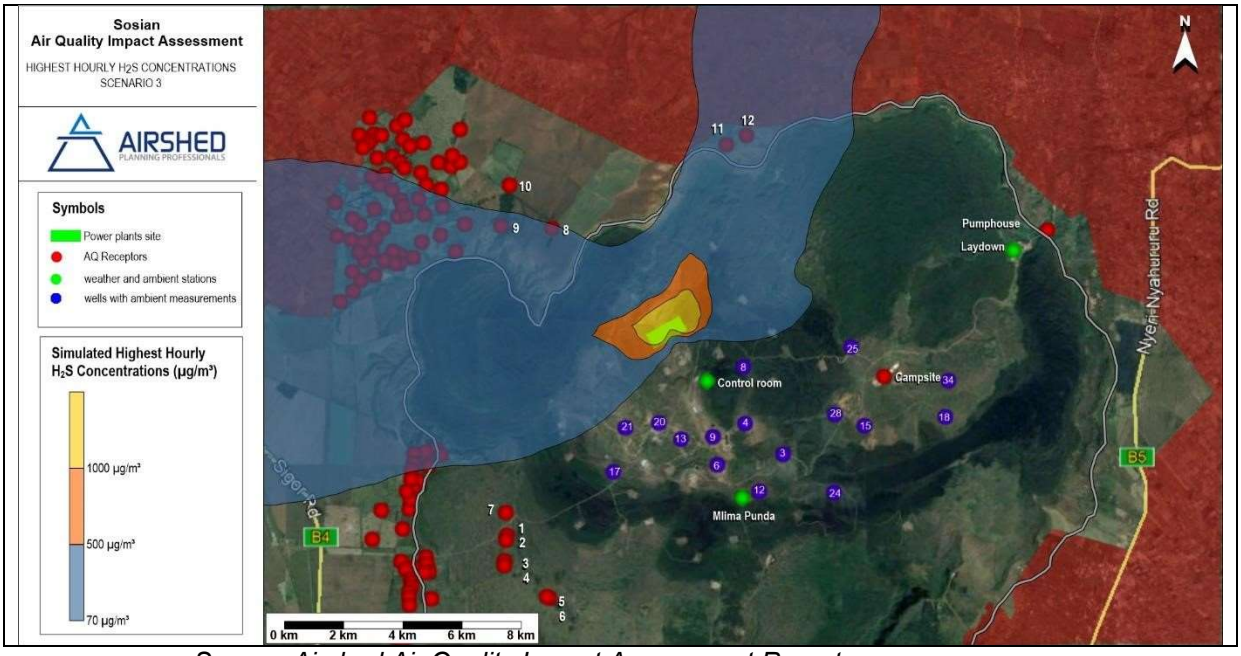


Figure 7-29: Highest hourly ground level H_2S concentrations – Scenario 2B



Source: Airshed Air Quality Impact Assessment Report

Figure 7-30: Highest hourly ground level H_2S concentrations – Scenario 3A

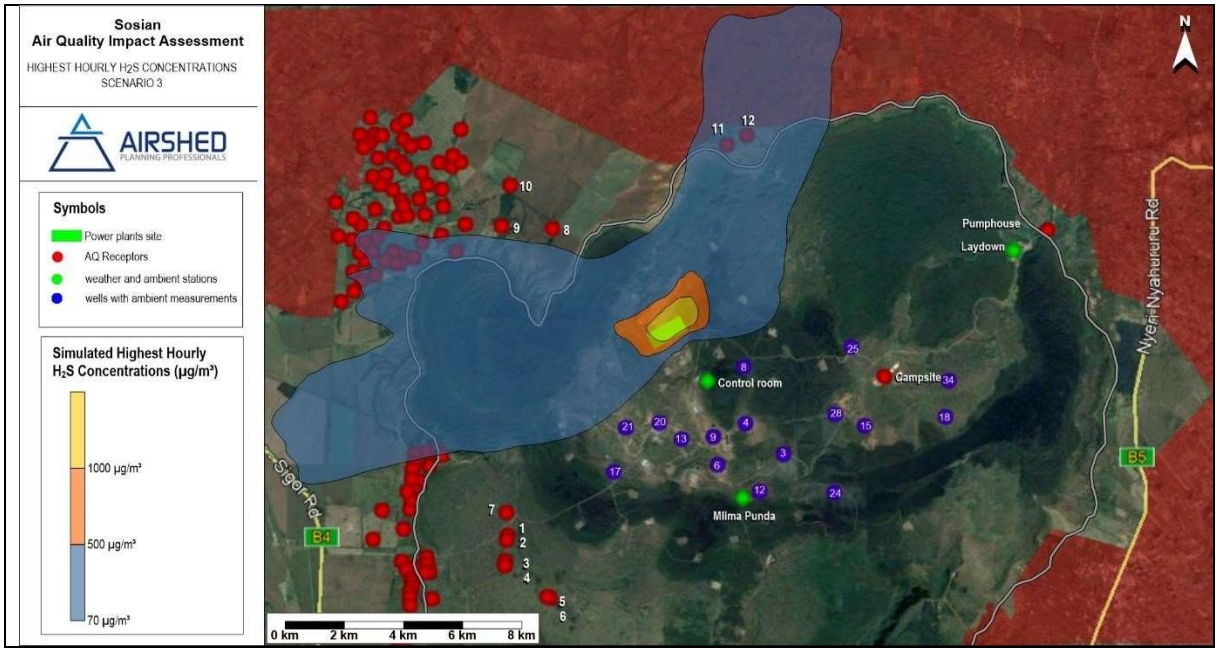


Figure 7-31: Highest hourly ground level H_2S concentrations – Scenario 3B

(f) Summary of Air Quality Impacts Modelling.

The main findings as summarised in the air quality report are as follows:

Receiving environment:

- The wind direction for the area is predominantly from the south and northeast. Long term air quality impacts are therefore expected to the north and southwest of the proposed operations.
- Ambient air quality monitoring conducted at the wells by the Geothermal Development Company (GDC), from 2016 to 2019 indicated ambient air pollutant levels that exceed the odour threshold as well as the American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Value (TLV) of 1 ppm.

- Several AQSRs are situated within the vicinity of the proposed power plant (several homesteads in the caldera, 3.5 km southwest of the plant, and areas outside of caldera 2 km northwest of the plant, Marigo, and 2.5 km north-northeast of the plant, Rigogo).

Public Health Impact:

For Scenario 1A, with Sosian and Quantum emitting from a single stack and OTTL emitting from cooling tower fans, simulated 24-hour ambient H_2S concentrations exceed the Iceland guideline of 50 µg/m³ at some of the AQSRs in the Rigogo and Marigo areas. However, the Kenyan Tolerance Limit and World Health Organization (WHO) daily guideline value of 150 µg/m³ is not exceeded at any of the AQSRs. Simulated annual average ambient H_2S concentrations exceed the California Office of Environmental Health Hazard Assessment (OEHHA) screening level for chronic exposure (10 µg/m³) at some of the AQSRs in the Rigogo and Marigo areas.

For Scenario 2A, with Sosian emitting from a single stack while OTTL and Quantum emitting from cooling tower fans, simulated 24-hour ambient H_2S concentrations exceed the Iceland guideline of 50 µg/m³ at some of the AQSRs in the Rigogo and Marigo areas. However, the Kenyan Tolerance Limit and WHO daily guideline value of 150 µg/m³ is not exceeded at any of the AQSRs. Simulated annual average ambient H2S concentrations exceed the OEHHA screening level for chronic exposure (10 µg/m³) at some of the AQSRs in the Rigogo and Marigo areas. Impacts are slightly lower than in scenario 1, as the dispersion via cooling towers results in lower impacts.

For Scenario 3A, Sosian's incremental impact if a single stack is adopted, simulated 24-hour ambient H_2S concentrations do not exceed the Kenyan limit or the WHO daily guideline value of 150 µg/m³ at any of the AQSRs but do exceed the Iceland guideline of 50 µg/m³ at some AQSRs. Simulated annual average ambient H_2S concentrations exceed the OEHHA screening level for chronic exposure (10 µg/m³) at the Rigogo area. For Sosian venting emissions through multiple (40) vents above the condenser fans (Scenario BB), a small reduction in impact is seen, but not a significant reduction compared to Scenario 3A of a single stack.

Occupational Impact:

For Scenario 1 and 2, the ACGIH TLV of 1ppm (1500 µg/m³) is exceeded both on-site as well as ~ 200 m and 150 m from the site boundary. For Scenario 3, the ACGIH TLV of 1ppm (1500 µg/m³) is exceeded for a very small area just off-site. None of the scenarios exceed the WHO lowest observable adverse effect level (LOAEL) of 15 mg/m³ (15 000 µg/m³) or 10 ppm.

Odour Impact:

The results of the modelling suggest it is possible that there will be a H_2S odour impact at the AQSRs under certain meteorological conditions.

Given the natural occurrence of H_2S in the project area, the New Zealand guideline value for odour nuisance is deemed applicable for the settlements bordering the Menengai crater.

Impact Analysis Matrix

Impact without Mitigation	
Severity of impact	*-4*
Spatial scope of impact	*-3*
Duration of impact	*-4*
Frequency of activity / duration of activity	*-4*
Frequency of impact	*-5*
Result	***-99 Medium - High***

Mitigation measures

The following options have been provided by the IFC (2007) EHS Guidelines for Geothermal Plants to manage emissions to air:

- Sosian should adopt the cooling tower technology and also incorporate H_2S safety systems for the plant as well as for the occupational hazard detection system. This will facilitate continuous monitoring and allow any further mitigation interventions where necessary;
- If necessary, after confirmation of all the three plants design, use of abatement systems to remove H_2S emissions from NCGs. Examples of H_2S controls can include wet or dry scrubber systems or a liquid phase reduction / oxidation system, while Hg emissions controls may include gas stream condensation with further separation or adsorption methods.

To ensure the lowest possible impact on AQSRs and the environment it is recommended that an air quality management plan should be jointly adopted by all the IPPs and GDC in their operations within the Menengai geothermal field. This includes:

- The mitigation of sources of emission;
- The management of associated air quality impacts; and
- Ambient air quality monitoring both within the caldera an at the identified sensitive receptors.

While Sosian can readily undertake the plant-specific air quality management plan, close collaboration will be required among all the IPPs in Menengai Geothermal area and GDC to achieve overall success.

For occupational health impacts, it is certain that some workers will occasionally be exposed to elevated H_2S concentrations. Mitigations measures proposed include:

- Continuous monitoring of H_2S within the Plant boundaries and other active activity sites within the caldera;
- Training of all workers on the dangers of being exposed to H_2S; and
- Installation of automatic H_2S data logging monitors with alarm system including use of personal monitors by staff in potentially dangerous areas;

For odour impacts, liaison strategy for communication with communities who may be affected by nuisance is recommended in addition to the air quality management plan for the Menengai geothermal field. Such community liaison should incorporate sharing of the monitoring results for transparency and to allay any community health fears.

7.6.13 Operation Noise impacts

During operation phase noise will be generated by a number of elements at the plant. The main sources of noise will include:

- The steam turbine;
- The generator;
- The droplet separator;
- The steam strainer;
- Valves (main and stop valves);
- Pumps (incl. oil pumps, vacuum pumps, hot well pumps and cooling water pumps)
- Ejectors;
- The main condenser;
- The cooling towers; and
- Transformers

The main noise source inventory and noise propagation modelling and results for the operational phase are discussed below respectively.

(a) Noise Sources and Sound Power Levels

(i) Sosian Geothermal Power Plant

Sosian provided the LP's 1 meter from the main sources of noise as well as the locations, quantities and height above ground. A summary of the technical noise information provided is given in Table 7-14.

Table 7-14: Technical information on the main sources of noise for the Sosian Geothermal Power Plant

Point	Description	Qty. per facility	Height of source (m)	L_P (dBA)	Distance from source of L_P (m)
A01	Silencer 1	1	8.2	NA	1
A02	Silencer 2	1	8.2		1
A03	NCG Stack	1	25.0		1
A04	Unit 1 – Generator	1	2.8	85	1
A05	Unit 1 – Screw Turbine 1	1	2.8	85	1
A06	Unit 1 – Screw Turbine 2	1	2.8	85	1
A07	Unit 2 – Generator	1	2.8	85	1
A08	Unit 2 – Screw Turbine 1	1	2.8	85	1
A09	Unit 2 – Screw Turbine 2	1	2.8	85	1
A10	Unit 3 – Fan	98	7.2	79.9	1
A11	Unit 3 – Generator	1	2.5	82	1
A12	Unit 3 – ORC Turbine	1	2.5	82	1
A13	Unit 4 – Fan	98	7.2	79.9	1
A14	Unit 4 – Generator	1	2.5	82	1
A15	Unit 4 – ORC Turbine	4	2.5	82	1
A16	Unit 5 – Fan	56	7.2	79.9	1
A17	Unit 5 – Generator	1	2.0	85	1
A18	Unit 5 – ORC Turbine	1	2.0	85	1

For use in the noise propagation simulations representative LW's for these sources were determined from the Equation below for the spherical diversion of noise from a point source:

$$LP = LW + 10.\ log10r + 8dB$$

Where LP is the source pressure level in dB at distance r from the source and LW is the actual sound power level of the source under consideration.

The octave sound power levels were determined by the CadnaA software. A summary of sources and associated LW's as included in the simulations is given in Table 7-15.

Table 7-15: Source inventory summary for the facility

Source	Octave Band Sound Power Levels; LWi (dB)									LWA (dBA)
	31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz	
Unit 1 – Generator	46.6	59.8	69.9	77.4	82.8	86.0	87.2	87.0	84.9	93.1
Unit 1 – Screw Turbine 1	46.6	59.8	69.9	77.4	82.8	86.0	87.2	87.0	84.9	93.1
Unit 1 – Screw Turbine 2	46.6	59.8	69.9	77.4	82.8	86.0	87.2	87.0	84.9	93.1
Unit 2 – Generator	46.6	59.8	69.9	77.4	82.8	86.0	87.2	87.0	84.9	93.1
Unit 2 – Screw Turbine 1	46.6	59.8	69.9	77.4	82.8	86.0	87.2	87.0	84.9	93.1
Unit 2 – Screw Turbine 2	46.6	59.8	69.9	77.4	82.8	86.0	87.2	87.0	84.9	93.1
Unit 3 – Fan	33.5	46.7	56.8	64.3	69.7	72.9	74.1	73.9	71.8	80.0
Unit 3 – Generator	41.1	54.3	64.4	71.9	77.3	80.5	81.7	81.5	79.4	87.6
Unit 3 – ORC Turbine	41.1	54.3	64.4	71.9	77.3	80.5	81.7	81.5	79.4	87.6
Unit 4 – Fan	33.5	46.7	56.8	64.3	69.7	72.9	74.1	73.9	71.8	80.0
Unit 4 – Generator	41.1	54.3	64.4	71.9	77.3	80.5	81.7	81.5	79.4	87.6
Unit 4 – ORC Turbine	41.1	54.3	64.4	71.9	77.3	80.5	81.7	81.5	79.4	87.6
Unit 5 – Fan	33.5	46.7	56.8	64.3	69.7	72.9	74.1	73.9	71.8	80.0
Unit 5 – Generator	46.6	59.8	69.9	77.4	82.8	86.0	87.2	87.0	84.9	93.1
Unit 5 – ORC Turbine	46.6	59.8	69.9	77.4	82.8	86.0	87.2	87.0	84.9	93.1

(ii) QPEA (Quantum) Geothermal Power Plant

A summary of sources and associated LW's as obtained from the noise impact assessment completed for QPEA in 2015 (von Reiche, 2015) is provided in Table 7-16.

Table 7-16: Source inventory summary for the QPEA Geothermal Power Plant

Source	Qty. per facility	Octave Band Sound Power Levels; LWi (dB)							LWA (dBA)
		63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	
Droplet Separator	1	72.0	58.0	52.6	53.2	62.0	60.8	58.1	66.2
Main Condenser	1	91.2	91.2	95.8	98.4	99.2	97.0	94.2	103.4
Ejector	3	95.0	95.0	102.6	111.2	115.0	112.8	113.1	119.5
Inter Condenser	1	87.0	87.0	95.6	103.2	107.0	104.8	105.1	111.5
Vacuum Pump	4	90.0	97.0	96.6	97.2	94.0	89.8	86.2	98.8

Hotwell Pump	2	64.0	90.0	97.6	91.2	87.0	79.8	71.3	93.2
Auxiliary Cooling Water Pump	2	110.0	102.0	95.6	87.2	82.0	79.8	77.2	92.4
Cooling Tower per Cell	4	103.5	100.9	98.8	98.0	99.7	99.1	98.9	106.1
Turbine Hall (effective L_W)	1	110.9	112.3	92.1	82.1	76.3	64.7	60.3	96.9
Transformers (11 kV to 132 kV)	1	99.7	103.7	97.7	93.7	93.7	87.7	82.7	97.7
Transformers (11 kV to 0.69 kV)	1	86.0	90.0	84.0	80.0	80.0	74.0	69.0	84.0
Transformers (11 kV to 00.415 kV)	1	72.8	76.8	70.8	66.8	66.8	60.8	55.8	70.8

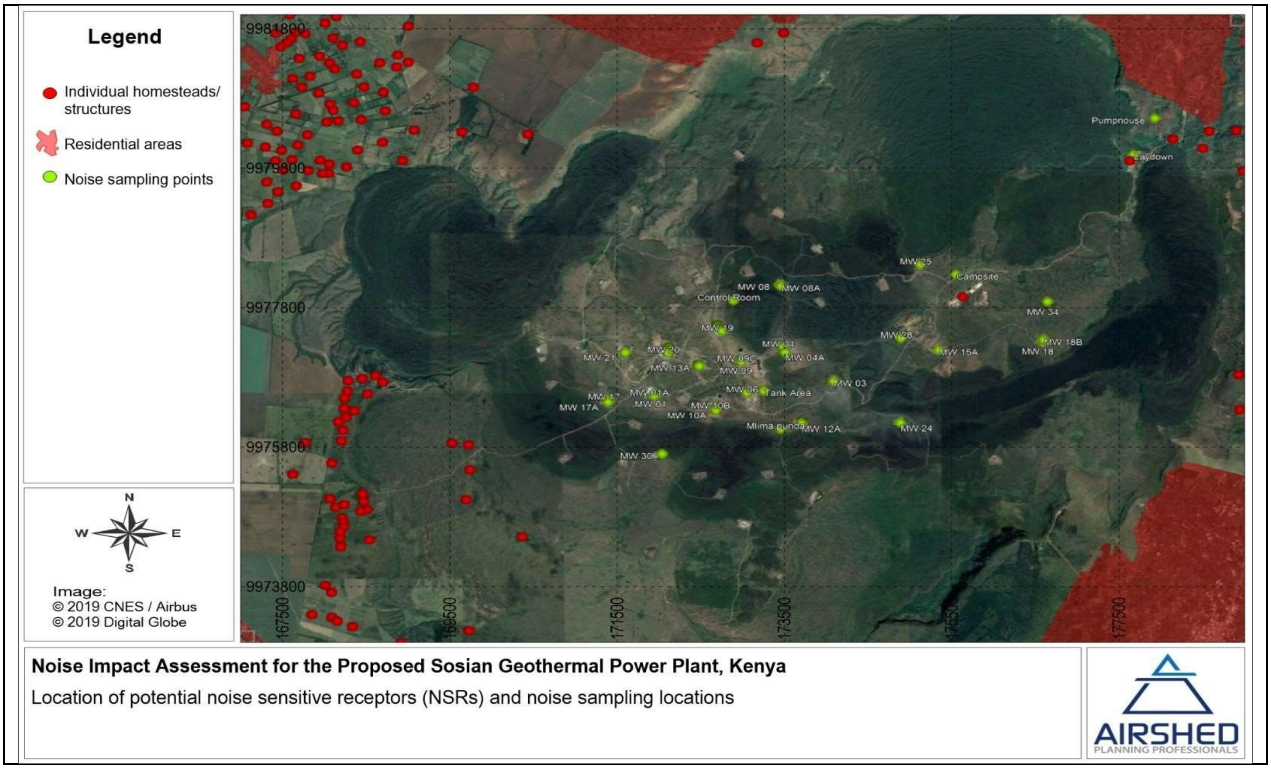
(iii) OTTL Geothermal Power Plant

The complete noise sources and sound power levels are contained in the noise impact assessment that has been completed for this Geothermal Power Plant (von Gruenewaldt, 2019).

(b) Noise Propagation and Simulated Noise Levels

The propagation of noise generated during the operational phase was calculated with CadnaA in accordance with ISO 9613. The main meteorological and site-specific acoustic parameters include wind speed, wind direction, temperature and Noise reduction caused by a barrier (i.e. natural terrain, installed acoustic barrier, building). These along with other parameters such as relative humidity, air pressure, solar radiation and cloud cover affect the stability of the atmosphere and the ability of the atmosphere to absorb sound energy.

Meteorological data measured at the Control Room, ~1 km south east of the Geothermal Power Plant, for the period 2017 was used for the assessment. The data set indicates wind flow primarily from the south (Figure 3-3). On average, noise impacts are expected to be more notable north and north-northeast of the project activities.



Source: Airshed Noise Impact Assessment Report

Figure 7-32: Location of potential noise sensitive receptors and noise sampling locations

Based on the anticipated extent of impacts and the location of potential noise sensitive receptors (NSRs), the propagation of noise was calculated over a distance of approximately 12 km east-west by 9 km north-south at 20 m intervals. Results are presented in tabular and isopleths form. An isopleth is a line on a map connecting points at which a given variable (in this case LP) has a specified constant value. This is analogous to contour lines on a map showing terrain elevation. In the assessment of environmental noise, isopleths present lines of constant noise level as a function of distance.

Table 7-17 gives a summary of maximum downwind distances over which Kenyan sound level limits and IFC noise level guidelines are exceeded should the Sosian Geothermal Power Plant be operational on its own (Figure 7-33 to Figure 7-39) and with the OTTL and QPEA facilities (Figure 7-34, Figure 7-36, Figure 7-38 and Figure 7-40).

From Table 7-17 it is evident that even with all three facilities operating simultaneously the overall maximum increase in noise level over the baseline will reduce to less than 3 dBA at around 1.72 km from the boundary of operations. As expected, the noise impact would be most notable at night when baseline noise levels are lower and assessment criteria more stringent. Since the closest NSRs are situated at least 2 km away from these sites it is however unlikely a change in day or night-time noise levels will be detected at these locations. SANS 10103 (2008) indicates that at an increase of between 0 and 5 dBA, sporadic complaints with little or no community action may be expected.

The relatively small impact area is the combined result of the baseline noise levels (already in exceedance of assessment criteria), the design specifications of the facilities, and the absence of permanent noise sensitive receptors (NSRs) within 2 km radius from site.

It can therefore be concluded that, when referring to noise levels and increases in ambient noise levels as a result of the geothermal power plants' operational design

sound power levels, as provided for the geothermal power facilities, will be sufficient to ensure that no annoyance will be caused at the closest NSRs.

Table 7-17: Maximum downwind distances over which Kenyan and IFC noise criteria are exceeded

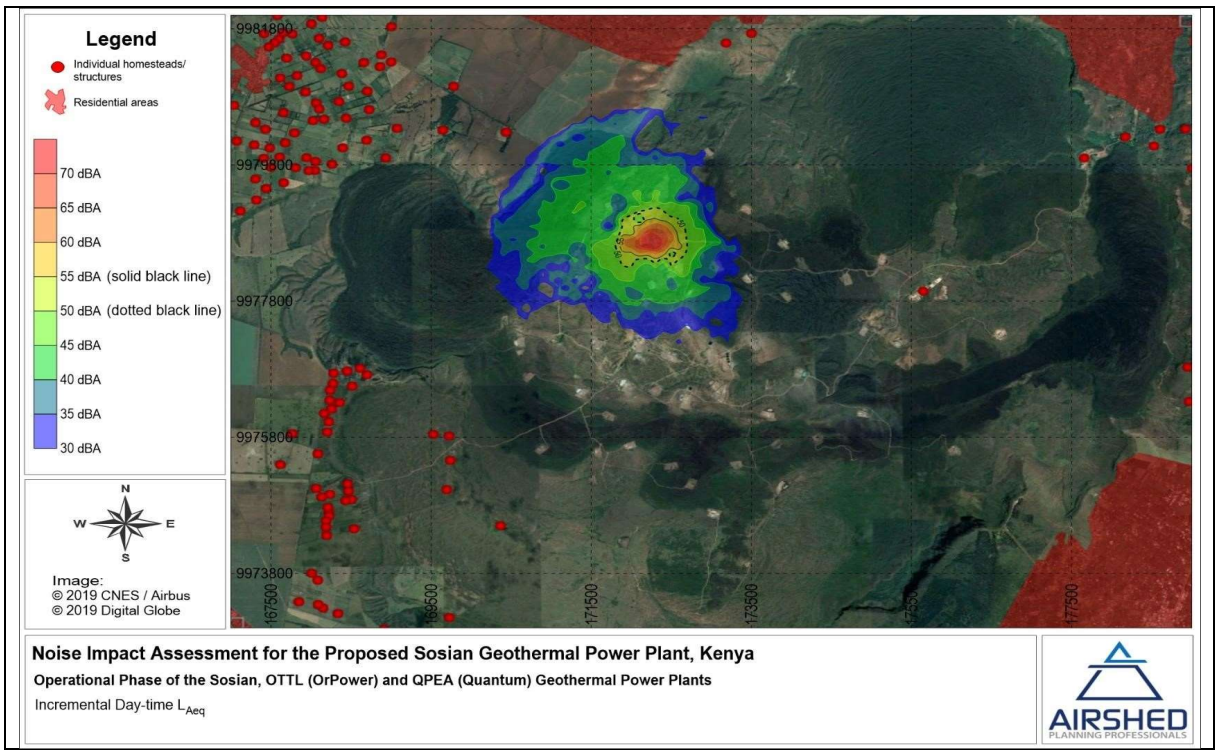
Source	Kenya Sound Level Limits		IFC Noise Level Guidelines	
	Day-time (50 dBA)	Night-time (35 dBA)	Day-time (55 dBA)	Night-time (45 dBA)
Sosian Geothermal Power Plant				
Incremental	50 dBA at 140 m	35 dBA 380 m	55 dBA at 100 m	45 dBA at 200 m
Cumulative (in addition to baseline)	Baseline of 57.9 dBA[(a)] exceeds limit	Baseline of 47.9 dBA[(b)] exceeds limit	Baseline of 57.9 dBA[(a)] exceeds guideline	Baseline of 47.9 dBA[(b)] exceeds guideline
Increase above baseline	Not applicable	Not applicable	3 dBA at 90 m	3 dBA at 160 m
Sosian, OTTL and QPEA Geothermal Power Plants				
Incremental	50 dBA at 530 m	35 dBA 1 970 m	55 dBA at 390 m	45 dBA at 790 m
Cumulative (in addition to baseline)	Baseline of 57.9 dBA[(a)] exceeds limit	Baseline of 47.9 dBA[(b)] exceeds limit	Baseline of 57.9 dBA[(a)] exceeds guideline	Baseline of 47.9 dBA[(b)] exceeds guideline
Increase above baseline	Not applicable	Not applicable	3 dBA at 390 m	3 dBA at 610 m

(a) As no noise sampling was undertaken at sensitive receptors, background noise levels were taken from the pumphouse sampling point. This sampling location is within 300m of the closest sensitive receptor and is located away from the drilling and discharge noise from the wells.

(b) Only day-time noise levels were sampled. As the difference in day and night time noise levels in areas where there is human activity is usually about 10 dBA (SANS 10103, 2008), the estimated 47.9 dBA baseline night-time noise level was used.

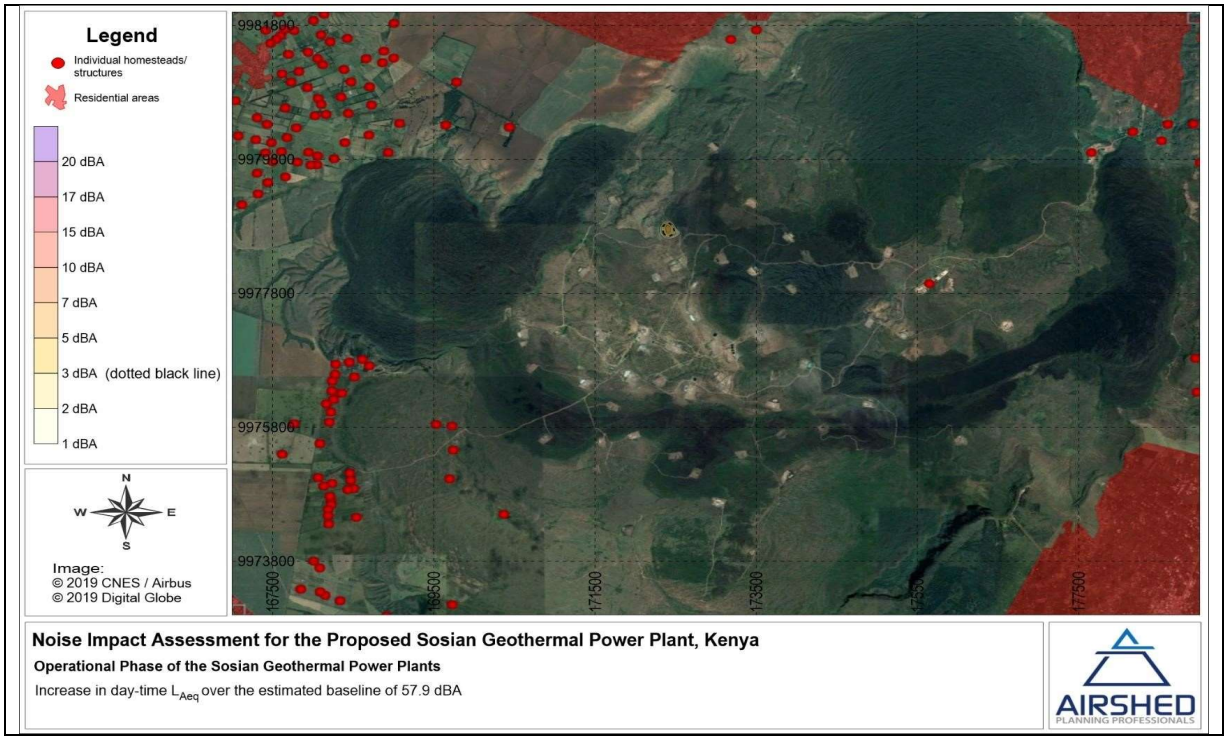
Source: Airshed Noise Impact Assessment Report

Figure 7-33: Incremental day- time LAeq as a result of the operational phase of the Sosian Geothermal Power Plant



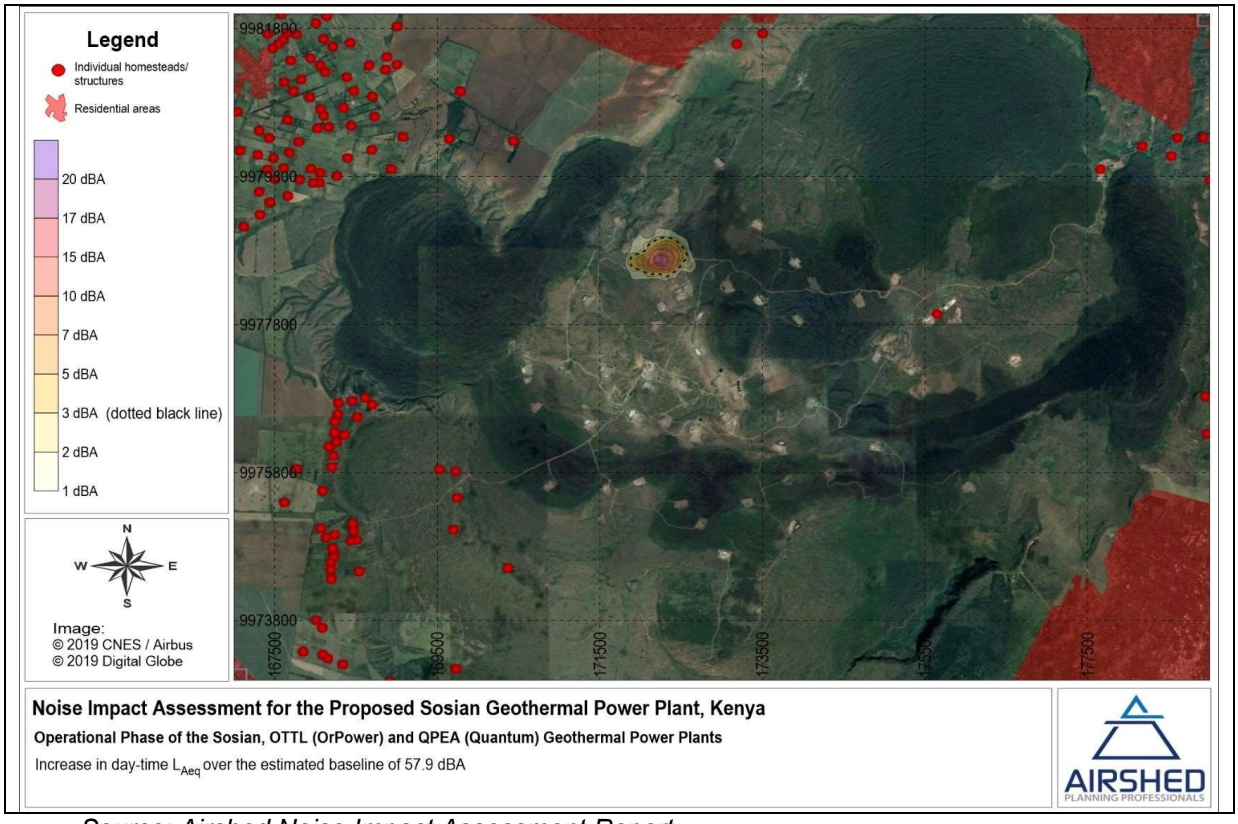
Source: Airshed Noise Impact Assessment Report

Figure 7-34: Incremental day-time LAeq as a result of the operational phase of the Sosian, OTTL and QPEA Geothermal Power Plants



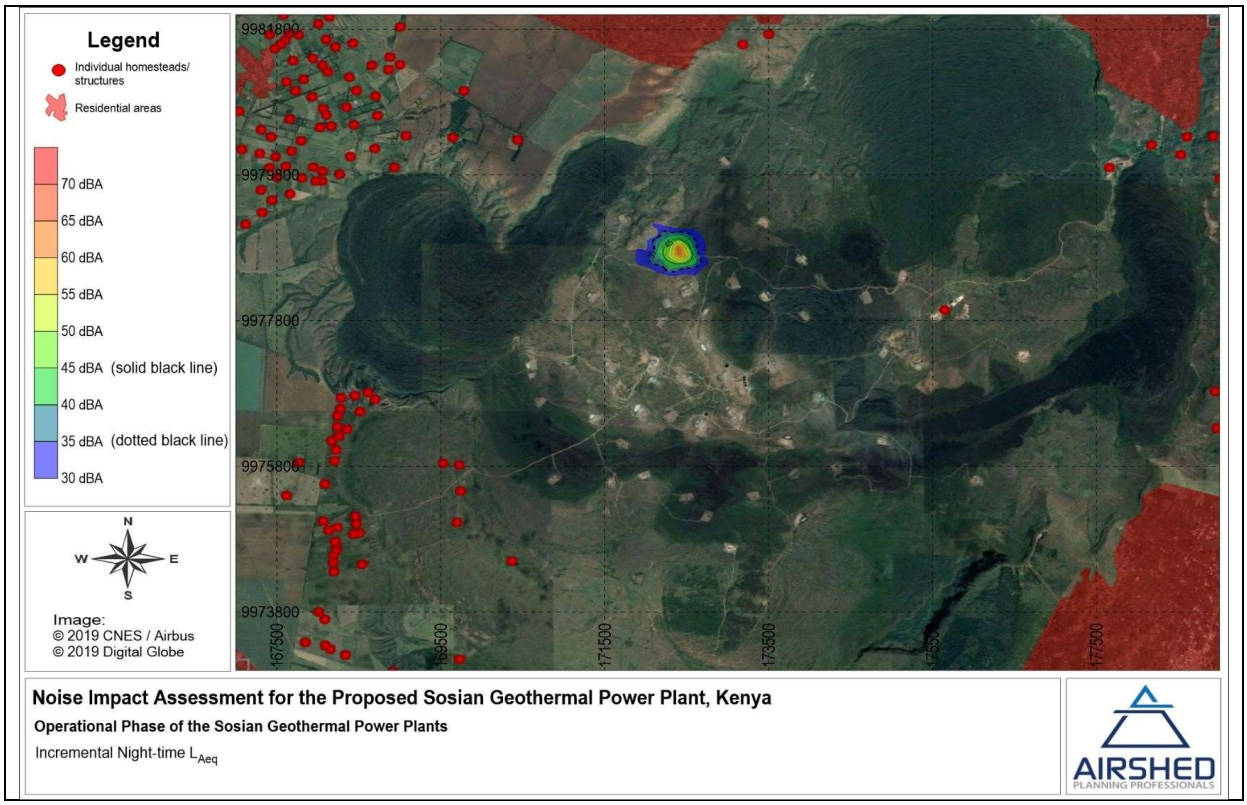
Source: Airshed Noise Impact Assessment Report

Figure 7-35: Increase in day-time LAeq over the baseline of 57.9 dBA as a result of the operational phase of the Sosian Geothermal Power Plant



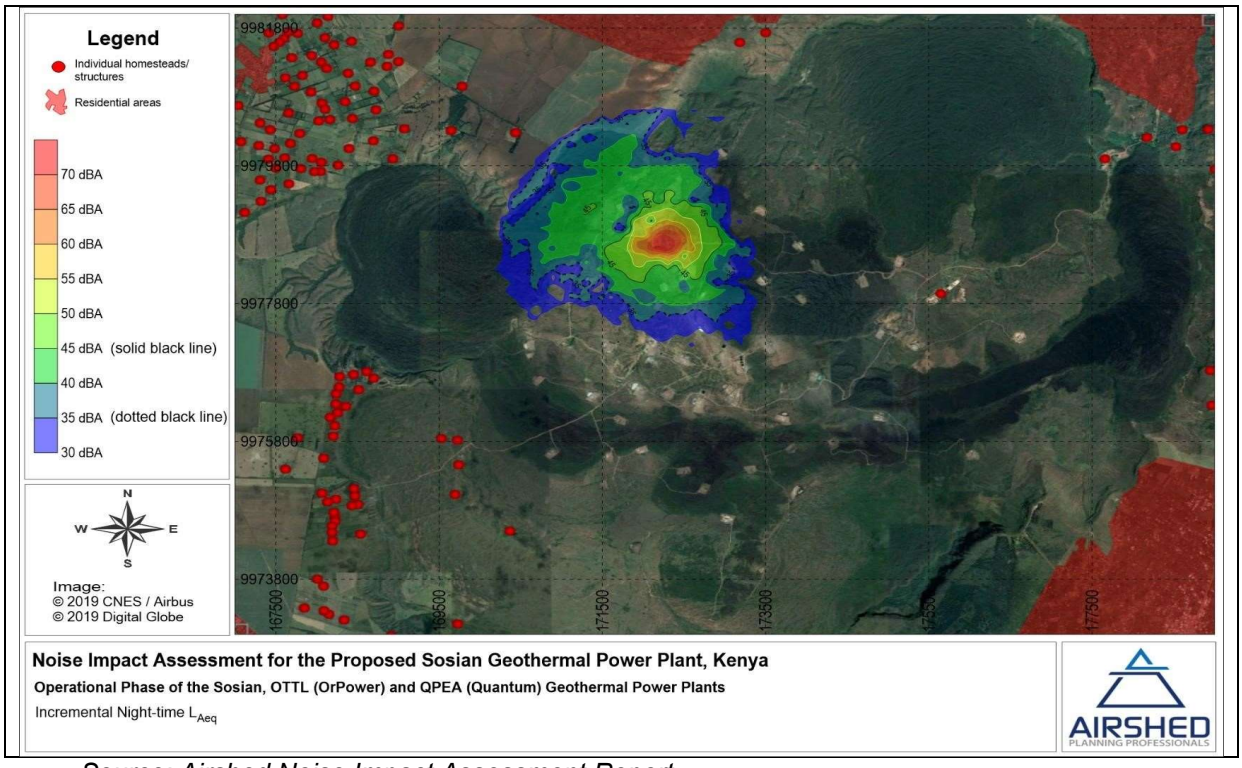
Source: Airshed Noise Impact Assessment Report

Figure 7-36: Increase in day-time LAeq over the baseline of 57.9 dBA as a result of the operational phase of the Sosian, OTTL and QPEA Geothermal Power Plants



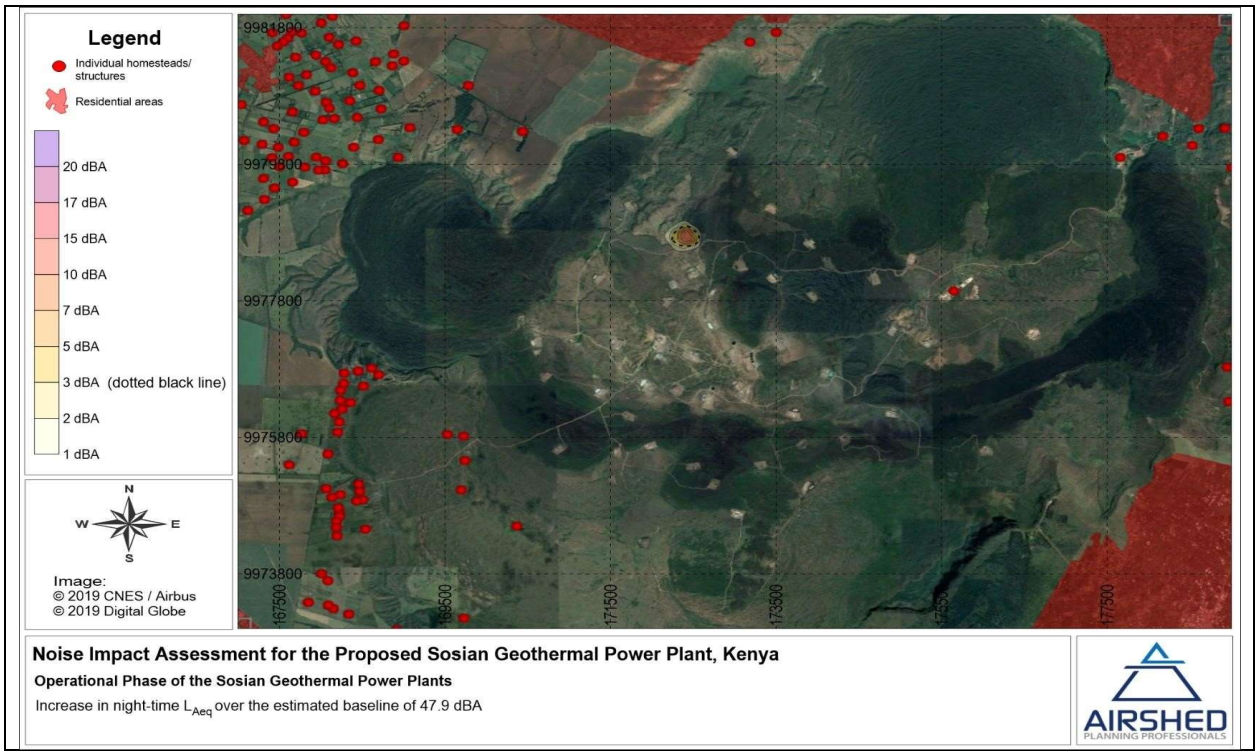
Source: Airshed Noise Impact Assessment Report

Figure 7-37: Incremental night-time LAeq as a result of the operational phase of the Sosian Geothermal Power Plant



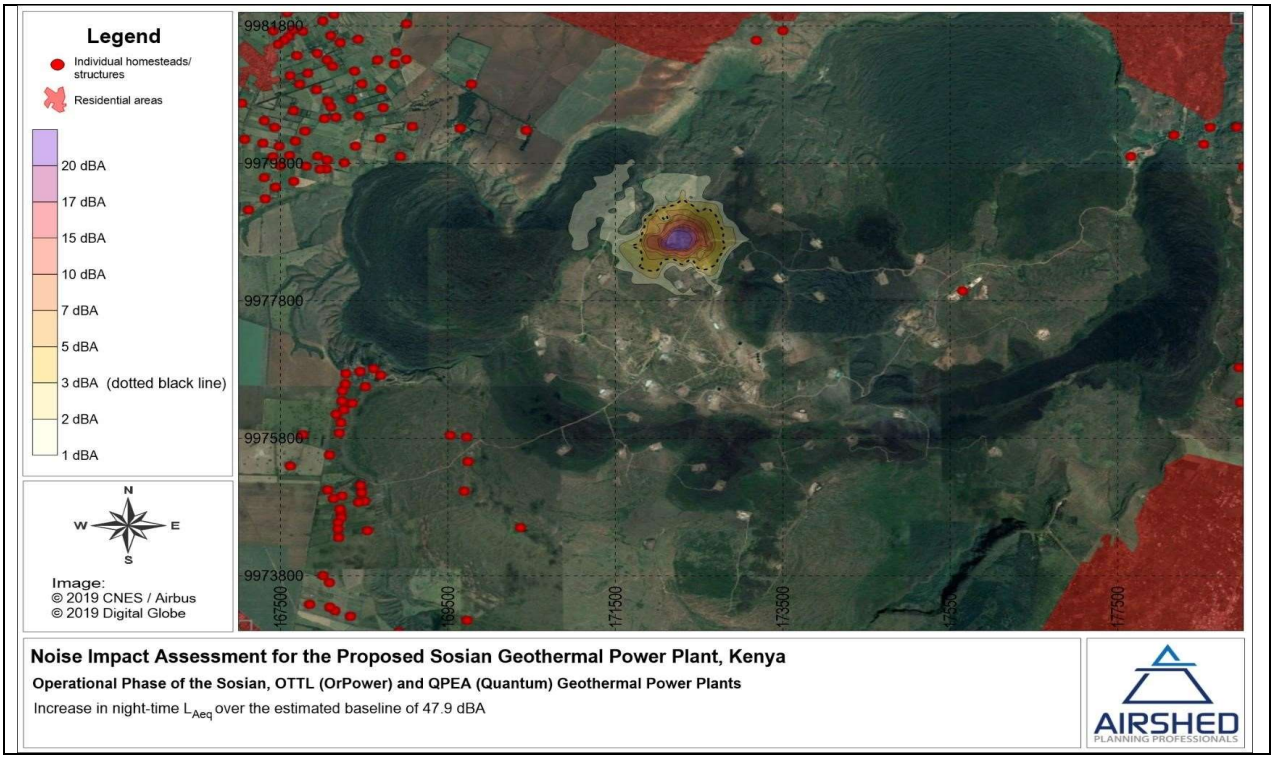
Source: Airshed Noise Impact Assessment Report

Figure 7-38: Incremental night-time LAeq as a result of the operational phase of the Sosian, OTTL and QPEA Geothermal Power Plants



Source: Airshed Noise Impact Assessment Report

Figure 7-39: Increase in night-time LAeq over the baseline of 47.9 dBA as a result of the operational phase of the Sosian Geothermal Power Plant



Source: Airshed Noise Impact Assessment Report

Figure 7-40: Increase in night-time LAeq over the baseline of 47.9 dBA as a result of the operational phase of the Sosian, OTTL and QPEA Geothermal Power Plants

Noise impacts from discharging wells

Once the wells are drilled, they are left to discharge while they are being tested. This may take a few months before the well is shut in. During this period, there may be excessive noise levels from the well. As this noise source is temporary, it was not simulated with the routine operations of the geothermal power plants. However, in order, to understand the potential noise impacts from this source, the noise sampling data was assessed. From the noise sampling data, detail on the phase of the wells was provided for the period 2016. Well MW09 was discharging during 2016 and noise sampling at this site was undertaken for the same period. The highest noise level sampled at this site was 95.3 dBA. The noise attenuation was simulated for this source assuming a sound power level of 95.3 dBA and a height of 2 m. The simulated noise levels for this source is provided in Table 7-18. The overall maximum increase in noise level over the baseline will reduce to less than 3 dBA at around 160 m from a discharging well (assuming a baseline noise level of 57.9 dBA for day-time conditions as measured at the pumphouse). The closest NSR to the wells is the campsite (~700 m to MW25).

Table 7-18: Maximum downwind distances for a discharging well over which Kenyan and IFC noise criteria are exceeded

Source	Kenya Sound Level Limits		IFC Noise Level Guidelines	
	Day-time (50 dBA)	Night-time (35 dBA)	Day-time (55 dBA)	Night-time (45 dBA)
Discharging well	50 dBA at 60 m	35 dBA 400 m	55 dBA at 100 m	45 dBA at 200 m
Cumulative (in addition to baseline)	Baseline of 57.9 dBA[(a)] exceeds limit	Baseline of 47.9 dBA[(b)] exceeds limit	Baseline of 57.9 dBA[(a)] exceeds guideline	Baseline of 47.9 dBA[(b)] exceeds guideline
Increase above baseline	Not applicable	Not applicable	3 dBA at 70 m	3 dBA at 160 m

(a) *As no noise sampling was undertaken at sensitive receptors, background noise levels were taken from the pumphouse sampling point. This sampling location is within 300m of the closest sensitive receptor and is located away from the drilling and discharge noise from the wells.*

(b) Only day-time noise levels were sampled. As the difference in day and night time noise levels in areas where there is human activity is usually about 10 dBA (SANS 10103, 2008), the estimated 47.9 dBA baseline night-time noise level was used.

Impact Analysis Matrix

Impact without Mitigation	
Severity of impact	*-2*
Spatial scope of impact	*-2*
Duration of impact	*-4*
Frequency of activity / duration of activity	*-5*
Frequency of impact	*-3*
Result	***-64 Low- Medium***

Mitigation measures

In order to minimize impacts of both construction and operational noise on the receiving environment it is recommended that the following measures be adopted as part of the noise management plan.

Good Engineering and Operational Practices

- To minimize noise generation, equipment vendors must be required to guarantee optimized equipment design noise levels;
- Acoustic attenuation devices should be installed on all ventilation outlet and high-pressure gas or liquid should not be ventilated directly to the atmosphere, but through an attenuation chamber or device;
- Vibrating equipment must be on vibration isolation mountings;
- The site layout should be designed in such a manner that the noisiest sections of the plant are at the center of the site, using surrounding buildings as noise attenuation shields;
- Implement routine equipment maintenance program to minimize noise/vibration associated with mobile parts power transmission/vibration;
- Plant areas/sections with excessive noise should be clearly labelled with warning signages and those accessing them required to have appropriate PPEs to protect against excessive noise i.e. ear plugs/muffs;
- A plan to monitor noise levels, record and respond to complaints and mitigate impacts should be developed.

Monitoring

It is recommended that short term 24-hour to 1-week sampling be conducted at the facility boundaries as well as nearest NSRs. Monitoring should be conducted in accordance with the procedures specified by the IFC (2007). Samples, at least 24-hours in duration should include the following parameters: L_{Aeq}, L_{A90}, and the un-weighted octave band sound pressure levels (L_{Zeq}). In the interpretation and reporting of sampled environmental noise levels, use should be made of a trained specialist.

In addition to ambient noise monitoring it is recommended that source noise measurements of turbine building facades and sources located inside and outside buildings be sampled to verify L_W's applied in noise modeling study.

7.7 Negative Impacts during Decommissioning

Decommissioning will involve take out of the power plans and associated infrastructures after useful life. Sosian Geothermal Power Plants Ltd tender agreement with GDC is to install the power Plant on a Build Own and Operate (BOO) basis for 25 years, a typical economic design life of the major project equipment. However, it is not uncommon for power plant such as the proposed development to operate for 40 years or more.

The decision to decommission the Power Station will depend on its economic viability and continued well productivity. Decommissioning must take account of the environmental legislation and the technology available at the time.

The notable adverse impact at this phase is leaving abandoned plant, equipment and buildings without any attempt to rehabilitate leading to the deterioration of habitat. Unplanned, careless and disorganised site decommissioning can result in interference of habitat. Site decommissioning will involve closure and removal of facilities and disconnection from wells, including infrastructures such as roads and pipelines and finally vegetation restoration and landscaping. Vegetation can restore naturally through succession or intervened rehabilitation to achieve average status with the neighbouring area. An additional problem is the abandoned wells (holes) which can be fall off for wildlife and human.

A lot of solid waste will also be generated during decommissioning. The majority of the solid wastes generated will be similar to the construction phase of the project. These include;

- Demolition rubble;
- Top soils and excavation wastes;
- General demolition wastes;
- Waste metal (including, disc cutters, piping etc.);

- Waste oils and lubricants;
- Waste paints and solvents;
- Empty paint, oil and chemical/ solvent containers;
- Wood;
- Plastics;
- Electrical cabling and electrical components;
- Domestic wastes, including food wastes;
- Sewage effluent;
- Paper;
- Empty oxygen and acetylene tanks (if oxy-acetylene welding and cutting required); and
- Glass.

Sosian would develop a decommissioning plan incorporating both safety and environmental management and the works would be undertaken in accordance with an Environmental Management Plan.

The first step of decommissioning will be to make the plant safe for work in accordance with relevant safety procedures. The Power Station would be de-energised in conjunction with the electricity network operators, Kenya Power and KETRACO. The steam supply system by GDC would also require safe disconnection at the provided interfaces.

Disused equipment and materials would be sold where possible or disposed of off-site by a licensed contractor. Closed vessels, pipes and other areas which could have hazardous gases present would be vented in accordance with normal operating procedures. These would then be tested to ensure that they are safe for entry or removal.

Once the plant is completely disconnected, and all hazardous materials removed, it will be handed over to a competent contractor (or contractors) to complete the dismantling and demolition work.

These decommissioning steps may be summarised and involve the following steps presented below;

- Make the site safe – ensure all electrical connections and supplies are disconnected and any dangerous chemical stores are identified and made safe;
- Removal and sale/recycling of plant and materials;
- Disposal of waste materials by appropriate methods in accordance with waste management regulations; and
- Re-instatement and landscaping of the power plant site with suitable mix of indigenous species. This should be done in liaison with the local KFS office.

Sosian must prepare and submit a decommissioning plan to NEMA for approval at least three months before decommissioning.

8 ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

8.1 Introduction

The Environmental Social Management Plan (ESMP) is developed to demonstrate how site-specific concerns and mitigation measures are managed through the detailed design, pre-construction, construction and post-construction / operation phase of the Project. It provides confidence on the part of project planners that a reliable scheme will be put in place to deal with any contingency that may arise during all phases of development, from preliminary study to abandonment.

Environmental management activities of the proposed Geothermal Power Plant Project will be governed by a series of regulations that impose standards and mitigation of environmental hazards. Thus, it is a planned and integrated programme aimed at ensuring that both identified and unidentified impacts that may arise during the various phases of the project are brought to an acceptable level.

This Environmental Management Plan has the following specific long-term objectives:

- Ensure compliance with legislation and Company policy;
- Achieve, enhance and demonstrate sound environmental performance built around the principle of continuous improvement;
- Integrate environment fully into the business;
- Rationalise and streamline existing environmental activities to add value in efficiency and effectiveness;
- Encourage and achieve the highest performance and response from individual employees and contractors;
- Provide standards for overall planning, operation, audit and review;
- Enable management to establish environmental priorities;
- Be applicable throughout the organisation;
- Hold early consultations with communities and regulating authorities to ensure hitch free operations.

8.2 Framework for Implementation of the ESMP

8.2.1 Organisation Roles and Responsibilities

In order to ensure the sound development and effective implementation of the ESMP, it will be necessary to identify and define the responsibilities and authority of the various persons and organizations that will be associated with the project. The following entities should be involved in the implementation of this ESMP:

- Sosian Geothermal Power Plants Ltd Senior Management;
- GDC;
- KETRACO and KPLC;
- Project Manager;
- EPC Contractor and Subcontractors;
- NEMA;
- Energy and Petroleum Regulatory Authority (Formerly ERC)
- Project Consultant;
- Nakuru County Government; and
- Local Administration

During the implementation of the ESMP, Sosian has to take the lead in implementing the ESMP within the Power plant site whereas GDC will to take the lead within the entire Caldera as well as coordinating collaborations between all the IPPs as applicable.

(a) Sosian Geothermal Power Plants Ltd Management

It will be the responsibility of Sosian to oversee or appoint qualified and competent team to oversee the construction and operational phases of the Project. This team shall form part of the project implementation team (PIT). According to the PISSA agreement Sosian responsibility is confined within the boundaries of the power plant.

Sosian's proposed project implementation organogram is presented in Appendix X. It includes provision of an HSE personnel within the EPC contractors' staff. However, no HSE slot is indicated for Sosian itself or the proposed Owner's Engineer team.

Health, Safety and Environment (HSE)Expert

Given the need for overall coordination of ESMP issues at the plant and close collaboration required with GDC and other IPPs, it is recommended that Sosian enlist the services of a duly qualified HSE expert. The inhouse expert will, in addition to the above coordination roles, help in mainstreaming the requirements of the ESMP in the EPC contract, assessing the readiness of the EPC contractor to implement the ESMP and also monitor the ESMP implementation throughout both construction and operational phases.

The HSE office should have suitably qualified staff in the field of environment and occupational safety and health management. The department will work in liaison with GDC and Sosian Geothermal Power Plants Ltd contractors to ensure sound environmental and social performance by undertaking the following:

- Conduct readiness reviews with contractors to ensure their environmental and social management system (EMS) implementation meets Project requirements;
- Work with contractors to improve their ESMS where gaps are identified;
- Conduct training and awareness programmes with personnel involved in ESMP implementation;
- Ensure regular monitoring and evaluation of the Project's performance against the ESMP;
- Maintain records of all non-conformances and work with the relevant parties to resolve within reasonable time frames;
- Assess the efficacy of the mitigation measures and manage continuous improvement around these measures;
- Collate all required Project environmental and social reports and ensure they meet Project reporting requirements;
- Provide regular advice on all Project environmental and social requirements;
- Ensure occupational safety and health requirements by OSHA and AfDB standards are met by Sosian and appointed contractors;
- Liaise with regulatory bodies in addressing environmental and safety issues in Sosian operations;
- Maintain accurate records of open and closed grievances, and work with contractors towards reducing the number of grievances lodged by implementing appropriate mitigation measures;
- Work with contractors and GDC counterpart to close out any grievances lodged by communities within the defined timelines; and
- Assist with the development of relevant and timely communications to Project-impacted communities by providing information to the Stakeholder Engagement team on upcoming Project activities.

(b) GDC

GDC is the government Special Purpose Vehicle that has entered into geothermal steam sales agreement with Sosian.

According to the PISSA, GDC will be responsible, at its cost, for all the requirements of GDC ESIA, internationally applicable engineering standards, the environmental standards and all applicable legal requirements throughout the term. On the other hand, Sosian shall be responsible for the same requirements as far as they relate exclusively to the plant.

As the overall developer of the Menengai geothermal field, GDC is responsible for overall management of geothermal development activities in Menengai Caldera including for:

- Holding of the head lease with KFS;
- Drilling wells for geothermal production, steam gathering system network including the re-injection of spent geothermal fluid after the electric power generation by the IPP;
- Project enabling infrastructure (roads, water supply and electric power) up to the boundary of the power plant at which the various infrastructure interfaces with Sosian power plant ltd will be provided; and
- Agreements with the other two IPPS expected to develop and operate similar power plants side by side with Sosian power plant ltd.

GDC has a well-established environment and community liaison departments comprising a multidisciplinary group of professionals. The various disciplines cut across biology, ecology, bio-chemistry, analytical chemistry, natural resource management, forestry, eco-toxicology, community development, and others. These professionals are grouped into sections according to their expertise to undertake environmental monitoring as per the Menengai Environmental Management Plan (EMP). The sections include rehabilitation, afforestation and biodiversity conservation, waste management, air quality and meteorological monitoring, noise monitoring, waste water management, precipitation, soil and vegetation quality, and regulatory compliance.

The community liaison department exists independently and deals with community development within the project. Through the department, GDC has developed a Grievance Redress Mechanism (GRM) to address concerns from any affected communities from the ongoing geothermal development activities. This existing GDC system will be sustained and enhanced by Sosian through the development of a project specific GRM. GDC shall be in the forefront when it comes to any community/stakeholder engagement that should be carried out throughout the project life.

GDC shall ensure environmental sustainability is maintained throughout all the stages of geothermal power production in Menengai. As part of this, GDC has to ensure that as part of the steam purchase agreement with Sosian power plant ltd, the latter meets all the environmental sustainability requirements as contained in GDC's Environmental Policy and GDC Safety, Health and Environment Policy.

GDC, through its environment department shall also liaise with Sosian power plant ltd to ensure regular monitoring of all environmental and occupational health and safety performance within the proposed power plant.

(c) KETRACO and KPLC

KETRACO was responsible for the construction of the power evacuation substation and transmission line and hence attending environmental and social management. KPLC holds a PPA with Sosian and will manage the line, hence will be key in monitoring its

performance during the operation phase and also connect the power to the national grid.

(d) Project Managers- Owner's Engineer and EPC Contractor

A project manager position is proposed for both the EPC contractor and the owners engineer.

The Project Managers should work with their respective team members to implement the mitigation measures designed during the ESIA. Each of the managers should monitor the implementation over time, amend measures as necessary to increase effectiveness, and report on the implementation and performance of the ESMP to senior management. They should also participate in the Project management meetings to ensure that relevant issues relating to the ESMP are raised and dealt with effectively. In the event of a non- compliance with the ESMP, it will be the responsibility of the Project Managers to ensure appropriate investigation, reporting, and implementation of corrective actions.

(e) Sub-Contractors

Sub-Contractors engaged by the EPC contractor will be required to comply with the requirements of the ESIA, the ESMP in this report and other relevant legislations. They will also be required to implement the Environmental policy together with the Human resource policy that shall be provided by Sosian in liaison with GDC.

(f) Project Consultants

The contracted project consultant will undertake periodic third-party audits as required by the Project or lender groups.

(g) NEMA

The responsibility of the National Environment Management Authority (NEMA) is to exercise general supervision and co-ordination over all matters relating to the environment and to be the principal instrument of government in the implementation of all policies relating to the environment.

(h) Energy and Petroleum Regulatory Authority. (EPRA i.e. formerly ERC)

As a lead agency in the power sub sector, EPRA is vested with licensing and enforcement requirements for environmental performance. In anticipation of these responsibilities, EPRA developed for enforcement EHS monitoring protocols for geothermal power generators in the EHS (2005) policy framework. Therefore, Sosian Power Plant Ltd should mainstream all the policy related requirements on licensing, monitoring and audit as part of EHS performance.

(i) County Government of Nakuru, Ministry of Environment, Natural Resources, Energy and Water

The Nakuru County government should be actively engaged in ensuring that project activities are environmentally sustainable through participatory monitoring, undertaking general environmental conservation and ensuring public participation in the environmental management activities under the project.

(j) Local administration

These mainly include local areas chiefs and their assistants. The local administration shall form one of the primary points of contact between the local communities and Sosian power plant ltd as well as the other players in Menengai geothermal field (GDC, KFS, KWS and the other two IPPS). There shall be a free communication between the

local administration and Sosian power plant ltd allowing free passage of information (including address of community concerns as well as initiation of any beneficial activities) to and from the communities.

8.2.2 Training, Education and Competency

Sosian, as the proponent, assumes overarching responsibility for implementation of the ESMP and, as such, it is important that all contractors and personnel responsible for the implementation of the tasks and requirements contained in the ESMP are competent on the basis of education, training and experience.

The Project should undertake internal training and education activities to ensure that Project expectations regarding environmental and social performance are achieved. In addition, the Project should provide guidance to contractors regarding expectations for environmental and social impact management training, education and competencies. Environmental and social competencies should be appropriate to the respective parties' scope of activity and level of responsibility. Project should undertake an initial evaluation of training needs associated with this ESMP and, on this basis, develop and maintain an ESMP training matrix.

The Project's environmental and social training programmes should include several levels of competency, depending on each individual's level of involvement and responsibility:

- **ESMP Induction Training and Awareness**: this training should be for visitors or individuals who do not have direct roles or responsibilities for implementing the ESMP, and should cover basic Project environmental and social commitments.

- **ESMP Management Training and Awareness**: this training focuses attention on management, covering key aspects of the ESMP and providing an overview of the Project's environmental and social impact management expectations and the supporting processes and procedures prescribed in the ESMS to meet performance expectations.

- **ESMP Job-specific Training and Awareness**: job-specific training should be provided to all personnel who have direct roles and responsibilities for implementing or managing components of the ESMP. This training should also include all people whose specific work activities may have an environmental or social impact.

On site, these provisions and responsibilities should apply to all contractors and subcontractors. Those responsible for performing site inspections should receive training by drawing on external resources as necessary. Upon completion of training and once deemed competent by management, staff will be ready to train other people. The Project will require each contractor to institute training programmes for their personnel. All contractors and their subcontractors should be responsible for implementing relevant and adequate training programmes to maintain the required competency levels. Contractor training programmes should be subject to approval by Project Management and should be assessed to confirm that:

- Training programmes are adequate;
- All relevant personnel have been trained; and
- Competency is achieved.

Contractors will be required to report on their training activities, and the Project should maintain records of all training delivered.

8.2.3 Assessment and Improvement

Assessment and improvement processes associated with this ESMP include: inspection, monitoring, audit, corrective action and improvement. These activities form an integral part of implementing the ESMP, and are necessary to:

- Verify and document the management and implementation of the mitigation measures

identified in the ESMP;
- Monitor and document the effectiveness of the mitigation measures and assess the actual impacts;
- Demonstrate compliance with applicable legal and other requirements;
- Evaluate the effectiveness of the ESMS; and
- Highlight areas in need of improvement to drive continuous improvement for all ESMP activities.

Inspection

The contractor's EHS manager and GDC will undertake daily inspection of the construction activities to ensure the implementation of the ESMP. The Contractors will be required to implement field-based inspection programs that demonstrate their implementation of the ESMP and, in some instances, the effectiveness of the mitigation measures. The Project will, in turn, inspect the contractors' documents to verify that they have implemented the required programs.

Monitoring

Contractors will be required to implement field-based environmental and social monitoring through the EHS Manager to monitor the effectiveness of the mitigation measures, assess impacts and demonstrate compliance with legal and other requirements. The Project through the Project Manager and HSE officer should conduct similar monitoring events and also verify contractors' monitoring activities.

Auditing

Internal audits should be carried out internally by the Project to ensure compliance with ESMP requirements, regulatory requirements and compliance with management systems, standards, policies and procedures. Periodic external (third party) audits should also be carried out to meet NEMA regulatory and lender requirements. A qualified consultant should perform the audits, and results be described in a report that will determine the severity of non-compliances, as well as the recommended remedial action.

Corrective Action and Improvement

The Project should implement a formal environmental and social tracking system that will include the details of all environmental and social non-conformances, identify the corrective actions required, assign actions/timings to responsible parties and indicate the status of the actions required. This will ensure a coordinated approach between the Project and its contractors, and drive changes for continuous improvement.

There are several mechanisms for implementing corrective action, both during the construction and operational phases:

<u>Verbal instruction</u>

Verbal instructions are likely to be the most frequently used form of corrective action and are given in response to minor transgressions that are evident during routine site inspections. Verbal instructions are also used to create further awareness amongst Contractors, as often the transgressions are a function of lack of awareness.

<u>Written instructions</u>

Written instructions will be given following an audit. The written instructions will indicate the source or sources of the problems, and proposed solutions to those problems. The implementation of these solutions can also be assessed in a follow-up audit and further written instructions issued if required. All written instructions will be centrally logged to ensure that there is an auditable record of such instructions and how they were responded to.

Contract notice

A contract notice is a more extreme form of written notice because it reflects the transgression as a potential breach of contract. If there is not an adequate response to a contract notice, then the next step can be to have the contractor removed from the site and the contract cancelled. Contracts will be drafted with this in mind.

8.2.4 Incident Management

The Project should develop an incident management process that will describe the Project's requirements for managing safety, health, environment, social and security-related incidents that can occur due to Sosian Power Plant ltd activities, including near misses. The underpinning principles should be to:

- Avoid and reduce harm to communities, personnel, environment and assets;
- Confirm proper remedial action and perform appropriate follow-up surveillance to ensure injuries, damage or illnesses do not escalate;
- Communicate incident details to internal and external stakeholders as appropriate; and
- Investigate all incidents to identify root causes and implement corrective actions to prevent incident recurrence and drive continuous improvement.

The incident management system will involve the following, which may occur concurrently during implementation:

- securing the construction site;
- initiating emergency response procedures if required;
- performing case management for injuries or illness;
- incident classification, notification and investigation;
- implementing corrective actions;
- relevant reporting; and
- Lessons learned.

8.2.5 Reporting

Reports on ESMPs performance should include the following:

- Progress towards achieving targets;
- Non-compliances and results of any investigations; and
- Corrective actions.

It is envisaged that reporting should cover at least the following areas, which shall be included as contractual requirements for both the Owner's Engineer and the EPC Contractor:

(a) Contractor Monthly Reporting

Contractors should work closely with the Project Management prior to the commencement of work to define the structure, content and format for their environmental and social monthly report. This report should contain key information around the contractors' implementation of the environmental and social requirements and mitigation measures and should cover, among others:

- Environmental and social assessment and improvement findings;
- Incident notifications;
- Non-conformances/non-compliances and corrective actions;
- Key performance indicators;
- Details of any environmental or social surveys or studies; and
- Environmental and social training conducted.

(b) Quarterly Reporting

The Project will prepare and submit to the relevant government departments a Project Environmental and Social Quarterly Report. The structure, content and format will be agreed with government prior to the commencement of work. This quarterly report will document key information on the Project's performance against the ESMP requirements.

(c) Incident Notification and Reporting

Contractors will notify the Project immediately following any environmental or social incident. Project will ensure that all environmental and social incidents are appropriately documented, that the relevant parties are notified, and that reporting requirements around the incident are met.

8.2.6 Management Review

The final component of the ESMP management cycle is a formal management review that takes place at defined intervals, both during the construction and operational phases. The purpose of the management review is for senior project management to review the environmental management performance during the preceding period and to propose measures for improving that performance in the spirit of continuous improvement.

8.2.7 Liaison and communication to stakeholders

Throughout the project, ongoing liaison should be maintained with authorities and communities alike to ensure the following:

- Timeouts advance warning of any project activities that may have some adverse impact on surrounding communities, e.g. plant pre-commissioning;
- Ongoing feedback on the environmental performance of the project; and
- Prompt external grievance redress.

Given the various parties operating in the Caldera, the above will require that Sosian liaises with GDC in formulating own Stakeholders Engagement Plan which ties in the existing GDC communication plan. The plan shall incorporate a jointly agreed grievance management mechanism, especially as far as external grievances are concerned.

8.2.8 Grievance Management

GDC, through its Community liaison department, has developed a Grievance Redress Mechanism (GRM) that has been operation in the project area, addressing concerns from any affected communities from the ongoing geothermal development activities. This GRM has been very successful in addressing the concerns of the affected communities and/or interested parties since commencement of the geothermal development activities in Menengai. Various community representatives have also been enlisted through thematic committees, as discussed in section 6.6, which once formalized will enhance the GRM process This GRM should be sustained and enhanced by Sosian through adoption of a project-specific GRM. Based on the feedback from stakeholders, this assessment has suggested a procedure, see Appendix VII.

The grievance procedure describes how community members can raise grievances regarding the project's activities. The Grievance Procedure will address verbal or written grievances, which should include sufficient information about the complaint or claim so that a proper and informed evaluation of the grievance can be made. When a grievance is filed, it should be logged and evaluated. All grievances should be tracked for monitoring and reporting purposes and to ensure timely and proper resolution.

8.3 Environmental and Social Management Plan during Construction Phase

Table 8-1 gives a summary of the Environmental and Social Management Plans during construction phases of the project.

Table 8-1: Summary of the Environmental and Social Management Plans during Construction Phase

Environmental and Social Aspects	Recommended mitigation and/ or management measure	Location	Responsibility for implementation	Cost (KES)
Impact on flora	• Any sandal wood identified on site should be marked out and made known to the engineers and contractor; • Re-vegetate disturbed areas along roads, pipelines and steam lines and other construction sites. While the invasive *Datura stramonium* will rapidly colonize the disturbed bare grounds and still act as surrogate habitat for some fauna species, it is still desirable to minimize/discourage its dominance by planting native trees such as *Croton megalocarpus*-. Additionally, *Digitaria sp* a native grass commonly growing at the site can be very used in checking soil erosion especially on loose soil dumps or bare slopes created during construction. • Create awareness among the local communities and discourage them from engaging in charcoal burning; • Monitor regeneration of natural vegetation as well as the appearance/spread of invasive or opportunistic species within the disturbed areas. Monitoring should include spotting and uprooting of unwanted germinating plants.	Construction site Menengai Geothermal Field	Contractor Sosian Geothermal Power Plants Ltd GDC KFS	500,000
	• Ensure that construction site is clearly demarcated and there is selective clearing of the vegetation to allow future re-growth and regeneration. This will ensure minimal disruption of wild fauna's natural movement, territoriality, and other ecological processes;	Construction Site	Contractor Sosian	
Impact on micro fauna	• Limit speed of construction traffic within the caldera e.g. through erection of bumps and signage; • Vehicular disturbances such as hooting should be discouraged accordingly; • Incident records (of poaching, accidents and other human wildlife conflicts etc) should be kept by monitoring and taking of corrective measures; • Roads into/out of the Caldera area should be maintained as routes for tourist's activities and wildlife management; • Access for earthmoving machines should be regulated; • Brine ponds should be located close to the source. Distant flow should be piped to prevent animal or vegetation contact; •	Construction site Menengai Geothermal Field	Contractor Sosian Geothermal Power Plants Ltd GDC	500,000
	• Monitor wildlife abundance, distribution and movement in relation to this infrastructural development during construction and operation stages to aid in decision making; and	Menengai Geothermal Field	KWS	

Environmental and Social Aspects	Recommended mitigation and/ or management measure	Location	Responsibility for implementation	Cost (KES)
	• Ensure that forest rules are enforced within the caldera throughout;		KFS, GDC, Contractor, Sosian Geothermal Power Plant Ltd	
Impact on Avifauna	• High heat points and emission vents within the project area should be sheltered or fitted with inhibitors to deter birds which may get killed as a result of using such areas	Construction site Menengai Geothermal Field	Contractor Sosian Geothermal Power Plants Ltd GDC	1,500,000
	• High voltage transmission lines should be fitted with wire markers and flappers to alert birds on flight; and		GDC and KETRACO	
	• Develop and implement an avifauna monitoring scheme, assessing bird population trends and direct hazards relating to the project.		KWS FOMEC	
Impact Herpetofauna and invertebrates	• Capture any reptiles encountered hiding under rocks and sheltered terrains such as *Python sebae* and safely release them in suitable habitats; and • Re-vegetation of the cleared areas and landscaping the plant site.	Construction site Menengai Geothermal Field	Contractor Sosian Geothermal Power Plants Ltd GDC KWS	
Livestock access to brine ponds	• Fence off any constructed ponds; and	Menengai Geothermal Field	GDC, Sosian Energy; and	
	• Control access to the caldera by herders.		KFS	

Environmental and Social Aspects	Recommended mitigation and/ or management measure	Location	Responsibility for implementation	Cost (KES)
Landscape and visual intrusion impacts	• Limitation of vegetation clearance and earthworks to construction areas only Implementation of soil conservation measures; • Re-vegetation of the cleared vegetation as soon as feasible; • The colour of structures within the project area should be carefully selected to reduce visual impact. Neutral, non-reflective colours blend well with the surrounding landscape. • Pipeline colouring should be green or given appropriate colour • Lighting to be switched off when not required; • Lighting of temporary working areas and site compounds during periods of darkness to be minimised where possible; • Preparation of a landscaping plan for the entire project area. Planting plan to be comprised of 75% indigenous species and to be rid of any invasive species. • Stripped topsoil to be preserved and used during landscaping; and • All embankments to be vegetated or stone pitched to prevent soil erosion.	Construction site Menengai Geothermal Field	Contractor Sosian Geothermal Power Plants Ltd GDC	2,000,000
Soil erosion	• No grey water runoff or uncontrolled discharges from the site/working areas (including wash down areas) to adjacent watercourses and/or water bodies shall be permitted; • Water containing pollutants such as cements, concrete, lime, chemicals and fuels shall be discharged into a conservancy tank for removal from site; • Potential pollutants of any kind and in any form shall be kept, stored and used in such a manner that any escape can be contained and the water table not endangered; • Wash areas shall be placed and constructed in such a manner so as to ensure that the surrounding areas (including groundwater) are not polluted.	Construction site	Contractor Sosian Geothermal Power Plants Ltd	1,000,000

Environmental and Social Aspects	Recommended mitigation and/ or management measure	Location	Responsibility for implementation	Cost (KES)
Impact on natural sources of construction materials	• Obtain appropriate authorisation including from NEMA and Mines and Geology department to do or use any proposed borrows pits and quarries will be obtained before commencing activities; • Any new borrow pits and quarries shall be located more than 100 meters from watercourses in a position that will facilitate the prevention of storm-water runoff from the site from entering the watercourse; • Notice will be given 14 days to nearby communities of intention to excavate in the borrow pits or quarries; • Borrow areas' rehabilitation plans will be prepared prior to use and approved by the local authorities; • Storm-water and groundwater controls through appropriate drainage shall be implemented to prevent runoff entering streams and the slumping of soil from hillside above; • The use of borrow pits or quarries for material spoil sites must be approved by the local authorities (and/or with the appropriate consent of the "landowner"). Where this occurs, the materials spoiled in the borrow pit shall be profiled to fit into the surrounding landscape covered with topsoil and re-vegetated. and • In the event that blasting for rock will be done: o A current and valid authorisation from the Department of Mines prior to any blasting activity shall be obtained; o A qualified and registered blaster by the Department of Mines and Geology shall supervise all blasting and rock-splitting operations at all times; o The Contractor shall ensure that appropriate pre blast monitoring records are in place (i.e. photographic and inspection records of structures in close proximity to the blast area); o Sosian Geothermal Power Plants Ltd and the Contractor shall ensure that emergency services are notified, in writing, a minimum of 24 hours prior to any blasting activities commencing on Site; o Sosian Geothermal Power Plants Ltd and the Contractor shall take necessary precautions to prevent damage to special features and the general environment, which includes the removal of fly-rock.	Quarry site	Contractor	1,000,000

Environmental and Social Aspects	Recommended mitigation and/ or management measure	Location	Responsibility for implementation	Cost (KES)
	Environmental damage caused by blasting/drilling shall be repaired at the Contractor's expense; ○ The Contractor shall ensure that adequate notification is provided to the local communities immediately prior to all blasting. It is preferable that warning / informative signage and billboards be erected at the site indicating operation hours as well as commencement and end of operations. All signals shall also be clearly given; ○ Sosian Geothermal Power Plants Ltd and the Contractor shall use blast mats for cover material during blasting. Topsoil shall not be used as blast cover. ○ Precautionary and corrective measures will be taken to avert defacing and deformation of the land features.			
Impact on water resources	• GDC and the Contractor shall ensure that necessary approvals/permits from the water authorities for the abstraction of water is adhered to; •	Menengai Geothermal Field	WRMA GDC Sosian Geothermal Power Plants Ltd contractor	
	• Accidental leakages and bursts of water supply pipelines should be reported and repaired immediately; • Recycle water as much as possible should be encouraged for example water used for curing of concrete can be used for spraying dusty roads; • Control of the water flows and the water consumption records must be kept and availed to the supervising and Sosian Geothermal Power Plants Ltd Resident Engineers at the end of working day; • All employees should be sensitized on water usage practices like discouraging unnecessary opening of taps; • Monitoring of taps and their efficiency should be done regularly; • Where feasible, curing of concrete should be done in conservancy tank to avoid wastage; • Harvest water during rainfall times to complement other sources; • Continued monitoring of underground water levels;		GDC Contractor Sosian Geothermal Power Plant Ltd	

Environmental and Social Aspects	Recommended mitigation and/ or management measure	Location	Responsibility for implementation	Cost (KES)
	• The Contractor will be required to comply with the water quality regulations; • No grey water runoff or uncontrolled discharges from the site/working areas (including wash-down areas) to adjacent watercourses and/or water bodies shall be permitted; • Water containing pollutants such as cements, concrete, lime, chemicals and fuels shall be discharged into a conservancy tank for removal from site; and • The Contractor shall instruct their staff and sub-contractors that they must use toilet provided and not the bush or watercourses.		Contractor, Sosian Geothermal Power Plant Ltd	
Air quality and dust	• All construction machinery shall be maintained and serviced in accordance with the manufactures' specifications; • Workers shall be trained / sensitized on dust minimization techniques and management of air pollution from vehicles and machinery; • The removal of vegetation shall be avoided until such time as clearance is required and exposed surfaces shall be re-vegetated or stabilized as soon as practically feasible; • Frequent watering of exposed surfaces and piles of soil to prevent airborne dust emissions; • All vehicles accessing the site shall observe low speed limits; • Minimize vehicles idling time; • Incorporate dust/fumes arrestors in the batching plant e.g. use of dust nets • Provision of appropriate protective personal equipment including respirators and aprons to affected personnel.	Construction site	Contractor Sosian Geothermal Power Plants Ltd	1,000,000
Solid waste	• Apply the 3R (Reduce, Reuse and Recycle) principles. Diligence on the part of the Contractors during construction activities will minimise the amount of debris, and also will ensure that debris is disposed of in a sensible manner, at a specified and approved dump site; • The tender documents should specify the proper disposal of waste during construction; • The tender documents should also ensure that the contractor leaves the site in a clean condition on completion of works. The Contractors should be	Construction site	Contractor Sosian Geothermal Power Plants Ltd	750,000

Environmental and Social Aspects	Recommended mitigation and/ or management measure	Location	Responsibility for implementation	Cost (KES)

	required to restore and landscape all areas to the satisfaction of the GDC and Sosian Geothermal Power Plants Ltd.
	• All solid waste generated during construction should be carefully monitored, collected, stored, and taken out of the crater for final disposal.
	• The development and rehabilitation of spoil areas shall include the following activities:
	  • Stripping and stockpiling of topsoil;
	  • Removal (to a nominal depth of 500mm) and stockpiling of subsoil;
	  • Placement of spoil material;
	  • Contouring of spoil site to approximate natural topography and drainage and/or reduce erosion impacts on the site;
	  • Placement of excavated subsoil and then topsoil over spoil material;
	  • Contouring and re-vegetation;
	  • The Contractor shall ensure that the placement of spoil is done in such a manner to minimise the spread of materials and the impact on surrounding vegetation and that no materials 'creep' into 'no-go' areas.			

Increase in the amount and tonnage of traffic	• Upgrading of existing roads where necessary to take care of the new traffic; • Erection of proper signage along all roads exploited for the construction process especially on approaches to blind corners and in populated areas; • Construct speed bumps along Bahati entrance road and the roads within the caldera; • Sensitization and training of construction drivers; • Monitoring, enforcement and disciplinary action of offenders. • Use of escort and chase vehicles where necessary.	Construction site	Contractor Sosian Geothermal Power Plants Ltd	800,000

Environmental and Social Aspects	Recommended mitigation and/ or management measure	Location	Responsibility for implementation	Cost (KES)

Occupational and public health and safety	• Sosian should engage services of an Environment, Safety and Health personnel to oversee environmental and safety management throughout its operations;
	• Contractor must develop Construction Safety and Health Policy in compliance with OSHA, and international best practice e.g. IFCs Environmental, Health and Safety Guidelines;
	• Undertake comprehensive assessment for PPE requirements, provide and enforce use of all ranges of required PPEs;
	• Contractors to establish a comprehensive Health and Safety Policy which should be in compliance with GDC's Occupation Health and Safety Policy and be approved by Environment, Health and Occupation Manager from GDC;
	• Ensure compliance with all standards and legally required health and safety regulations in line with OSHA;
	• Include standard best practice health and safety provisions in the construction contract. The provisions should include insurance to enable the contractor to pay for any and all treatments required by his workers including those of all sub-contractors, together with any subsequent lifelong disability payments in line with WIBA;
	• Employ a full-time qualified Health and safety Officer;
	• Include a specific and independent task in the supervision contract concerning H&S supervision and compliance, together with the staff resources to carry this out;
	• Establish and enforce a strict code of conduct for all project drivers including outside suppliers delivering materials. The code should focus on safety, especially speed, and loading, especially banning all carriage of staff, workers and passengers except in seats;
	• Implement the specified H&S programme throughout the construction period. This should incorporate but not limited to:
	  • An emergency response procedure and display on all work areas. This is likely to require one vehicle on site equipped as an ambulance and a paramedic on site at all times during construction activities;
	  • Provision of a standard first aid kit at the site office at all times;
		Construction site
		
		Menengai Geothermal Field
			Contractor
			
			Sosian Geothermal Power Plants Ltd	

Environmental and Social Aspects	Recommended mitigation and/ or management measure	Location	Responsibility for implementation	Cost (KES)
	• Provision of fire-fighting equipment available at the workers camp; • Provision of medical facilities for staff; • Installation of appropriate safety signage for all work sites; • Registration of the work place; • Maintain an accident register; • Carry out accident and incidents investigations and implement corrective actions; • Establishment of Occupational Health and Safety Committee; • Staff and visitor induction; • Toolbox and monthly safety meetings; • Routine inspections.			
HIV/AIDs and STIs	• Education and sensitisation of workers and the local communities on HIV/AIDs and STIs in conjunction with Rongai and Nakuru North Sub-County Public Health Officers; • Provision of condoms to the construction workers, project team and the public. This should be kept in places that are not locked and are accessible to the above persons; • Where possible conduct regular sensitisation campaigns and monitoring and evaluation of the modes used during course of the project; • Formation of peer groups from among the project staff to ensure continuity in training and awareness raising; • The contractor has to institute HIV/AIDS awareness and prevention campaign amongst workers for the duration of the contract e.g. erect and maintain HIV/AIDS information posters at prominent locations as specified by the Resident Engineer in consultation with the GDC Community Liaison Office; • The contractor has to ensure that staff are made aware of the risks of contracting or spreading sexually transmitted diseases; and • The contractor should ensure that the project workers are sensitised on the local culture.	Construction site	Contractor Sosian Geothermal Power Plants Ltd PHO (Rongai and Nakuru North)	3,000,000

Environmental and Social Aspects	Recommended mitigation and/ or management measure	Location	Responsibility for implementation	Cost (KES)
Contractor's camp	• Any contractor's camp should have a comprehensive waste management and sanitation plan and facilities commensurate with population of workers and activities in the camps; • Any storage tanks and equipment should have correct labels and Material Safety Data Sheets; Adequate Emergency Response Plan should be in place in the camps; • The contractor should employ best practice management "housekeeping" (site cleanliness, waste disposal etc.) at all times; and • The contractor's facilities should be completely removed from site after use and the land restored to its previous condition or better.	Contractor's camp	Contractor Sosian Geothermal Power Plants Ltd	
Risk of wild fires	• Include an adequate fire buffer zone around the proposed power plant construction site. This could be open bare ground/un-vegetated areas and planting fire resistant trees e.g. Mexican green ash (*Fraxinus sp*) around the plant should be maintained throughout during the construction and the operation period; and • Liaise with the Menengai KFS office to sensitize construction and operation staff on wildfires and train on emergency responses.	Construction site Menengai Geothermal Field	Contractor Sosian Geothermal Power Plants Ltd GDC KFS	
Impact of fuel and chemical storage on site	• ensure that the employees on site are aware of the company procedures for dealing with spills and leaks from oil storage tanks for the construction machinery though induction and safety training; • In case of spillage, isolate the source of oil spill and contain the spillage using sandbags, sawdust, absorbent material and/or other materials approved by NEMA; • ensure that there is always a supply of absorbent material such as saw dust on site during construction, readily available to absorb/breakdown spill from machinery or oil storage; • All vehicles and equipment should be kept in good working order, serviced regularly and stored in an area approved site by GDC and Sosian Geothermal Power Plants Ltd; • Ensure that filling areas, Oil storage drums / products storage areas have a smooth impermeable (concrete or thick plastic covered in gravel) floor. The floor should be bunded and sloped towards a sump to contain any spillages of substances in accordance with The Kenya Bureau of Standards (KEBS)	Construction site	Contractor Sosian Geothermal Power Plants Ltd	

Environmental and Social Aspects	Recommended mitigation and/ or management measure	Location	Responsibility for implementation	Cost (KES)
	KS 1969: 2006 The Petroleum Industry -The installation of underground storage tanks, pumps/dispensers and pipe work at service stations and consumer installations - Code of Practice.			
Chance encounter and interference with buried archaeological artefacts.	• Retain an archaeologist from NMK on site during earthworks; • Notify NMK if any artefacts or bones are uncovered in the course of excavations in accordance with the National Museums of Kenya Chance Finds Procedure (Appendix VI); and • Implement to the chance find procedure.	Construction site	Contractor Sosian Geothermal Power Plants Ltd NMK	

8.4 Environmental and Social Management Plan during Operation Phase

Table 8-2 gives a summary of the Environmental and Social Management Plans during operation phases of the project.

Table 8-2: Environmental and Social Management Plan during Operation Phase

Environmental and Social Aspects	Recommended mitigation and/ or management measure	Location	Responsibility for implementation	Cost
Impact on flora	• Monitor invasive plant species at the project area and uproot unwanted germinating plants; • Plant soil-erosion preventing grass species such as *Cynodon dactylon, Digitaria abyssinica, Pennisetum clandestinum* and *Hyparrhenia sp* at bare sloppy grounds or loose soil dumps; • Rehabilitate disturbed areas along roads, pipelines and abandoned campsites etc by planting native plant species such as *Acacia mearnsii, Psidium guajava* and *A. melanoxylon*– this should be done as soon as practicable to avoid colonization by invasive and opportunistic pioneer species; • Create awareness among the local communities on the importance of vegetation cover and discourage them from engaging in charcoal burning.	Power Plant Site Menengai Geothermal Field	Sosian Geothermal Power Plants Ltd GDC KFS	
	• Assess concentration geothermal gaseous effluents such as H_2S, SO_2, NH_3 and CO_2 (e.g. by use of automatic sensors) and continually test for any evidence of acid rain; • Steam pipe insulations should have a well camouflaged colours that are maintained so that animals don't perceive pipelines as barriers a green colour is recommended; • Brine flows and ponds should be located close to the source. Distant flow should be transmitted through closed pipes		GDC, Sosian Geothermal Power Plant Ltd.	
Impact on macro fauna	• Vehicular disturbances such as hooting should be discouraged accordingly; • Incident records (of poaching, accidents and other human wildlife conflicts etc) should be kept by monitoring and taking of corrective measures; • Brine ponds should be located close to the source and fenced. Distant flow should be piped to prevent animal or vegetation contact; • Erect speed bumps in wildlife crossing zones should these be established from monitoring activities.	Power Plant Site Menengai Geothermal Field	GDC Sosian Geothermal Power Plants Ltd	
	• Ensure enforcement of forest rules within the caldera; and		KFS	

Environmental and Social Aspects	Recommended mitigation and/ or management measure	Location	Responsibility for implementation	Cost
	• Monitor wildlife abundance, distribution and movement in relation to this infrastructural development during construction and operation stages to aid in decision making;	Menengai Geothermal Field	GDC and KWS	
Impact on Avifauna	• High heat points and emission vents like NCGS stack should be sheltered or fitted with inhibitors to deter birds from perching or hovering around; • Develop and implement an avifauna monitoring scheme, assessing bird population trends and direct hazards relating to the project; and	Power Plant Site Menengai Geothermal Field	GDC Contractor Sosian Geothermal Power Plants Ltd	
	• High voltage transmission lines should be fitted with wire markers and flappers to alert any birds on flight.	Menengai Geothermal Field	KETRACO	
Impact on Herpetofauna	• Where feasible, water and steam pipe lines should be laid across (perpendicular to) the valleys rather than running along them – as this will mean destroying large patch of this ecologically sensitive keystone habitat for many species; • re-vegetate disturbed areas along roads, pipelines and steam lines and other construction sites; and • Create awareness among the local communities and discourage them from engaging in charcoal burning which is evidently on the increase in this area.	Power Plant Site Menengai Geothermal Field	GDC Contractor Sosian Geothermal Power Plants Ltd KFS	
Operation solid wastes	• Use integrated solid waste management system i.e. source reduction; reuse; and recycling; • Donate any recyclable materials to local community groups, institutions and individuals; • Provide segregated waste respectable/bins within the plan premises and create awareness among staff on usage; • Dispose waste responsibly through a licensed waste handler for final disposal at designates sites; • Ensure compliance with waste management regulations; • Track waste handling from generation to final disposal in line with the waste management regulations.	Power Plant Site Menengai Geothermal Field	GDC Contractor Sosian Geothermal Power Plants Ltd	

Environmental and Social Aspects	Recommended mitigation and/ or management measure	Location	Responsibility for implementation	Cost
Operation liquid wastes	• Domestic waste water and sewer from septic tanks should be disposed through NEMA- licensed exhaust service providers; • Obtain and maintain a valid effluent discharge licence in accordance with NEMA requirements; • Track waste handling from generation to final disposal in line with the EMCA waste management regulations; • Brine ponds should be sited close to the source; • Any brine ponds constructed should be lined with durable impervious materials of suitable quality and protected from any form of vandalism; • Ensure brine re-injection through re-injection wells into underground reservoir; • Chemical composition and parameters of the brine should be regularly monitored; • Sensitize communities on hazards associated with vandalising brine pond installations.	Power Plant Site Menengai Geothermal Field	GDC Contractor Sosian Geothermal Power Plants Ltd Nakuru County Government	
Fire risk	• Implemental and maintain the proposed fire protection system of fire water tanks, fire extinguishers, fire hydrants, hose reels, fire alarms and sprinklers; • Formulate a fire emergency response plan; • Ensure no smoking signages are put up in the necessary areas; • Establish and maintain a fire break (against wild fires) along the plant boundary; • Train some staff to be fire marshals and ensure availability on site at any given time in line with OSHA requirements; • Carry out regular (at least once annually) fire drills; • Regularly inspect the installed firefighting equipment to ensure serviceability and maintain records; • Undertake regular fire and safety audits in line with the OSHA requirements	Power Plant Site	Sosian Geothermal Power Plants Ltd	

Environmental and Social Aspects	Recommended mitigation and/ or management measure	Location	Responsibility for implementation	Cost
Accidental Oil spill/Hazardous pollution	• Spill and drip trays used during servicing of machinery; • Use septic tanks while ensuring doesn't flow to the surface; • Response plans for accidental spills to be formulated and routinely tested; • Bunded storage areas and secondary containment for oil and chemicals; • Use of an oil interceptor in the plant; • Place hazardous materials up to 2 kilometres away from the public water supply reservoirs such as in Ol Banita groundwater reservoirs. Also avoid placing within flood levels; • Storage of fuel and other flammable materials shall comply with standard fire safety regulations; • A secured compound shall be provided for storage tanks for chemicals and fuel. All chemicals and fuels shall be stored with manufacturer's instructions in mind as per the material safety data sheets; • Storage areas or secondary containment shall be constructed of waterproof reinforced concrete or approved equivalent, which is not adversely affected by contact with chemicals captured within them; • The minimum volume for secondary containment shall be 110% of the capacity of the largest tank system, plus 10% of the total capacity of all other separate tanks and containers within the bund wall with closed valves for controlled draining during rains; • Pipe-work carrying product from the tank to facilities outside the containment shall be provided with secondary containment; • Tank equipment such as dispensing hoses, valves, meters, pumps, and gauges shall be located within the containment or provided with own containment.	Power Plant Site	Contractor Sosian Geothermal Power Plants Ltd Nakuru County Government	

Environmental and Social Aspects	Recommended mitigation and/ or management measure	Location	Responsibility for implementation	Cost
Occupational safety and health	• Formulate a plant occupational safety and health management plan. The plan as a minimum MUST have and require: • Compliance with GDC Health, Safety and Environment policy; • Compliance with OSHA, 2007; • Continuous H_2S monitoring within the plant premises; • Equipping employees with necessary Personal Protective Equipment (PPE) including personal H_2S monitors for workers in exposed environments; • Regular and induction training, of members of the safety committee and new staff respectively on First Aid; • Ensure the plant and office blocks have adequate supply of First Aid Kits; • Location of appropriate safety and warring signs around the plant; • Inspections on conditions of machinery and equipment -Register the plant as a workplace with DOSH; • Medical examination of all employees before, during and after termination of employment; • Detailed emergency response plan; • Provision and display of relevant emergency contacts; and • Regular independent Occupational Health and Safety audits.	Power Plant Site	Contractor Sosian Geothermal Power Plants Ltd	
Potential thermal pollution of groundwater resources	• Obtain baseline ground water quality data inclusive of levels (depths), discharge rates and temperature. • Undertake joint studies to investigate possibility of thermal contamination of underground water aquifers within the area with geothermal steam production wells and institute appropriate mitigations where necessary; • Continually monitor water utilization in the plant's operation and enhance conservation efforts through water efficient fixtures; • Formulate efficient water use practices for both domestic and plant water requirements; and • Maintain and audit water use records	Plant site, Caldera and Ol Banita areas	GDC, NAWASCO and WRMA	
Air quality	• Adopt the cooling tower technology and incorporate H_2S safety systems for the plant as well as for the occupational hazard detection system. This will facilitate continuous monitoring and allow any further mitigation interventions where necessary.	Power Plant site	Sosian Geothermal Power Plant; GDC	

Environmental and Social Aspects	Recommended mitigation and/ or management measure	Location	Responsibility for implementation	Cost
	• Installation of H_2S monitors and ensure daily monitoring of H_2S with alarm system within the Plant boundaries; • Ensure servicing and regular maintenance of site machines that use fuel to minimise the generation of CO_2 • Adopt collaborative (with GDC and other IPPs) air quality management plan incorporating: o Installation of H_2S monitors and regular monitoring of H_2S within the caldera boundaries and at selected locations within the identified potential sensitive receptors; o Liaison strategy for communication with communities who may be affected by odour nuisance. This should include disclosure of air quality monitoring results			
Noise impacts	• All diesel-powered equipment and plant vehicles must be kept at a high level of maintenance. This must particularly include the regular inspection and, if necessary, replacement of intake and exhaust	Power plant site	Sosian Geothermal Power Plant; GDC; and contractors	

Environmental and Social Aspects	Recommended mitigation and/ or management measure	Location	Responsibility for implementation	Cost
	silencers. Any change in the noise emission characteristics of equipment must serve as trigger for withdrawing it for maintenance. • To minimise noise generation, vendors must be required to guarantee optimised equipment design noise levels; • Acoustic attenuation devices should be installed on all ventilation outlet and high-pressure gas or liquid should not be ventilated directly to the atmosphere, but through an attenuation chamber or device. • Ensure plant's vibrating equipment are on vibration isolation mountings; • The site layout should be designed in such a manner that the noisiest sections of the plant are at the centre of the site, using surrounding buildings as noise attenuation shields; • Areas within the plant with excessive noise should be clearly labelled and signages include requirements for appropriate PPE: • Ensure all exposed staff have and use noise protection equipment e.g. ear plugs; • A mechanism to monitor noise levels, record and respond to complaints and mitigate impacts should be developed; • Liaise with GDC to extend the regular monitoring of noise levels within the caldera to selected locations (identified potential Noise sensitive receptors) within the nearby settlements; • Develop a liaison strategy for communication with communities who may be affected by cumulative noise nuisance.			

8.5 Environmental and Social Management Plan during Decommissioning Phase

Sosian Geothermal Power Plants Ltd must prepare and submit a power plant decommissioning plan to NEMA for approval at least three months before decommissioning in line with NEMA license conditions. The plan shall include an update of all activities involved in the decommissioning process, identification of potential environmental, safety and health risks associated with the process and review of relevant standards applicable. Table 8-3 gives a summary of the preliminary Environmental and Social Management Plans during decommissioning phase of the project. The plan does not include decommissioning of wells which are assumed to be the responsibility of GDC. Key issues identified at this stage are:

- Occupational safety and health of demolition staff.
- Management of demolition wastes; and
- Rehabilitation of site biophysical environment.

Table 8-3: Summary of the Environmental and Social Management Plans during Decommissioning Phase

Environmental and Social Aspects	Recommended mitigation and/ or management measure	Location	Responsibility for implementation	Cost (KES)
Occupational safety and health	• Make the site safe by ensuring all electrical connections and supplies are disconnected and any dangerous chemical stores are identified and made safe	Power Plant Site	Sosian Geothermal Power Plants Ltd KETRACO and KPLC	
	• Comply to the OSHA; • Provide for appropriate signage and warnings; • Any closed vessels, pipes and other areas which could have hazardous gases present would be vented in accordance with normal operating procedures. These would then be tested to ensure that they are safe for entry or removal; • Provide for First Aid facilities for staff as per the OSHA, 2007; • Monitor H_2S levels during demolition works; • Maintain appropriate and serviceable firefighting equipment on site; • Designate an emergency assembly point within the plant and create general awareness on use for all staff; • Provide and clearly display emergency contacts; and • Develop a detailed and demolition-specific Emergency Response Plan		Sosian Geothermal Power Plants Ltd and Contractor	1,500,000
Redundant plant equipment and recyclable wastes	• Careful removal and sale/recycling of plant and materials including	Power Plant Site	Sosian Geothermal Power Plants Ltd	
Non-recyclable demolition waste	• Ensure demolition wastes are segregated on site; • Disposal of waste materials by appropriate methods in accordance with waste management regulations; • Procure services of licensed waste handlers for safe disposal of both hazardous and non-hazardous wastes; and • No burning of any wastes should be done on site.	Power Plant Site	Sosian Geothermal Power Plants Ltd	3,000,000
Re-instatement of biophysical environment	• Landscape of the power plant site with suitable mix of indigenous species. This should be done in liaison with the; and • Ensure landscaped species are established prior to final close out of the site	Power Plant Site	Sosian Geothermal Power Plants Ltd and KFS	2,500,000

8.6 Environmental and Social Monitoring

8.6.1 Monitoring framework

The Environmental and Social Management Plan will be subject to monitoring. In general, monitoring will have two key elements:

- Routine monitoring against set standards or performance criteria.
- Periodic review or evaluation. This will often focus on the effectiveness and impact of the programme or plan as a whole. In some cases, independent parties will undertake review and evaluation.

8.6.2 Monitoring Plan

The monitoring plan evaluates the effectiveness of the management and implementation of the mitigation measures associated with the projected environmental and social impacts.

The monitoring plan is complementary to the audits, inspections and reporting activities defined in the Section 8.2. framework for implementation of the ESMP.

The proposed monitoring plan is summarized in Table 8-4, Monitoring Plan. The table lists the related indicators, the items to be measured, the measurement frequency and the person/institution responsible and monitoring cost estimate.

Table 8-4: Environmental Monitoring Plan

Project Activity/Aspect	Parameter	Indicator	Institutional Responsibilities		Project Phase	Monitoring Cost Estimates (KES)
			Monitoring Responsibility	Frequency		
Impact on Flora (vegetation loss)	Visual inspection	• Monitoring records of cleared and rehabilitated areas • Soil cover; • Soil erosion features; • Abundance of species.	Contractor Sosian	Weekly	Construction	Included in Supervision scope and Costs
Impacts on fauna	Site inspection and reviews of records	• Incorporation of relevant measures in workers' code of conduct and induction/training materials; • Incorporation of KWS and KFS in the communication and site emergency response plans • Incident records (of encounters and actions taken)	Sosian and contractor	Continuous	Construction and operation	EPC contractor's cost
	Monitoring plan	• Abundance of species • Records of incidents involving wildlife	GDC and KWS	Quarterly	Operation	GDC cost
Air Emissions and Air Quality Dust	Document review Parameter measurements	• Air Quality management plan • H&S Plan in use; • Availability and use of appropriate PPE; • Record of Induction for Workers and relevant trainings • Active dust suppression measures • Air quality records (TSP, SO_2, CO, H_2S, CO_2, CH_4) • Received complaints • Volumes of fuel used (from receipts/invoices)	Contractor Sosian & GDC	Monthly Monthly	Construction Operation	Sosian to determine
	Hydrogen sulphide (H_2S)	• H_2S instrumentation; and	Sosian	Twice a week for hand held monitors and	Operation	Hydrogen sulphide (H_2S)

Project Activity/Aspect	Parameter	Indicator	Institutional Responsibilities		Project Phase	Monitoring Cost Estimates (KES)
			Monitoring Responsibility	Frequency		
		• Levels from Air quality monitoring records		continuously for automatic loggers		
Worker and Public Safety	Visual inspection Incident and accident records	• Health and safety management plan; • Induction training • Safe working procedures • Shoring & appropriate precautions in place	Contractor and Sub contractors Sosian and GDC	Daily	Construction	Included in Supervision scope and Costs
Public Safety	Dust and Noise	• Air quality & noise level monitoring records • Visual inspection; • Relevant traffic management plan • Sensitization records; • Relevant grievance management records • Measures under Air Quality management • Protected brine ponds	Contractor and Sub contractors Sosian and GDC	Twice during the dry season	Construction and Operation	Worker and Public Safety
Occupational Safety and Health	Health and Safety records Visual inspection	• OHS Management Plan • Relevant regulatory permits • Training and induction records • Active and passive monitoring records • Workplace safety culture • Accident/incident statistics • Independent OSHA audit reports	Contractor Sosian Energy's Senior Management Sosian Geothermal Power Plants Ltd Health Safety and Environment officer	Daily	Construction and Operation	Included in Supervision scope and Costs
	Inspection, maintenance and servicing records of fire appliances	• Quarterly record of reports by local fire appliances (fire extinguishers and hose reel pipe and pump) dealers		Quarterly	Operation	

Project Activity/Aspect	Parameter	Indicator	Institutional Responsibilities		Project Phase	Monitoring Cost Estimates (KES)
			Monitoring Responsibility	Frequency		
Conservation of Ground Water Resources		• Measures incorporated in the production wells design; • Re-injection of brine; • Installed meters and utility records/bills • Sensitization records/corporate strategies on utility conservation • Installed oil interceptors for plant's surface drainage • Quality monitoring records of water, brine/effluent	Sosian and GDC	Monthly apart from design that is reviewed once	Construction and Operation	Included in Supervision scope and Costs
Water Quality (both surface and underground)	pH, BOD, Temperature, COD, Turbidity, Conductivity, Dissolved Oxygen, Nitrates	• Monitoring records; • Water quality report.	GDC Sosian	Monthly	Operation	
	Brine discharge	• Monitoring report for Measurements of • pH @ 25°C, TDS and SiO_2; • Visual inspection of re-injection systems.	GDC	Monthly	Operation	GDC cost
Storage of hazardous materials and chemicals	Spillages Visual inspection	• MSDS for all stored Chemicals • Functioning storage containers and storage areas with secondary containments • Chemical usage records • Records on soil analysis following spill incidence, that is measured levels of Hg, Zn, As, Cd, Cr, B as well as measured levels of VOCs/TPH.	Contractor Sosian	Monthly Audit Review	Construction and Operation	Included in Supervision scope and Costs
Traffic concerns	Visual inspection Records review	• Prepared and implemented Traffic Management Plan	Contractor Sosian and GDC	Monthly	Construction and operation	Included in Supervision scope and Costs

Project Activity/Aspect	Parameter	Indicator	Institutional Responsibilities		Project Phase	Monitoring Cost Estimates (KES)
			Monitoring Responsibility	Frequency		
		approved by GDC and plant manager • Traffic incidents/accident register • Community feedback/complaints • Barriers and signages as appropriate.				
Public Awareness and Community Perceptions	Records	• Agreed Stakeholders Engagement Plan (SEP) and periodic programs • Grievance redress mechanism and associated records • Consultation records	Sosian and GDC	Monthly	Construction and operation	Included in Supervision scope and Costs
Noise	Records and sample measurements	• Measure included in Design and Procurement plans • Health and safety plan; • Hearing Protection and PPE in use; • Record of Plant equipment Maintenance	Contractor Sosian	Monthly	Construction and operation	Included in Supervision scope and Costs
Soil Erosion	Visual inspection Record of periodic assessment	• Bare soil; • Soil pillars; • Cracks across the slope • Sediment management interventions • %Cover of revegetated sites	Contractor Sosian	Weekly	Construction	Included in Supervision scope and Costs
Solid waste management	Slag, domestic refuse, metallic scraps, sludge	• Comprehensive waste management plan; • Documented Approvals for placement of wastes; • Records on tracking the volume of solid waste generated.	Contractor Sosian	Monthly	Construction and operation	Included in Supervision scope and Costs
Employment Opportunities	Labour Records	• HR policies for Sosian and contractors	Sosian and appointed contractors	Monthly	Construction and Operation	-

Project Activity/Aspect	Parameter	Indicator	Institutional Responsibilities		Project Phase	Monitoring Cost Estimates (KES)
			Monitoring Responsibility	Frequency		
		• Number of persons (by gender and region) employed directly by the project and levels of skills as captured in labor returns • Standard workers' agreements and codes of conduct • Relevant Insurance covers				
HIV/AIDS awareness and behaviour influence programs	Observation and records review	• Agreements with service providers • Sensitization records; • Campaign materials (posters, banners etc. on camp site and along project area)	Sosian and contractors	Monthly	Construction and operation	-
Power generation	Records	• Installed Plant Capacity • Annual Power generation trend • Electricity sold	Sosian	Annually	Operation	-

9 CONCLUSION

In general, the proposed project will result in appreciable benefits to the country power production in line with Kenyan Vision 2030, and create opportunities for both social and economic development.

The ESIA has demonstrated that the overall impacts associated with the Geothermal Power Plant Project in Menengai can be managed within reasonable and acceptable limits by applying all identified mitigation measures contained in this report. There is no land take for the power plant since the land for the power plant is public land and Sosian has a sub-lease agreement in place with GDC. From both noise and air quality modelling outcomes, no adverse public health impacts are anticipated on the nearest sensitive receptors (settlements) relative to the adopted WHO and Kenyan standards. Further, the requisite conditions for most of the mitigations have been incorporated by Sosian and GDC on project design and agreement documents reviewed by the consultant.

The identified potential adverse impacts of the proposed project shall be eliminated or significantly minimized through the implementation of the recommended mitigation measures by the various parties. The long-term benefits that will be derived from the proposed power plant project are therefore much greater than the short-term environmental effect.

Public and stakeholders' consultations feedback to date revealed that the local communities have high socioeconomic interests and a lot of expectations with the geothermal power development activities going on within the Menengai caldera. It is recommended that Sosian, in liaison with GDC, develop and implement a community liaison strategy with proper communication and feedback mechanism; and a clear and transparent employment policy for the local communities as project opportunities arise.

It is recommended that the proposed project be implemented in compliance with all the relevant legislation and planning requirements of Kenya as well as the AfDB operational safeguards at all times. In line with this, the proponent Sosian and the appointed contractor (s) must take the legislative and policy framework reviewed in this report into consideration, during and after the implementation of the project, as will be appropriate. Further, the following are recommended:

- Sosian should enlist services of a suitably qualified Environment, Safety and Health personnel who will work in liaison with GDC, appointed contractors and relevant government lead agencies to ensure sound environmental and social performance;
- Sosian shall ensure that the appointed contractor adopts the ESMP, formulate and implement all the management plans required by the ESMP;
- In liaison with GDC, ensure that community expectations are managed through well-structured stakeholders' engagement plan and proper information disclosure to the communities;
- Ensure that community and workers grievances are attended to and resolved on time to avoid conflicts which might hinder the progression of the project;
- Ensure compliance with NEMA approval conditions throughout the project phases;
- Ensure that regular environmental health and social monitoring is carried out to comply with the proposed monitoring plan; and
- Ensure statutory annual environmental as well as occupational safety and health audits are carried out throughout the project operation period.

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APPENDICES

Appendix I: MoU between GDC and KFS
Appendix II: Biodiversity Checklist
Appendix III: Key Informants Interview Records
Appendix IV: Records of Public Meetings
Appendix V: EIA License
Appendix VI: NMK Chance Find Procedure and Letter of No Objection
Appendix VII: Draft Grievance Redress Mechanism
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Appendix I: MoU between GDC and KFS

KENYA
Forest Service

GDC Geothermal Development Company
Powering the Vision

MEMORANDUM OF UNDERSTANDING (MOU)

BETWEEN

KENYA FOREST SERVICE

AND

GEOTHERMAL DEVELOPMENT COMPANY LIMITED

ON

GEOTHERMAL RESOURCES DEVELOPMENT AT MENENGAI CRATER FOREST RESERVE

THIS Memorandum of Understanding (MOU) is made this 15th day of July Two Thousand and Eleven between **KENYA FOREST SERVICE**, a body corporate established under the Forests Act No 7 of 2005, of the Laws of the Republic of Kenya, whose address is Kiambu Road, Post Office Box Number 30513-00100, Nairobi in the Republic of Kenya (hereinafter called "the Service") of the one part and **GEOTHERMAL DEVELOPMENT COMPANY LIMITED** a registered entity duly established under the laws of the Republic of Kenya and whose address is Post Office Box Number 100746 -00101, Nairobi (hereinafter called "the Company") of the other part.

WHEREAS

A. The Service is a State corporation established under the Forests Act, 2005 as a body corporate with the overall mandate of ensuring establishment, development and sustainable management, including conservation and rational utilisation of forest resources for the socio-economic development of the country.

B. The Company is 100 % owned by the Government of Kenya and is mandated to promote rapid development of geothermal resources in Kenya through surface exploration and drilling for steam and managing the geothermal reservoir's (where the steam has been harnessed) so as to ensure constant supply of steam for power generation.

C. The Service and the Company agree to co-operate in the development of geothermal Resources, management and conservation of Forest resources.

PURPOSE

This MOU is entered into by the parties to ensure proper co-existence and safeguard the interests of the two parties and therefore it shall operate so long as the need for the parties to work in the same environment and areas exists.

NOW THIS MOU WITNESSETH that it is hereby agreed and declared by and between the parties hereto as follows:-

In this MOU, unless the context otherwise requires:-

'Agent' means a person appointed by the Company or the Service to act on its behalf.

'Company Premises' means all or any part of or portion of Forest that the Service shall by way of sub-lease or otherwise grant to the Company for its use.

'Contractor' means a person contracted by the Company to carry out work or to provide supplies under a specific contract.

'Flora' means all the plants including trees within the Company premises and in the surrounding forest area.

'Fauna' means all animals inhabiting the Company premises and the surrounding forest area.

"Term" means the term of this Memorandum of Understanding.

'Visitor' means one who visits the Company premises, on the Company's invitation or to carry out official business with the Company.

'Forest' means any land declared to be a forest land under the Forest Act, 2005.

ARTICLE 1: ENVIRONMENTAL CONSERVATION

The Service shall regularly create awareness to the staff of the Company on the forest rules and regulations particularly with regard to conservation, proper disposal of waste, and handling of forest visitors by the Company's staff.

1.1 Forest conservation

The impacts on flora will be assessed during development and production of geothermal resources and appropriate mitigation measures undertaken against removal of vegetation in areas to be cleared for roads, buildings and other structures.

AS WITNESSED by the hands of the duly authorized representatives of the parties the day and year first above written

SIGNED by **David .K. Mbugua**
For and on behalf of **KENYA FOREST SERVICES**)
In the presence of: -)
)
)
In the presence of)
)
Sam Owino)
Corporation Secretary)
)
MANAGING DIRECTOR)
GEOTHERMAL DEVELOPMENT CO. LTD.)
P. O. Box 100746 - 00101)
NAIROBI, KENYA.)
SIGNED by **Dr. Silas Simiyu**)
For and on behalf of **GEOTHERMAL DEVELOPMENT)**
COMPANY LIMITED)
)
In the presence of)
COMPANY SECRETARY)
GEOTHERMAL DEVELOPMENT CO. LTD.)
P. O. Box 100746 - 00101)
NAIROBI, KENYA.)
Praxidis Saisi)
Company Secretary)

Appendix II: Biodiversity Checklists

1. List of Amphibians in the Nakuru Area

Checklist 1: List of Amphibians in the Nakuru Area

	Frogs and toads	Amphibian Scientific name	The IUCN Red List of Threatened Species	Wildlife (Conservation and Management) Act
1	Garman's toad	*Bufo garmani*	Least Concern	Not listed
2	Kerinyaga toad	*Bufo Kerinyagae*	Least Concern	Not listed
3	Marbled Snout Burrower (possible)	*Hemisus marmoratus*	Least Concern	Not listed
4	Bocage's burrowing tree frog	*Leptopelis bocagii*	Least Concern	Not listed
5	Silver Bladdered reed frog	*Hyperolius cystocandius*	Not Assessed	Not listed
6	Sharp nosed reed frogs	*Hyperolius nasutus*	Least Concern	Not listed
7	Other reed frogs spp. Water lily reed frog	*Hyperolius spp.*	Not Assessed	Not listed
		H. viridiflavus viridiflavus	Not Assessed	Not listed
		H.Pusillus	Not Assessed	Not listed
8	Senegal Kassina	*Kassina sengalensis*	Not Assessed	Not listed
9	Northern Foam nest frog	*Chrimantis petersi*	Not Assessed	Not listed
10	Angolan river frog	*Rana angolensis*	Least Concern	Not listed
11	Galam white-lipped/ golden backed frog(possible)	*Amnirana galamensis*	Least Concern	Not listed
12	Boettger's dainty frog (possible)	*Cacosternum bottgeri*	Not Assessed	Not listed
13	Eastern groove-crowned bullfrog	*Hoplobatracus occipitalis*	Not Assessed	Not listed
14	Coast Puddle frog	*Phrynobatrachus acridoides*	Least Concern	Not listed
15	Natal puddle frog	*Phrynobatrachus natalensis*	Least Concern	Not listed
16	Dwarf Puddle frog (possible)	*Phrynobatrachus mababiensis*	Least Concern	Not listed
17	Anchieta's rocket frog	*Ptychadena anchietae*	Least Concern	Not listed
18	Mascarene Rocket frog	*Ptychadena mascareniensis*	Least Concern	Not listed
19	Sharp nosed rocket frog (possible)	*Ptychadena orxyrhnchus*	Not Assessed	Not listed
20	Small Rocket frog (possible)	*Ptychadena taenioscelis*	Least Concern	Not listed
21	Cryptic sand frog	*Tomopterna Cryptotis*	Least Concern	Not listed
22	African Bullfrog	*Pyxicephalus adspersus*	Least Concern	Not listed
23	Lake Victoria clawed frog	*Xenopus victorianus*	Least Concern	Not listed

Source: Koyo et. al, 2005 (Kenya Wildlife Services)

2. List of the birds of Menengai Caldera

Checklist 2: List of the Birds of Menengai Caldera

No.	Common Name	Scientific Name	Status	The IUCN Red List of Threatened Species	CITES Listing	Wildlife (Conservation and Management) Act
	Pelicanidae: Pelicans					
1	Great White Pelican	*Pelecanus onocrotalus*		Least Concern	Not listed	Not Listed
	Ardeidae: Herons, Egrets and Bitterns					
2	Cattle egret	*Bulbulcus ibis*	am	Not Assessed	Not listed	Not Listed
3	Grey heron	*Ardea cinerea*	am, pm	Least Concern	Not listed	Not Listed
4	Black –headed heron	*Ardea melanocehala*				
	Scopidae: Hamerkop					
5	Hamerkop	*Scopus umbretta*		Least Concern	Not listed	Not Listed
	Ciconidae: Storks					
6	White stork	*Ciconia ciconia*	PM	Least Concern	Not listed	Not Listed
7	Black stork	*Ciconia nigra*	X, PM	Least Concern	Appendix II	Not Listed
8	Abdim's stork	*Ciconia abdimii*	AM	Least Concern	Not listed	Not Listed
9	Wooly-necked stork	*Ciconia episcopus*		Vulnerable	Not listed	Not Listed
10	Marabou stork	*Leptoptilos crumeniferus*		Least Concern	Not listed	Not Listed
11	Yellow-billed stork	*Mycteria ibis*		Least Concern	Not listed	Not Listed
12	Sacred Ibis	*Threskiornis aethiopcus*		Not Assessed	Not listed	Not Listed
13	Hadada Ibis	*Bostrychia hagedash*		Least Concern	Not listed	Not Listed
	Phonicopteridae: Flamingos					
14	Lesser Flamingo	*Phoeniconaias minor*	am	Near Threatened	Appendix II	Near Threatened
	Anatidae: Duck and Geese					
15	Spur-winged Goose	*Plectopterus gambensis*		Not Assessed	Not listed	Not Listed
16	Egyptian Goose	*Alopochem aegyptiacus*		Not Assessed	Not listed	Not Listed
17	Knob-billed Duck	*Sarkidiornis melanotos*	am	Least Concern	Not listed	Not Listed
	Sagittaridae: Secretary Bird					
18	Secretary Bird	*Sagittarius serpentarius*		Vulnerable	Not listed	Protected Species
	Accipitridae: Vultures, Eagles Hawks, Kites and allies					
20	Bat Hawk	*Macheiramphus alcinus*	X	Least Concern	Not listed	Not Listed
21	Black-shoulder Kite	*Elanus caeruleus*		Least Concern	Not listed	Not Listed
22	Black Kite	*Milvus migrans*	am, pm	Least Concern	Not listed	Not Listed
23	Egyptian Vulture	*Neophron percnopterus*		Endangered	Appendix II	Endangered
24	African White-backed Vulture	*Gyps africanus*		Not Assessed	Appendix II	Not Listed
25	Black-chested Snake Eagle	*Circaetus pectoralis*		Least Concern	Appendix II	Not Listed
26	Brown Snake Eagle	*Circaetus cinereus*		Least Concern	Appendix II	Not Listed
27	African Harrier-Hawk	*Polyboides typus*		Not Assessed	Not listed	Not Listed
28	Pallid Harrier	*Circus macrourus*	PM	Near Threatened	Appendix II	Near Threatened
29	Montagu's Harrier	*Circus pygargus*		Least Concern	Appendix II	Not Listed
30	African Marsh Harrier	*Circus ranivorus*	X	Least Concern	Appendix II	Not Listed
31	Eurasian Marsh Harrier	*Circus aeruginosus*	PM	Least Concern	Appendix II	Not Listed
32	Eastern Pale chanting Goshawk	*Melierax poliopterus*		Not Assessed	Appendix II	Not Listed
33	Common Buzzard	*Buteo buteo*	PM	Least Concern	Appendix II	Not Listed
34	Augur Buzzard	*Buteo augur*		Least Concern	Appendix II	Not Listed
35	Lesser Spotted Eagle	*Aquila pomarina*	X, PM	Least Concern	Appendix II	Not Listed
36	Tawny Eagle	*Aquila rapax*		Vulnerable	Appendix II	Not Listed
37	Steppe Eagle	*Aquila nipalensis*		Endangered	Appendix II	Not Listed
38	Veraeux's Eagle	*Aquila verreauxii*		Least Concern	Appendix II	Not Listed
39	Booted Eagle	*Hieraaetus pennatus*	X, PM	Least Concern	Appendix II	Not Listed
40	Long-crested Eagle	*Lophaetus occipitalis*		Least Concern	Appendix II	Not Listed
41	African Crowned Eagle	*Stephanoaetus coronatus*		Near Threatened	Appendix II	Protected Species
42	Martial Eagle	*Polemaetus bellicosus*		Vulnerable	Appendix II	Protected Species
	Falconidae: Falcons					
43	Lanner Falcon	*Falco biarmicus*		Least Concern	Appendix II	Not Listed
44	Peregrine Falcon	*Falco peregrines*	pm	Not Assessed	Appendix I	Not Listed
45	Common Kestrel	*Falco tinnunculus*	pm	Least Concern	Appendix II	Not Listed
	Phasianidae: Quails and Francolins					
46	Harlequin Quail	*Coturnix delegorguei*		Least Concern	Not listed	Not Listed
47	Coqui Francolin	*Francolinus coqui*		Least Concern	Not listed	Not Listed
48	Hildebrandt's Francolin	*Pternistis hildebrandti*		Not Assessed	Not listed	Not Listed
	Numidae: Guineafowl					
49	Helmeted Guinea fowl	*Numida meleagris*		Least Concern	Not listed	Not Listed
	Turnicidae: Button-quail and Quailplover					
50	Common button-quail	*Turnix sylvaticus*		Not Assessed	Not listed	Not Listed
	Gruidae: Cranes					
51	Grey Crowned Crane	*Balearica regulorum*		Endangered	Appendix II	Protected Species
	Otididae: Bustards					
52	Kori Bustard	*Otis kori*		Not Assessed	Appendix II	Not Listed
53	Black-bellied Bustard	*Eupodotis melanogaster*		Least Concern	Appendix II	Not Listed
	Glareolidae: Egyptian-plover, Coursers and Pranticoles					
54	Temminck's Courser	*Cursorius temminckii*		Least Concern	Not listed	Not Listed
	Charadriidae: Plovers					
55	Black-headed plover	*Vanellus tectus*		Least Concern	Not listed	Not Listed
56	Black-winged plover	*Vanellus melanopterus*		Least Concern	Not listed	Not Listed
57	Crowned plover	*vanellus coronatus*		Least Concern	Not listed	Not Listed
	Scolpacidae: Sandpipers and relatives					

58	Common sandpiper	*Actitis hypoleucos*	PM	Least Concern	Not listed	Not Listed
	Laridae: Gull and Terns					
59	Whiskered Tern	*Chlidonias hybridus*	pm	Least Concern	Not listed	Not Listed
	Columbidae: Pigeons and Doves					
60	African Green Pigeon	*Treron calva*		Not Assessed	Not listed	Not Listed
61	Tambourine Dove	*Turtur tympanistria*		Least Concern	Not listed	Not Listed
62	Emerald-spotted wood dove	*Turtur chalcospilos*		Least Concern	Not listed	Not Listed
63	Namaqua Dove	*Oena capensis*		Least Concern	Not listed	Not Listed
64	Olive Pigeon	*Columba arquatrix*		Least Concern	Not listed	Not Listed
65	Speckled pigeon	*Columba ginea*		Not Assessed	Not listed	Not Listed
66	Feral Pigeon	*Columba livia*		Least Concern	Not listed	Invasive Species
67	Red-eyed Dove	*Streptopelia semitorquata*		Least Concern	Not listed	Not Listed
68	Ring-necked dove	*Streptopelia capicola*		Least Concern	Not listed	Not Listed
69	Dusky Turtle Dove	*Streptopelia lugens*		Least Concern	Not listed	Not Listed
70	Laughing Dove	*Streptopelia senegalensis*		Least Concern	Not listed	Not Listed
	Psittacidae: Parrots and Lovebirds					
71	Feral lovebird	*Agapornis personata x A. fischeri*		Not Assessed	Not listed	Not Listed
72	Fischers	*R. fischerri*		Not Assessed	Not listed	Not Listed
	Musophagidae: Turacos					
73	White-bellied Go-away-bird	*Corythaixoides leucogaster*		Least Concern	Not listed	Not Listed
	Cuculidae: Cuckoos and Coucals					
74	African Cuckoo	*Cuculus gularis*	am	Least Concern	Not listed	Not Listed
75	Black-and-white Cuckoo	*Oxylophus jacobinus*	am, pm	Not Assessed	Not listed	Not Listed
76	Great spotted Cuckoo	*Clamator glandarius*	X, pm	Least Concern	Not listed	Not Listed
77	Red-chested cuckoo	*Cuculus solitaries*		Not Assessed	Not listed	Not Listed
78	Klaas's Cuckoo	*Chrysococcyx klaas*		Least Concern	Not listed	Not Listed
79	Diederik Cuckoo	*Chrysococcyx caprius*		Least Concern	Not listed	Not Listed
80	White-browed Coucal	*Centropus superciliosus*		Least Concern	Not listed	Not Listed
	Tytonidae: Barn Owls					
81	Barn owl	*Tyto alba*		Least Concern	Appendix II	Not Listed
	Strigidae: Typical Owl					
82	African Scops Owl	*Otus senegalensis*		Least Concern	Appendix II	Not Listed
83	Cape Eagle-Owl	*Bubo capensis*		Least Concern	Appendix II	Protected Species
84	Spotted Eagle-owl	*Bubo africanus*		Least Concern	Appendix II	Not Listed
85	Verreaux's Eagle-Owl	*Bubo lacteus*		Least Concern	Appendix II	Not Listed
86	Marsh Owl	*Asio capensis*		Least Concern	Appendix II	Not Listed
	Caprimulgidae: Nightjars					
87	Montane Nightjar	*Caprimulgus poliocephalus*		Least Concern		Not Listed
88	Dusky Nightjar	*Caprimulgus fraenatus*	X, PM	Least Concern		Not Listed
89	Eurasian Nightjar	*Caprimulgus europaeus*	X	Least Concern		Not Listed
	Apodidae: Swifts					
90	Eurasian Swift	*Apus apus*	PM	Least Concern		Not Listed
91	Nyanza Swifts	*Apus niansae*		Least Concern		Proteceted Species
92	Molten Swift	*Apus aequitorialis*		Not Assessed		Not Listed
93	White-rumped Swift	*Apus caffer*		Least Concern		Not Listed
94	Horus Swift	*Apus hours*	X	Not Assessed		Not Listed
95	Little Swift	*Apus affinis*		Least Concern		Not Listed
	Coliidae: Mousebirds					
96	Speckled Mousebird	*Colius striatus*		Least Concern		Invasive Species
97	Blue-naped Mousebird	*Urocolius macrourus*		Least Concern		Not Listed
	Alcedinidae: Kingfisher					
98	Grey-headed kingfisher	*Halcyon leucocephala*	am	Least Concern		Not Listed
	Meropidae: Bee-eater					
99	Eurasian Bee-eater	*Merops apiaster*	PM	Least Concern		Not Listed
100	Little Bee-eater	*Merops pusillus*		Least Concern		Not Listed
101	Cinnamon-chested Bee-eater	*Merops oreobates*				
102	White-fronted Bee-eater	*Merops bullockoides*		Least Concern		Not Listed
	Coraciidae: Rollers					
103	Eurasian Roller	*Coracias garrulous*	PM	Not Assessed		Near Threatened
104	Abyssinian Roller	*Coracias abyssinica*	X	Least Concern		Not Listed
105	Lilac-breasted Roller	*Coracias caudate*	am	Not Assessed		Not Listed
	Upupidae: Hoopoe					
106	Hoopoe	*Upupa epops*	am, pm	Least Concern		Not Listed
	Phoeniculidae: Wood-hoopoes					
107	Green Wood-hoopoes	*Phoeniculus purpureus*		Not Assessed		Not Listed
	Bucerotidae: Hornbills					
108	Abyssinian Ground Hornbill	*Bucorvus abyssinicus*	X	Vulnerable		Not Listed
109	Hemprich's Hornbill	*Tockus hemprichii*	X	Least Concern		Not Listed
110	Crowned Hornbill	*Tockus alboterminatus*		Least Concern		Not Listed
111	African Grey Hornbill	*Tockus nasustus*		Not Assessed		Not Listed
	Capitonidae:					
112	Red-fronted Barbet	*Tricholaema diademata*		Least Concern		Not Listed
113	Spot-flanked Barbet	*Tricholaema lacrymosa*		Least Concern		Not Listed
114	D'arnaud's Barbet	*Trachyphonus darnaudii*		Least Concern		Not Listed
	Indicatoridae: Honeyguides					
115	Lesser honey guide	*Indicator minor*		Least Concern		Not Listed
	Picidae: Wrynecks and Woodpeckers					

116	Red-throated Wryneck		X	Least Concern		Not Listed
117	Nubian Woodpecker	*Campethera nubica*		Least Concern		Not Listed
118	Grey Woodpecker	*Mesopicos goertae*		Not Assessed		Not Listed
	Alaudidae: Larks					
119	Rufous-naped lark	*Mirafra Africana*		Least Concern		Not Listed
120	Red-capped lark	*Calandrella cinerea*		Least Concern		Not Listed
	Hirundinidae: Swallows and Martins					
121	Grey-rumped Swallow			Least Concern		Not Listed
122	Wire-tailed Swallow	*Hirundo smithii*		Least Concern		Not Listed
123	Barn Swallow	*Hirundo rustica*	PM	Least Concern		Not Listed
124	Red-rumped Swallow	*Hirundo daurica*		Not Assessed		Not Listed
125	Mosque Swallow	*Hirundo senegalensis*		Least Concern		Not Listed
126	Rufous-chested Swallow	*Cecropis semirufa*		Least Concern		Not Listed
127	Lesser Striped Swallow	*Cecropis abyssinica*		Least Concern		Not Listed
128	Rock Martin	*Hirundo fuligula*		Not Assessed		Not Listed
129	Black Saw-wing	*Psalidoprocne holomelas*		Not Assessed		Not Listed
	Motacillidae: Wagtails, Pipits and Longclaws					
130	African Pied Wagtail	*Moticilla aguimp*		Not Assessed		Not Listed
131	Yellow Wagtail	*Motacilla flava*	PM	Least Concern		Not Listed
132	Grassland Pipit	*Anthus cinnamomeus*		Least Concern		Not Listed
133	Tree Pipit	*Anthus trivialis*	PM	Least Concern		Not Listed
134	Yellow-throated longclaws	*Macronyx croceus*		Not Assessed		Not Listed
135	Rosy-breasted Longclaw	*Macronyx ameliae*		Least Concern		Not Listed
	Pycnonotidae: Bulbul					
136	Common bulbul	*Pycononotus barbatus*		Not Assessed		Not Listed
	Timaliidae: Babblers, Chatterers and Illadopses					
137	Black-loerd Babbler	*Turdoides sharpie*		Not Assessed		Not Listed
138	Arrow-marked Babbler	*Turdoides jardineii*		Least Concern		Not Listed
139	Rufous Chatterer	*Turdoides rubiginosus*		Least Concern		Not Listed
	Turdidae: Thrushes, Chats and relatives					
140	Abyssinian Wheatear	*Oenanthe lugrubis*		Not Assessed		Not Listed
141	Cape Robin-Chat	*Cossypha semirufa*		Least Concern		Not Listed
142	Rüppell's Robin-chat	*Cossypha sharpie*		Not Assessed		Not Listed
143	Brown-backed Scrub robin	*Erythropygia hartlaubi*	X	Least Concern		Not Listed
144	White-browed Scrub Robin	*Cercotrichas leucophrys*		Least Concern		Not Listed
145	Common Stone Chat	*Saxicola torquata*		Least Concern		Not Listed
146	Whinchat	*Saxicola rubetra*	PM	Least Concern		Not Listed
147	Pied Wheatear	*Oenanthe pleschanka*	PM	Least Concern		Not Listed
148	Isabelline Wheatear	*Oenanthe isabellina*	PM	Least Concern		Not Listed
149	Capped Wheatear	*Oenanthe pileata*		Least Concern		Not Listed
150	Northern Anteater Chat	*Myrmecocichla aethiops*		Least Concern		Not Listed
151	White-shouldered Cliff Chat	*Thamnolaea coronata*		Not Assessed		Not Listed
152	Common Rock Thrush	*Monticola saxatilis*	PM	Not Assessed		Not Listed
153	Olive Thrush	*Turdus olivaceus*		Least Concern		Not Listed
	Muscicapidae: Old World Flycatchers					
154	Spotted Flycatcher	*Muscicapa striat*	PM	Least Concern		Not Listed
155	White-eyed slaty Flycatcher	*Melaenornis fischeri*		Least Concern		Not Listed
	Sylviidae: Old World Warblers					
156	Garden Warbler	*Sylvia borin*	PM	Least Concern		Not Listed
157	Blackcap	*Sylvia atricapilia*	PM	Not Assessed		Not Listed
158	Willow Warbler	*Phylloscopus trochilus*	PM	Least Concern		Not Listed
159	Winding Cisticola	*Cisticola galactotes*		Least Concern		Not Listed
160	Stout Cisticola	*Cisticola robustus*		Least Concern		Not Listed
161	Pectoral-patch Cisticola	*Cisticola brunnescens*		Least Concern		Not Listed
162	Wing-snapping Cisticola	*Cisticola ayresii*		Least Concern		Not Listed
163	Tawny-flanked Prinia	*Apalis flavida*		Least Concern		Not Listed
164	Grey-backed Camaroptera	*Camaroptera brevicaudat*		Not Assessed		Not Listed
165	Yellow-breasted Apalis	*Apalis flavida*		Least Concern		Not Listed
166	Red-faced Crombec	*Sylvietta whytii*		Least Concern		Not Listed
167	Buff-bellied Warbler	*Phyllolais pulchella*		Least Concern		Not Listed
168	Brown Parisoma	*Parisoma lugens*		Not Assessed		Not Listed
169	Banded Parisoma	*Parisoma boehmi*		Not Assessed		Not Listed
	Zosteropidae: White-eyes					
170	Abyssinian White-eye	*Zosterrop abyssinicus*		Not Assessed		Not Listed
	Paridae: Tits					
171	White-bellied Tit	*Parus albiventris*		Least Concern		Not Listed
	Cathildae: Creeper					
172	Spotted creeper	*Salpornis spilanota*	X	Not Assessed		Not Listed
	Monarchidae: Monarch Flycatchers					
173	African Paradise Flycatcher	*Terpsiphone viridis*	am	Least Concern		Not Listed
	Platysterreidae: Batises, Wattle-eyes and relatives					
174	Chin-stop Batis	*Batis molitor*		Least Concern		Not Listed
175	Black-throated Wattle-eye	*Platysteira peltata*		Least Concern		Not Listed
	Prionopidae: Helmet-shrikes					
176	Grey-crested Helmet-Shrike	*Prionops poliolophus*	X	Near Threatened		Vulnerable
	Laniidae: Shrikes					
177	Red-backed Shrike	*Lanius collurio*	PM	Least Concern		Not Listed
178	Red-tailed Shrike	*Lanius isabellinus*	PM	Least Concern		Not Listed
179	Grey-backed Fiscal	*Lanius excubitoroides*		Least Concern		Not Listed
180	Common Fiscal	*Lanius collaris*		Least Concern		Not Listed

	Malaconotidae: Bush-shrikes					
181	Brown-crowned Tchagra	*Tchagra australis*		Least Concern		Not Listed
182	Three-streaked Tchagra	*Tchagra jamesi*		Least Concern		Not Listed
183	Sulphur-breasted Bush-shrike	*Telophorus sulfureopectus*		Least Concern		Not Listed
184	Black-fronted Bush-Shrike	*Telophorus nigrifrons*		Least Concern		Not Listed
185	Tropical Boubou	*Laniarius aethiopicus*		Least Concern		Not Listed
	Campehagidae: Cuckoo-shrikes					
186	Black Cuckoo-shrike	*Campephaga flava*	am	Least Concern		Not Listed
	Oriolidae: Orioles					
187	African Golden Oriole	*Oriolus auratus*	AM	Least Concern		Not Listed
	Corvidae: Crow and allies					
188	Black-headed Oriole	*Oriolus larvatus*		Least Concern		Not Listed
189	Pied Crow	*Corvus albus*		Least Concern		Not Listed
190	Fan-tailed Raven	*Corvus rhipidurus*		Least Concern		Not Listed
191	Cape Rook	*Corvus capensis*		Least Concern		Not Listed
	Sturnidae: Starlings and Oxpeckers					
192	Red-winged starling	*Onychognathus morio*		Least Concern		Not Listed
193	Greater Blue-eared Starling	*Lamprotornis chalybaeus*		Least Concern		Not Listed
194	Rüppell's long-tailed Starling	*Lamprotornis purpuroptera*		Not Assessed		Not Listed
195	Hildebrant's Starling	*Lampprotornis hildebranti*		Not Assessed		Not Listed
196	Superb Sterling	*Lamprotornis superbus*		Least Concern		Not Listed
197	Violet-backed Sterling	*Cinnnyricincluc leucogaste*	am	Not Assessed		Not Listed
198	Magpie Sterling	*Speculipastor bicolor*	X	Least Concern		Not Listed
199	Wattled Sterling	*Creatophora cinerea*	am	Least Concern		Not Listed
	Nectarinidae: Sunbirds					
200	Collared Sunbird	*Anthreptes collaris*		Least Concern		Not Listed
201	Amenthyst Sunbird	*Nectarinia amethystins*		Not Assessed		Not Listed
202	Variable Sunbird	*Nectarinia vinustia*		Not Assessed		Not Listed
203	Scarlet-chested Sunbird	*Chalcomitra senegalensis*		Least Concern		Not Listed
204	Bronze Sunbird	*Necterinia kilimensis*	am	Least Concern		Not Listed
205	Golden-winged Sunbird	*Drepanorhynchus reichenowi*		Least Concern		Not Listed
206	Malachite Sunbird	*Nectarinia famosa*		Least Concern		Not Listed
	Passeridae: Sparrows and Petronias					
207	Rufous Sparrow	*Passer motitensis*		Not Assessed		Not Listed
208	Grey-headed Sparrow	*Passer griseus*		Least Concern		Not Listed
	Ploceidae: Weavers and relatives					
209	Baglafecht Weaver	*Ploceus baglafect*		Not Assessed		Not Listed
210	Spectacled Weaver	*Ploceus ocular*		Least Concern		Not Listed
211	Black-headed Weaver	*Ploceus cucullatua*		Least Concern		Not Listed
212	Chestnut Weaver	*Ploceus rubiginosus*	am	Least Concern		Not Listed
213	Red-headed Weaver	*Anaplectes rubriceps*		Least Concern		Not Listed
214	Cardinal Quelea	*Quelea cardinalis*		Least Concern		Not Listed
215	Red-headed Quelea	*Quelea erythrops*	X, am	Least Concern		Not Listed
216	Yellow Bishop	*Euplectes capensis*		Least Concern		Not Listed
217	Red-collared widowbird	*Euplectes ardens*		Least Concern		Not Listed
218	Long-tailed Widowbird	*Euplectes progne*		Least Concern		Not Listed
219	Jackson's Widowbird	*Euplectes jacksoni*		Least Concern		Near Threatened
220	Estrildidae: waxbill			Not Assessed		Not Listed
221	Red-billed Firefinch	*Lagonosticta senegala*		Least Concern		Not Listed
222	African Firefinch	*Lagonostista rubricate*		Not Assessed		Not Listed
223	Yellow-bellied Waxbill	*Coccopygia quartinia*		Least Concern		Not Listed
224	Crimson-rumped Waxbill	*Estrilda rhodopyga*		Least Concern		Not Listed
225	Common Waxbill	*Estrilda astrild*		Least Concern		Not Listed
226	Red-checked Cordon-bleu	*Uraeginthus bengalus*		Least Concern		Not Listed
227	Purple Grenadier	*Uraeginthus ianthinogaster*		Least Concern		Not Listed
228	Quail-Finch	*Ortygospiza atricollis*		Least Concern		Not Listed
229	African Silverbill	*lonchura cantaans*		Not Assessed		Not Listed
230	Bronze Mannikin	*Lonchura cucullata*		Least Concern		Not Listed
	Estrildidae: subfamily Viduinae: Indigobirds and Whydahs					
231	Village Indigobird	*Vidua chalybeate*		Not Assessed		Not Listed
232	Pin-tailed Whydah	*Vidua macroura*		Least Concern		Not Listed
	Fringillidae: Seedeaters, Canaries and relatives					
233	African Citril	*Serinus citrinelloidees*		Not Assessed		Not Listed
234	White-bellied Canary	*Serinus dorsostriatus*		Least Concern		Not Listed
235	Brimstone Canary	*Serinus sulphuratus*		Least Concern		Not Listed
236	Steaky seedeater	*Serinus striolatus*		Least Concern		Not Listed
	Emberizidae: Old World Buntings					
237	Cinnamon-breasted Bunting	*Emberiza tahapisi*		Least Concern		Not Listed

Key
NT; Near threatened globally: VU; Vulnerable globally: PM; Palaearctic Migrant: AM; Afrotropic Migrant: pm/am: Palaearctic or Afrotropical migrant occurring alongside resident individuals: X; Rare sighting

3. List of the Flora of Menengai Caldera

Checklist 3: List of the Flora of Menengai Caldera

No.	Botanical name	Family	Origin Habit	The IUCN Red List of Threatened Species	CITES Listing	Wildlife (Conservation and Management) Act
1	*Rumex usambarensis*	Polygonaceae	Indigenous Shrub	Not assessed	Not listed	Not listed
2	*Saturea biflora*	Labiatae (Lamiaceae)	Indigenous Herb	Not assessed	Not listed	Not listed
3	*Conyza bonariensis (C. floribunda)*	Compositae	Indigenous Herb	Not assessed	Not listed	Not listed
4	*Rhus natalensis*	Anacardiaceae	Indigenous Shrub	Not assessed	Not listed	Not listed
5	*Crotalaria agatiflora*	Papilionaceae	Indigenous Shrub	Not assessed	Not listed	Not listed
6	*Conyza newii*	Compositae	Indigenous Shrub	Not assessed	Not listed	Not listed
7	*Dissotis senegambiensis*	Melastomataceae	Indigenous Shrub	Not assessed	Not listed	Not listed
8	*Dodonaea viscosa*	Sapindaceae	Indigenous Shrub	Not assessed	Not listed	Not listed
9	*Notonia petraea*	Compositae	Indigenous Herb	Not assessed	Not listed	Not listed
10	*Rhus vulgaris*	Anacardiaceae	Indigenous Shrub	Not assessed	Not listed	Not listed
11	*Tarchonanthus camphoratus*	Compositae	Indigenous Shrub	Not assessed	Not listed	Not listed
12	*Protea gaguedi*	Proteaceae	Indigenous Shrub	Not assessed	Not listed	Not listed
13	*Gerbera viridifolia*	Compositae	Indigenous Herb	Not assessed	Not listed	Not listed
14	*Gomphocarpus semilunatus*	Apocynaceae	Indigenous Herb	Not assessed	Not listed	Not listed
15	*Ozoroa insignis*	Anacardiaceae	Indigenous Tree	Least Concern	Not listed	Not listed
16	*Faurea saligna*	Proteaceae	Indigenous Tree	Not assessed	Not listed	Not listed
17	*Erythrina abyssinica*	Papilionaceae	Indigenous Tree	Not assessed	Not listed	Not listed
18	*Acacia xanthophloea*	Mimosaceae	Indigenous Tree	Not assessed	Not listed	Not listed
19	*Tetradenia riparia*	Labiatae/Lamiacea	Indigenous Shrub	Not assessed	Not listed	Not listed
20	*Nuxia congesta*	Loganiaceae	Indigenous Tree	Not assessed	Not listed	Not listed
21	*Cynodon nlemfluensis*	Gramineae/Poaceae	Indigenous Grass	Not assessed	Not listed	Not listed
22	*Trimeria grandifolia*	Flacoutiaceae	Indigenous Shrub	Not assessed	Not listed	Not listed
23	*Olinia rochetiana*	Oliniaceae	Indigenous Tree	Not assessed	Not listed	Not listed
24	*Plectranthus barbatus*	Labiatae	Indigenous Shrub	Not assessed	Not listed	Not listed
25	*Pellaea calomelanos*	Adintaceae	Indigenous Fern	Not assessed	Not listed	Not listed
26	*Acacia hockii*	Mimosaceae	Indigenous Tree	Not assessed	Not listed	Not listed
27	*Gladiolus dalenii*	Iridaceae	Indigenous Herb	Not assessed	Not listed	Not listed
28	*Asplenium sp.*	Adintaceae	Indigenous Fern	Least Concern	Not listed	Not listed
29	*Anthospermum welwitschii*	Rubiaceae	Indigenous Shrub	Not assessed	Not listed	Not listed
30	*Rhynchosia minima*	Papilionaceae	Indigenous Herb	Least Concern	Not listed	Not listed
31	*Entada abyssinica*	Mimosaceae	Indigenous Tree	Not assessed	Not listed	Not listed
32	*Kohautia caespitosa*	Rubiaceae	Indigenous Herb	Not assessed	Not listed	Not listed
33	*Rothea myricoides*	Labiatae (Lamiaceae)	Indigenous Shrub	Not assessed	Not listed	Not listed
34	*Artemisia afra*	Compositae	Indigenous Shrub	Not assessed	Not listed	Not listed
35	*Myrsine Africana*	Myrsinaceae	Indigenous Shrub	Not assessed	Not listed	Not listed
36	*Cyphostemma maranguense*	Vitaceae	Indigenous Climber	Not assessed	Not listed	Not listed
37	*Rubia cordifolia*	Rubiaceae	Indigenous Climber	Not assessed	Not listed	Not listed
38	*Maytenus senegalensis*	Celastraceae	Indigenous Shrub	Not assessed	Not listed	Not listed
39	*Agauria salicifolia*	Ericaceae	Indigenous Tree	Not assessed	Not listed	Not listed
40	*Osyris lanceolata*	Santalaceae	Indigenous Tree	Least Concern	Appendix II	Endangered
41	*Rhynchetrum scabridum*	Gramineae/Poaceae	Indigenous Grass	Not assessed	Not listed	Not listed
42	*Solanum indicum*	Solanaceae	Indigenous Shrub	Not assessed	Not listed	Not listed
43	*Lippia javanica*	Verbenaceae	Indigenous Shrub	Not assessed	Not listed	Not listed
44	*Pluchea bequaertii*	Compositae	Indigenous Shrub	Least Concern	Not listed	Not listed
45	*Helichrysum forskahlii*	Compositae	Indigenous Herb	Not assessed	Not listed	Not listed
46	*Helichrysum globosum*	Compositae	Indigenous Herb	Not assessed	Not listed	Not listed
47	*Helichrysum odoratissimum*	Compositae	Indigenous Shrub	Not assessed	Not listed	Not listed
48	*Pennisetum cladestinum*	Gramineae/Poaceae	Indigenous Grass	Not assessed	Not listed	Not listed
49	*Hyparrhenia sp.*	Gramineae/Poaceae	Indigenous Grass	Not assessed	Not listed	Not listed
50	*Rhynchelytrum repens*	Gramineae/Poaceae	Indigenous Grass	Not assessed	Not listed	Not listed
51	*Fuerstia Africana*	Labiatae (Lamiaceae)	Indigenous Herb	Not assessed	Not listed	Not listed
52	*Hypoestes verticillaris*	Acanthaceae	Indigenous Herb	Not assessed	Not listed	Not listed
53	*Sida cuneifolia*	Malvaceae	Indigenous Herb	Not assessed	Not listed	Not listed
54	*Aster muricata*	Compositae	Indigenous Herb	Not assessed	Not listed	Not listed
55	*Cenchrus ciliaris*	Gramineae/Poaceae	Indigenous Grass	Least Concern	Not listed	Not listed
56	*Themeda triandra*	Gramineae	Indigenous Grass	Not assessed	Not listed	Not listed
57	*Hibiscus aponeurus*	Malvaceae	Indigenous Herb	Not assessed	Not listed	Not listed
58	*Kyllinga sp.*	Cyperaceae	Indigenous Sedge	Not assessed	Not listed	Not listed
59	*Commelina Africana*	Commelinaceae	Indigenous Herb	Least Concern	Not listed	Not listed
60	*Clutia abyssinica*	Euphorbiaceae	Indigenous Shrub	Not assessed	Not listed	Not listed
61	*Portulaca oleraceae*	Portulacaceae	Indigenous Herb	Not assessed	Not listed	Not listed
62	*Ficus glumosa*	Moraceae	Indigenous Tree	Not assessed	Not listed	Not listed
63	*Pentas longiflora*	Rubiaceae	Indigenous Herb	Not assessed	Not listed	Not listed
64	*Rhus ruspolii*	Anacardiaceae	Indigenous Shrub	Not assessed	Not listed	Not listed
65	*Phragmanthera dschallensis*	Loranthaceae	Indigenous Parasitic	Not assessed	Not listed	Not listed

66	*Leucas tomentosa*	Labiatae (Lamiaceae)	Indigenous Shrub	Not assessed	Not listed	Not listed
67	*Ajuga remota*	Labiatae	Indigenous Herb	Not assessed	Not listed	Not listed
68	*Steganotaenia araliacea*	Araliaceae	Indigenous Tree	Not assessed	Not listed	Not listed
69	*Rhoicissus tridentate*	Vitaceae	Indigenous Climber	Not assessed	Not listed	Not listed
70	*Phytolacca octandra*	Phytolaccaceae	Indigenous Shrub	Not assessed	Not listed	Not listed
71	*Buddleja polystachya*	Loganiaceae	Indigenous Shrub	Not assessed	Not listed	Not listed
72	*Trema orientalis*	Ulmaceae	Indigenous Tree	Least Concern	Not listed	Not listed
73	*Croton macrostachyus*	Euphorbiaceae	Indigenous Tree	Not assessed	Not listed	Not listed
74	*Acacia abyssinica*	Mimosaceae	Indigenous Tree	Not assessed	Not listed	Not listed
75	*Hypoestes verticillaris*	Acanthaceae	Indigenous Herb	Not assessed	Not listed	Not listed
76	*Grevillea robusta*	Proteaceae	Exotic Tree	Not assessed	Not listed	Not listed
77	*Vernonia auriculifera*	Compositae	Indigenous Shrub	Not assessed	Not listed	Not listed
78	*Cussonia holstii*	Araliaceae	Indigenous Tree	Not assessed	Not listed	Not listed
79	*Acacia senegal var Senegal*	Mimosaceae	Indigenous Tree	Not assessed	Not listed	Not listed
80	*Pteridium aquilinum*	Dennstaediaceae	Indigenous Fern	Least Concern	Not listed	Not listed
81	*Crotalaria lachnocarpoides*	Papilionaceae	Indigenous Shrub	Not assessed	Not listed	Not listed
82	*Acacia lahai*	Mimosaceae	Indigenous Tree	Not assessed	Not listed	Not listed
83	*Indigofera spicata*	Papilionaceae	Indigenous Herb	Not assessed	Not listed	Not listed
84	*Cucumis aculeatus*	Cucurbitaceae	Indigenous Climber	Not assessed	Not listed	Not listed
85	*Microglossa pyrifolia*	Compositae	Indigenous Shrub	Not assessed	Not listed	Not listed
86	*Euphorbia prostrata*	Euphorbiaceae	Indigenous Herb	Critically Endangered	Not listed	Not listed
87	*Rubus steudneri*	Rosaceae	Indigenous Climber	Not assessed	Not listed	Not listed
88	*Rubus apetalus*	Rosaceae	Indigenous Climber	Not assessed	Not listed	Not listed
89	*Pluchea bequaertii*	Compositae	Indigenous Shrub	Least Concern	Not listed	Not listed
90	*Crotalaria laburnifolia*	Papilionaceae	Indigenous Shrub	Not assessed	Not listed	Not listed
91	*Bidens pilosa*	Compositae	Indigenous Herb	Not assessed	Not listed	Not listed
92	*Crassocephalum vitellinum*	Compositae	Indigenous Herb	Not assessed	Not listed	Not listed
93	*Chenopodium ambrosioides*	Chenopodiaceae	Indigenous Herb	Not assessed	Not listed	Not listed
94	*Nicotiana glauca*	Solanaceae	Exotic Shrub	Not assessed	Not listed	Not listed
95	*Tinnea aethiopica*	Labiatae (Lamiaceae)	Indigenous Shrub	Not assessed	Not listed	Not listed
96	*Juniperus procera*	Cupressaceae	Indigenous Tree	Least Concern	Not listed	Not listed
97	*Hymenodictyon parvifolium*	Rubiaceae	Indigenous Tree	Not assessed	Not listed	Not listed
98	*Psydrax schimperiana*	Rubiaceae	Indigenous Tree	Not assessed	Not listed	Not listed
99	*Acalypha fruticosa*	Euphorbiaceae	Indigenous Shrub	Not assessed	Not listed	Not listed
100	*Plectranthus sp.*	Labiatae (Lamiaceae)	Indigenous Herb	Not assessed	Not listed	Not listed
101	*Fimbristylis exilis*	Cyperaceae	Indigenous Sedge	Not assessed	Not listed	Not listed
102	*Sporobolus pyramidalis*	Gramineae/Poaceae	Indigenous Grass	Not assessed	Not listed	Not listed
103	*Cyperus laevigatus*	Cyperaceae	Indigenous Sedge	Least Concern	Not listed	Not listed
104	*Pittosporum viridiflorum*	Pittosporaceae	Indigenous Shrub	Not assessed	Not listed	Not listed
105	*Heteromorpha trifoliata*	Umbelliferae	Indigenous Shrub	Not assessed	Not listed	Not listed
106	*Aloe volkensii*	Aloaceae	Indigenous Shrub	Least Concern	Appendix II	Not listed
107	*Erica arborea*	Euphorbiaceae	Indigenous Shrub	Least Concern	Not listed	Not listed
108	*Aloe kedongensis*	Aloaceae	Indigenous Herb	Not assessed	Appendix II	Not listed
109	*Eucalyptus sp.*	Myrtaceae	Exotic Tree	Not assessed	Not listed	Not listed
110	*Oxygonum sinuatum*	Polygonaceae	Indigenous Herb	Not assessed	Not listed	Not listed
111	*Erucastrum arabicum*	Cruciferae	Indigenous Herb	Not assessed	Not listed	Not listed
112	*Tagetes minuta*	Compositae	Indigenous Herb	Not assessed	Not listed	Not listed
113	*Cymbopogon nardus*	Gramineae	Indigenous Grass	Not assessed	Not listed	Not listed
114	*Aspilia mossambiscensis*	Compositae	Indigenous Shrub	Not assessed	Not listed	Not listed
115	*Laggera brevipes*	Compositae	Indigenous Herb	Not assessed	Not listed	Not listed
116	*Craterostigma sp.*	Scrophulariaceae	Indigenous Herb	Not assessed	Not listed	Not listed
117	*Enteropogon macrostachyus*	Gramineae	Indigenous Grass	Not assessed	Not listed	Not listed
118	*Triumfetta rhomboidea*	Tiliaceae	Indigenous Herb	Not assessed	Not listed	Not listed
119	*Withania somnifera*	Solanaceae	Indigenous Shrub	Not assessed	Not listed	Not listed

4. List of Invertebrates' Species of Menengai Caldera

Checklist 4: List of Invertebrates' Species of Menengai Caldera

No	Order	Family	Genus Species	The IUCN Red List of Threatened Species	CITES Listing	Wildlife (Conservation and Management) Act
1	Lepidoptera	Hesperiidae	*Borbo* Sp	Not Assessed	Not Listed	Not Listed
2	Lepidoptera	Nymphalidae	*Danaus Chrysippus*	Not Assessed	Not Listed	Not Listed
3	Lepidoptera	Nymphalidae	*Charaxes Varanes*	Not Assessed	Not Listed	Not Listed
4	Lepidoptera	Nymphalidae	*Junonia Hierta*	Least Concern	Not Listed	Not Listed
5	Lepidoptera	Nymphalidae	*Junonia Oenone*	Least Concern	Not Listed	Not Listed
6	Lepidoptera	Pieridae	*Belenois Aurota*	Not Assessed	Not Listed	Not Listed
7	Lepidoptera	Pieridae	*Catopsillia Florella*	Not Assessed	Not Listed	Not Listed
8	Lepidoptera	Pieridae	*Eurema Brigitta*	Least Concern	Not Listed	Not Listed
9	Lepidoptera	Lycaenidae	*Leptotes Pirithous*	Not Assessed	Not Listed	Not Listed
10	Lepidoptera	Lycaenidae	*Anthene* Sp	Not Assessed	Not Listed	Not Listed
11	Hymenoptera	Formicidae	*Polyrhachis Gagates*	Not Assessed	Not Listed	Not Listed
12	Hymenoptera	Formicidae	*Pheidole* Sp	Not Assessed	Not Listed	Not Listed
13	Hymenoptera	Formicidae	*Platythyrea* Sp	Not Assessed	Not Listed	Not Listed
14	Hymenoptera	Formicidae	*Tetramorium* Sp	Not Assessed	Not Listed	Not Listed
15	Hymenoptera	Formicidae	*Dorylus* Sp	Not Assessed	Not Listed	Not Listed
16	Hymenoptera	Formicidae	*Crematogaster* Sp	Not Assessed	Not Listed	Not Listed
17	Hymenoptera	Braconidae	*Osprynchotus* Sp	Not Assessed	Not Listed	Not Listed
18	Hymenoptera	Apidae	*Apis Mellifera*	Not Assessed	Not Listed	Not Listed
19	Hymenoptera	Apidae	*Xylocopa Calens*	Not Assessed	Not Listed	Not Listed
20	Hymenoptera	Sphecidae	*Chlorion* Sp	Not Assessed	Not Listed	Not Listed
21	Coleoptera	Scarabaeidae	*Onthophagus Gazelle*	Not Assessed	Not Listed	Not Listed
22	Coleoptera	Scarabaeidae	*Pachnoda Ephippiata*	Not Assessed	Not Listed	Not Listed
23	Coleoptera	Chrysomelidae	*Monolepta* Sp	Not Assessed	Not Listed	Not Listed
24	Orthoptera	Acrididae	*Acrotylus* Sp	Not Assessed	Not Listed	Not Listed
25	Orthoptera	Acrididae	*Acanthacris Ruficornis*	Not Assessed	Not Listed	Not Listed
26	Orthoptera	Acrididae	*Gastrimargus* Sp	Not Assessed	Not Listed	Not Listed
27	Orthoptera	Pyrgomorghidae	*Phymateus* Sp	Not Assessed	Not Listed	Not Listed
28	Diptera	Calliphoridae	*Chrysomyia* Sp	Not Assessed	Not Listed	Not Listed
29	Diptera	Sarcophagidae	*Sarcophaga* Sp	Not Assessed	Not Listed	Not Listed
30	Diptera	Syrphidae	*Phytomia* Sp	Not Assessed	Not Listed	Not Listed
31	Diptera	Muscidae	*Musca domestica*	Not Assessed	Not Listed	Not Listed
32	Diplopoda	Oxydesmidae		Not Assessed	Not Listed	Not Listed
33	Diplopoda	Odontopygidae	*Proxenodesmus Monocerus*	Not Assessed	Not Listed	Not Listed
34	Mantodea			Not Assessed	Not Listed	Not Listed
35	Chilopoda			Not Assessed	Not Listed	Not Listed
36	Isopoda			Not Assessed	Not Listed	Not Listed
37	Hemiptera	Scutelleridae		Not Assessed	Not Listed	Not Listed
38	Blattodea	Blaberidae	*Pseudoderopeltis* Sp	Not Assessed	Not Listed	Not Listed
39	Opiliones			Not Assessed	Not Listed	Not Listed
40	Aranaea	Lycosidae		Not Assessed	Not Listed	Not Listed
41	Isoptera	Termitidae	*Macrotermes* Sp	Not Assessed	Not Listed	Not Listed

Appendix III: Key Informants Interview Records

GDC
Powering the Vision

GIBB International
CONSULTING · DESIGN · MANAGEMENT

UPDATING THE ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT REPORT FOR 1x30 MW MENENGAI POWER PLANT

STAKEHOLDER CONSULTATION GUIDE

Nakuru North & Subcounties

SUB-COUNTY MEDICAL OFFICER OF HEALTH/PUBLIC HEALTH OFFICER

Introduction

GDC has entered into an agreement with Quantum Power East Africa (QPEA) GT Menengai Limited as one of the Independent Power Producers for Menengai Geothermal Power Plants. QPEA is applying for funding from international lenders to finance the development of the proposed 1x30MW power plant. One of the expected pre-requisites to funding is compliance with the specific lender's environmental and social safeguards. Based on the findings of the preliminary review and gap analysis of the existing project Environmental and Social Impact Assessment (ESIA) report, Licence from NEMA and Environmental and Social Management Plan (ESMP) it was determined that for the project to comply with MDBs and IFIs requirements, additional inputs to the Report will be required.

To achieve this QPEA which is to implement the project on behalf of GDC has contracted GIBB Africa to update the project ESIA and where necessary, undertake RAP to mitigate on impact on property.

The aim of this study is to collect information at household and institutional stakeholders for the purposes of impact analysis and development of mitigation measures.

Kindly assist by answering the following questions.

1. What are the top ten common illnesses within the Sub-county / District specifically the project area that is Bahati/Ngata/Kampi Ya Moto divisions?

Under 5 yrs	Over 5 yrs.
1) Diseases of respiratory system.	1) Diseases of respiratory system
2) Diarrhoea	2) Disease of the Skin.
3) Diseases of the Skin.	3) Dental diseases.
4) Clinical malaria.	4) Rheumatism, joints Pains.
5) Confirmed malaria.	5) Malaria
6) pneumonia	6) Typhoid fever.
7) Eye infection.	7) Confirmed malaria.
8) Mumps.	8) Diarrhoea.
9) Chicken Pox	9) Urinary tract infection.
10) Ear infection.	10 pneumonia.

2. What is the doctor patient ratio in the Sub County / area?

1: 60670

3. What are the HIV/AIDS prevalence rates in Nakuru North/Rongai Sub County?

Nakuru North: 2-8% for the general population.

4. What initiatives are in place to mitigate the spread of the above illnesses?

Prevention through: HIV testing & Counseling (Knowledge of status); PMTCT intervention
- Distribution & education on proper and Consistent Condom use to the community. - Education on Abstinence to the young Faithfulness for those in marriage.
- Timely commencement of HAART & education on adherence.

5. Which is the most vulnerable group to HIV/ AIDS infections?

- Those in marriage or serious union (attributed to low condom use).
- Women/Females (Attributed to anatomy).
- Women aged 35-39 yrs, and men aged 45-49 years
- Those living in the urban areas, as opposed to rural.

6. What health programs does the department have to deal with

a. HIV/AIDs menace?

- HIV Defaulter Tracing.
- HIV testing & Counseling (HTC)
- Prevention of Mother to Child transmission of HIV (PMTCT).
- Early Infant Diagnosis (EID).
- Prevention (Education, Condom distribution.
- HAART (see below). - STIs.
- VMMC. - HIV-Reproductive Health Integration.

- TB - HIV Integration
- Referrals & Linkages

b. TB

- TB Diagnosis and Treatment.
- TB Defaulter Tracing.
- TB - HIV Integration.
- TB sensitization & education.
- Referrals & Linkages.

Meanings of acronyms.

NB:
- STI: Sexually Transmitted Infections.
- PMTCT: Prevention of Mother to Child Transmission of HIV.
- HAART: Highly Active Anti-Retroviral Therapy.
- VMMC: Voluntary Medical Male Circumcision.

c. Vaccination

1) Daily routine Vaccination
2) National Campaigns eg. Polio Campaign.
3) Outreach services to the community eg to the hard to reach areas.
4) follow up of immunization defaulters.

7. What is the number of health facilities available in the divisions? What are the categories and distribution?

The sub county has three divisions, i'd

1) Kiamaina Division
Public facilities – 14
FBO – 1
Private – 8

2) Delndoi Division.
Public facilities – 3
FBO " – 3
Private " – 5

3) Bahati division.
Public facilities – 3
FBO " – 1
Private " – 1

8. What are the services offered in the health facilities near the project area?

1) Outpatient
2) Inpatient
3) Maternity.
4) Immunization.
5) Ante natal | Post natal.
6) Family planning.
7) Gender Based Violence services.
8) Youth friendly services.
9) Cancer screening services.
10) Post abortal Care
11) Dental services.
12) Physiotherapy | Occupational services
13) Opthamology services.
14) Comprehesive Care services.
15) Laboratory services.
16) Medical engineering services.
17) Environmental & Sanitation services.
18) Maternal & Child

9. Do you foresee any positive impacts from the proposed 1x30MW Geothermal Power Plant development?
   Yes ✓ or No, if yes what impacts do you see
   i. During construction

1) Community will get employment
2) Improved road network.
3) Cheap energy.
4) Community will get the supply.

   ii. During operation

1) Will get Cheap energy.
2) Almost the whole community will be supplied with energy.
3) Job opportunities and development of the area.
4) Improved water supply and security due to power.
5) Initiation & encouragement of self employment.
6) Improved quality of education. - Reduction of diseases eg Eye problems due to straining

10. Do you foresee any negative impacts from the proposed Northern Collector Tunnel development?
    Yes or No ✓, if yes what impacts do you see
    i. During construction

-

   ii. During operation

11. If your answer No. 7 is Yes, please suggest how the anticipated negative impacts can be mitigated.
    i. During construction

    ii. During operation

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UPDATING THE ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT REPORT FOR 1x30 MW MENENGAI POWER PLANT

STAKEHOLDER CONSULTATION GUIDE

SUB-COUNTY / DISTRICT GENDER AND SOCIAL DEVELOPMENT OFFICER

Makuru Mosl

Introduction

GDC has entered into an agreement with Quantum Power East Africa (QPEA) GT Menengai Limited as one of the Independent Power Producers for Menengai Geothermal Power Plants. QPEA is applying for funding from international lenders to finance the development of the proposed 1x30MW power plant. One of the expected pre-requisites to funding is compliance with the specific lender's environmental and social safeguards. Based on the findings of the preliminary review and gap analysis of the existing project Environmental and Social Impact Assessment (ESIA) report, Licence from NEMA and Environmental and Social Management Plan (ESMP) it was determined that for the project to comply with MDBs and IFIs requirements, additional inputs to the Report will be required.

To achieve this QPEA which is to implement the project on behalf of GDC has contracted GIBB Africa to update the project ESIA and where necessary, undertake RAP to mitigate on impact on property.

The aim of this study is to collect information at household and institutional stakeholders for the purposes of impact analysis and development of mitigation measures.

Kindly assist by answering the following questions.

1. What are the NGOs and Community Based Organizations (CBO's) within the project area?

LENAMADUBA
SCODE
Menengai Bee Keepers
Karimbux Community Based Organization
CRATER GRAZING Community Group
Kagiwa Community Health workers
Kahuho Environmental water Conservation & bee keeping

2. Which groups are considered vulnerable in the community? (With emphasis on the community around the proposed Menengai Power Plant project site)

Young men abusing alcohal
Children who are not going to school

Jobless Youths
People

3. What are the main social problems in the project area?

- Taking of illiat brew especially by young men (a good number of men of all ages do take illiat brew thus rendering them dependent and unfruitful.
- ~~for~~ High rates of joblessness leading to poverty and tention especially by youths of working age.
- Increased crime rate especially around Kagoto, Heshima Centres

4. What programs do you have in place to solve the above mentioned challenges

- Mobilization of the community into registered groups to encourage them to divert their energies into profitable activities e.g IGA
- Funding of group activities through Community development grants for creation and sustenance of IGAs
- Resolution of group conflicts
- Referall programs for ~~abusing~~ social issues

5. What economic and social activities are the vulnerable members of the community involved in?

Economic: Car wash, tree planting and selling of seedlings, mobilization of savings, table banking, boda boda services, donkey services, casual labour etc

Social activities: drinking illicit brew, attending church services, watching international football matches, pool

6. What support or welfare do you have in the project area

- Offering community grants to group projects.
- Providing referrals and linkages to institutions of concern
- Assessment, monitoring & evaluation of community projects
- Arbitration of group conflicts
- Registration of groups (self help groups, women groups & Youth groups)

7. What are the socio-cultural norms that guide property ownership specifically Land within the project area.

- Property inheritance (though this is minimal since most of property/land owners have subdivided/fragmented land for sale

8. Gender Issues

a) Resource ownership: Indicate sex (M/F)

Resources	Who buys	Who owns	Who controls	Who uses
Land	M	M	M	F
Trees and Forest				
Livestock	M	M	M	F
Crops	F	F	M/F	M/F
Household property	F	F	F	M/F
Cars motorcycles and bicycles	M	M	M	M

b) Gender roles: Who does the following? (Tick where applicable)

Activity	Men	Women	Boy	Girls
Digging	✓	✓	✓	✓
Cooking		✓		✓
Food collection		✓		
Vegetable collection		✓		
Fetching water		✓	✓	✓
Washing utensils		✓		✓
Collecting firewood		✓		✓
Looking after animals			✓	
Washing clothes		✓		✓
Total task	1 role	8 roles	3 roles	6 roles

9. Are you aware of any site of historical / Archeological importance to the community in the project are?

Menengai Crater

10. Are there NGO's and / or CBOs in the project area? If Yes, Please List them and their roles

(CBOs) Menengai Ecosystem climate Adaptation & Livelihood Project (MECLAD): ~~Lengnadutat~~ Bee keeping, tree nurseries, sheep rearing
SCODE:
Menengai Crater Bee Keepers
Bahati Community Health Based organization: Campaign against Drug/alcohol abuse.
Kahuho Environmental water Conservation & Bee keeping - Environment Conservation, Bee Keeping water catchment
House of Hope & Bread CBO: Running assorted businesses
Nakuru partners Empowerment link CBO: Caring for PLWHA
Bahati Environmental & Hygiene Community Project Service CBO: Garbage collection,

11. Do you foresee any negative impacts from the proposed development of the Geothermal Power Plant?
Yes or No, if yes what impacts do you see
i. During construction

- Further land fragmentation in areas around the project area.
- Increased moral decandence due to increased levels of disposable income: more drinking, higher numbers of vulnerable children etc.
- Destruction of scenic features characteristic of the Menengai landscape
- Hostility and increased tension among youth of working age perceiving that jobs are benefiting non-locals
- Environmental pollution: possible dust, noise, ~~and odour~~
- Displacement of monkeys into areas populated by humans

ii. During operation
- Adulteration of social norms occassioned by influx of non-residents working at the site.
- Environmental pollution: Odour, there is also
- Climatic change: There is a common belief that drilling of geothermal wells ~~has lead to heavy raining~~ is responsible for the heavy inconsistent raining currently witnessed

12. If your answer No. 7 is Yes, please suggest how the anticipated negative impacts can be mitigated.

i. During construction

- Lobbying for classification of the area as to policing to prevent fragmentation
- Mobilisation of individuals working at the site into self help groups or investment oriented groups
- Offering a percentage of works to qualified residents,
- Put Environmental protection measures in place.
- Constant and meaningfull involvement of residents at all levels of the project

ii. During operation

* put systems in place to curb odour
* Give an explanation as to the climatic changes experienced

13. What are your comments on this exercise?

The idea behind it is okay. It was however restrained by time ie. enough time was not given for detailed

Stakeholder Contacts:

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Locality:	Bahati - Sub-County HQ.		
Date:	11/11/2014		
Signature:			
Official Stamp: (if available)	SUB-COUNTY SOCIAL DEVELOPMENT OFFICER NAKURU NORTH SUB-COUNTY		

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STAKEHOLDER CONSULTATION GUIDE

Nakuru North. Sub-County.
Coverage: Bahati, Kiamama & Kabatini locations

SUB-COUNTY / DISTRICT WATER OFFICER

Introduction

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Kindly assist by answering the following questions.

1. What is the main water source for communities living in the project area?

- Bahati Chania River - (This reduces during dry season)
- Crater Stream - (seasonal) (From Aberdares)

Water is not adequate there are complaints of inadequate especially in dry season.

2. Who are the Water Users of underground water in the Menengai area?

- No Boreholes in the area.
- Major water users are domestic and Schools. No major factories in the area hence no industrial water users.

3. Is / are there any Water Users Association for the above water resources? What are their roles with regards to management of the underground water resources?

Yes.
- Olbamita River Water Resource users association. (0721803260/0726973262)
- Major role is to protect against farming near the river and to plant wrong trees; prevent soil erosion; Also ensure nobody uses water for irrigation since the water is inadequate.

4. In the event abstraction of underground water and connections to NAWASCO supplies to meet the plants' water needs, what is the foreseen net impact of this to the

(a) Underground water resources in the area?

- No impact anticipated since the areas mentioned above do not use boreholes

(b) Community living around and using the underground water resources

N/A

5. What corrective measure should be adopted to solve or enhance the above?

N/A

6. Do you foresee any positive impacts from the proposed Geothermal Power Plant development?
   Yes or No, if yes what impacts do you see
   i. During construction

If they are going to use NAWASCO supplies / NARUWASCO
there will be no problem. However, NARUWASCO
has no adequate water since even the current
demand cannot be met
NAWASCO has three water kiosks in Mali Kumi,
Amero & Mali Saba and Kiamaina.

   ii. During operation

There will be no problem if NAWASCO supply them
with water as NAWASCO has enough water.

7. Do you foresee any negative impacts from the proposed Geothermal Power Plant development to the environment and water resources around the project area?
   Yes or No, if yes what impacts do you see
   i. During construction

NARUWASCO – Nakuru Rural Water & Sanitation Company.
NAWASCO – NAKURU WATER & SANITATION COMPANY

ii. During operation

8. If your answer No. 3 is yes, please suggest how the anticipated negative impacts can be mitigated.
   i. During construction

   ii. During operation

Water for domestic use must be treated because of high fluoride content.

Stakeholder Contacts:

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Date:	5/11/2014		
Signature:	Wawe		
Official Stamp: (if available)	DISTRICT WATER OFFICE NAKURU NORTH DISTRICT		

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UPDATING THE ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT REPORT FOR 1x30 MW MENENGAI POWER PLANT

STAKEHOLDER CONSULTATION GUIDE

WATER USERS/SERVICE PROVIDERS

NAME: NAKURU WATER & SANITATION SERVICES Co Ltd

Introduction

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We kindly request for your opinion in line with the issues noted below to facilitate the update of the ESIA Report.

1. What does your organization do?

Water Supply Provision (WSP)

2. Within the project area and areas neighboring it how many other companies conduct the businesses that require a high consumption of water?

Limited to domestic use

3. What is your opinion of the proposed Power Plant development?

Good Initiative that would enhance economic growth probably enabling lower energy cost in Manufacturing/ Production sector

4. What do you see as the net impact of this the proposed project to:

(a) Your organization

Expected to reduce power outages that are currently frequent and affecting our production capacity. Noting that our system relying on Power supply (use of Boreholes for 90% production capacity).

(b) Community living around project site

Would enable town get connected to the power grid thus facilitating improved economic activities

5. What corrective measure should be adopted to solve or enhance the above?

6. Do you foresee any positive impacts from the proposed Power Plant development?
   Yes or No, if yes what impacts do you see
   i. During construction

   ii. During operation

7. Do you foresee any negative impacts from the proposed Power Plant project to the environment and water resources around the project area?
   Yes or No, if yes what impacts do you see
   i. During construction

- The drilling process goes beyond our Aquifer layers (250 - 300m) with that of the project at 2 - 3km. In this case the care is necessary if no leakage is to be expanded from our aquifer following the Project.
- Necessary Intervention during the aquifer to prevent dissipation of high temp. — Already high temperatures have been noted at our B/Holes (33°C to 42°C).

   ii. During operation

Increase in Hydrogen Sulphide levels into the natural environment which may change the Surface water Quality and which constitutes the groundwater recharge for our Aquifer

8. If your answer No. 7 is Yes, please suggest how the anticipated negative impacts can be mitigated.

   i. During construction

- Adoption of appropriate Construction/technology
- Provision of adequate Insulation material around the entire depth of our aquifer.

ii. During operation

- Adoption of Suitable Technology to reduce the Concentration of hydrogen Sulphide
- Incorporate Adequate Safety Measures to Safeguard against accidental discharges or in cases of plant breakdown.

Stakeholder Contacts:

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Designation:	WATER PRODUCTION SUPERINTENDENT		
Locality:	NAKURU		
Date:	11. 11. 2014		
Signature:			
Official Stamp: (if available)	NAWASSCO PRODUCTION SUPERINTENDENT 11 NOV 2014 P. O. Box 16314 NAKURU		

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STAKEHOLDER CONSULTATION GUIDE

WATER USERS/SERVICE PROVIDERS

NAME: RVWSB.

Introduction

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We kindly request for your opinion in line with the issues noted below to facilitate the update of the ESIA Report.

1. What does your organization do?

Development of Water & Sanitation Infrastructure in the Rift Valley region Covering Seven Counties - Nakuru, Narok, Nyandarua, Baringo, Elgeyo Marakwet/Keiyo, West Pokot & Turkana

2. Within the project area and areas neighboring it how many other companies conduct the businesses that require a high consumption of water?

Two water service providers, NAWASCO and NARUWASCO are the major water abstractors in the project area - Serving Nakuru town and Nakuru rural/outside Nakuru town.

Once the infrastructure has been commissioned, they are handed over to WSPs. In the project area, Boreholes have been developed by RVWSB including the main pipelines to ~~the~~ Nakuru town.

3. What is your opinion of the proposed Power Plant development?

The geothermal power plant development will add more power to the national grid and reduce electricity cost.

4. What do you see as the net impact of this the proposed project to:

(a) Your organization

There have been complaints by NAWASCO of rising borehole water temperatures since GDC commissioned their geothermal wells. This has impacted operation of Borehole water pumps and Motors which have to be replaced quite often. NAWASCO is thereby incurring increased operation costs. ~~Design~~ Equipment installed can only operate within temperatures around 30°C yet increases have been recorded to 40°C

(b) Community living around project site

The emissions from the plant may affect the local communities.

Consultant informed that there is air

dispersion modelling to establish the likely extent of air pollutants and recommendation for resettlement where necessary.
- Fear of volcanic activities being stimulated by the geothermal power production works.

5. What corrective measure should be adopted to solve or enhance the above?

6. Do you foresee any positive impacts from the proposed Power Plant development?
Yes or No, if yes what impacts do you see
i. During construction

- Geothermal Power injection into the national grid is anticipated to eventually lower the cost of electricity. This will eventually lower the cost of operation. Most boreholes are pumped using electricity.

ii. During operation

7. Do you foresee any negative impacts from the proposed Power Plant project to the environment and water resources around the project area?
   Yes ✓ or No, if yes what impacts do you see
   i. During construction

If casing is not properly done, there is a risk that water in the aquifers will be drained into the fault lines or contaminated by the minerals in the steam

   ii. During operation

- Fear of cross contamination of aquifers when brine is being reinjected.

8. If your answer No. 7 is Yes, please suggest how the anticipated negative impacts can be mitigated.

   i. During construction

Properly designed and controlled drilling process to ensure no contamination of aquifers

ii. During operation

- Reinjection wells should be encased to prevent any potential contamination of borehole aquifers.

Ensure that brine is pretreated before reinjection or disposed of safely.

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Locality:	NAKURU		
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UPDATING THE ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT REPORT FOR 1x30 MW MENENGAI POWER PLANT

STAKEHOLDER CONSULTATION GUIDE

INTERVIEW GUIDE

WATER RESOURCES MANAGEMENT AUTHORITY – Rift Valley Catchment Area

Introduction

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We kindly request for your opinion in line with the issues noted below to facilitate the update of the ESIA Report.

1. What is the main water source for communities living in the project area (Bahati, Kiamaina, Kampi Ya Moto and Ngata divisions)?

Boreholes – Groundwater and some Surface water supplied by NAKWASCO.

2. Who are the major users of water in the area?

The general public for domestic purposes and minor irrigation.

3. Is / are there any Water Users Association for the above Water Resources? What are their roles with regards to management of the water resources?

Crater Stream WRUA. The roles of the WRUA are: being integrally involved in mgt of water resources, undertaking water resource mgt activities that serve their best interest (eg surveillance on illegal or harmful activities, adoption of best land use & catchment management activities etc).
In more efficient (with respect to the WRMA) for the WRUA to mobilize the water users to solve problems at the grassroots level.

4. In the event abstraction of underground water and connections to NAWASCO supplies to meet the plants' water needs, what is the foreseen net impact of this to the

(a) Underground water resources in the area?

If the plant depends solely on groundwater pumped from the area there are possibilities of depleting or over abstracting from the aquifer
- It will also affect water supply for the local communities also.

(b) Community living around an using the identified water resources

The people living in the area might be occasioned to inadequate water supplies which might result to rationing.

5. What corrective measure should be adopted to solve or enhance the above?

Along side the underground water supplies, alternative sources should be sought like storage for rain harvesting. or alternative surface water supplies.

6. Do you foresee any positive impacts from the proposed Power Plant development?
   Yes or No, if yes what impacts do you foresee

   i. During construction

Yes - There will be jobs created for the locals. It will also come with development of other Social amenities

   ii. During operation

- It will boost the economy of the area hence development.
- Social amenities will be developed in the area

7. Do you foresee any negative impacts from the proposed Power Plant development to the environment and water resources around the project area?
   Yes or No, if yes what impacts do you see

   iii. During construction

- The construction of the plant will lead to destruction of natural environment ie forests
- It will affect groundwater recharge as the surfaces get covered by concrete.

iv. During operation

- The increase in population in the area is likely to have pressure on the available water resources and other environmental resources.
- Incoming of new people (outsiders) will affect the lives of the locals.

8. If your answer to No. 7 is Yes, please suggest how the anticipated negative impacts can be mitigated.
   i. During construction

- The destruction of the environment should be minimal. There should also be plans to restore the natural environment as it was.
-

ii. During operation

- Alternative sources of water should be developed to cater for the increased population.
-

9. What been the trend of underground water levels in the project area?

- The trend in underground water in the area has been steady the area has a good groundwater potential so it has not been over exploited

10. Will the commissioning of the power plant impact the above? And what are your proposals with regards to this?

- It is likely that the commissioning of the power plant will be accompanied by population explosion which will increase water demand hence strain the available resource.
- Alternative sources of water ought to be thought about to reduce dependancy on ground water.

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STAKEHOLDER CONSULTATION GUIDE

SUB-COUNTY MEDICAL OFFICER OF HEALTH/PUBLIC HEALTH OFFICER — RONGAI

Introduction

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Kindly assist by answering the following questions.

1. What are the top ten common illnesses within the Sub-county / District specifically the project area that is Bahati/Ngata/Kampi Ya Moto divisions?

① URTI
② Diarrhoea
③ Pneumonia
④ Skin diseases
⑤ Rheumatic Joint pains.
⑥ Typhoid
⑦ Eye infection
⑧ Malaria
⑨ Hyper tension
⑩ Chicken pox

2. What is the doctor patient ratio in the Sub County / area?

~~1:250~~ 1:19,000

3. What are the HIV/AIDS prevalence rates in Nakuru North/Rongai Sub County? 5.3%

This reflects the Prevelance of the entire County.

4. What initiatives are in place to mitigate the spread of the above illnesses?

- Programmes on promotion of behaviour change across board
- Programmes on Prevention with positives - targeting support groups
- Improvement of quality of life to PLWHAs through empowerment in IGAs
- Condom use promotion.

5. Which is the most vulnerable group to HIV/ AIDS infections?

- Sex workers in Urban Set ups.
- Women working in large firms & establishment eg flower farms, estate
- Orphan and Vulnerable Children, widows & PLWHAs.

6. What health programs does the department have to deal with

a. HIV/AIDs menace?

- Supporting the Community to own the above Programmes/Projects.
- Organize mobile HTC Outreaches
- Strengthening Referral systems for HIV positive Clients.

b. TB

(i) Diagnosis and Treatment.
(ii) Contact Tracing
(iii) Defaulter Tracing
(iv) Health Education on Infection/Prevention Control.

c. Vaccination

- Community mobilization.
- Health Education.

7. What is the number of health facilities available in the divisions? What are the categories and distribution?

5 - Health centres.
14 - Dispensaries.
10 - Others:
- Private
- F.B.O (Faith based).

8. What are the services offered in the health facilities near the project area?

- Curative services
- Immunization.
- Preventive / Promotive services
- Post / Ante-natal services.

9. Do you foresee any positive impacts from the proposed 1x30MW Geothermal Power Plant development?
   Yes or No, if yes what impacts do you see
   i. During construction

- Employment
- Improvement of infrastructure - Roads to and from the site.

   ii. During operation

- Employment.
- Construction/setting up of shopping centres
- Power generation.

10. Do you foresee any negative impacts from the proposed Geothermal Power Plant development?
    Yes or No, if yes what impacts do you see
    i. During construction

    ii. During operation

11. If your answer No. 10 is Yes, please suggest how the anticipated negative impacts can be mitigated.
    i. During construction

ii. During operation

Stakeholder Contacts:

Name:	EZEKIEL K. TERER.		
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Organization Represented:	MINISTRY OF HEALTH.		
Designation:	Sub-County Public Health Officer (SCPHO).		
Locality:	RONGAI		
Date:	21/11/2014		
Signature:			
Official Stamp: (if available)	RONGAI SUB-COUNTY HEALTH OFFICE 21 NOV 2014 Sign..... P.O. BOX 17643 NAKURU		

GDC
Powering the Vision

GIBB International
CONSULTING · DESIGN · MANAGEMENT

UPDATING THE ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT REPORT FOR 1x30 MW MENENGAI POWER PLANT

STAKEHOLDER CONSULTATION GUIDE

SUB-COUNTY / DISTRICT WATER OFFICER ROMGAI

Introduction

GDC has entered into an agreement with Quantum Power East Africa (QPEA) GT Menengai Limited as one of the Independent Power Producers for Menengai Geothermal Power Plants. QPEA is applying for funding from international lenders to finance the development of the proposed 1x30MW power plant. One of the expected pre-requisites to funding is compliance with the specific lender's environmental and social safeguards. Based on the findings of the preliminary review and gap analysis of the existing project Environmental and Social Impact Assessment (ESIA) report, Licence from NEMA and Environmental and Social Management Plan (ESMP) it was determined that for the project to comply with MDBs and IFIs requirements, additional inputs to the Report will be required.

To achieve this QPEA which is to implement the project on behalf of GDC has contracted GIBB Africa to update the project ESIA and where necessary, undertake RAP to mitigate on impact on property.

The aim of this study is to collect information at household and institutional stakeholders for the purposes of impact analysis and development of mitigation measures.

Kindly assist by answering the following questions.

1. What is the main water source for communities living in the project area?

- Boreholes are the main water sources in Kampi ya Moto and Kiamunyi
Other parts of the Sub county get water from Rongai River, Constructed pans/dams.

2. Who are the Water Users of underground water in the Menengai area?

Farmers — residential and livestock

3. Is / are there any Water Users Association for the above water resources? What are their roles with regards to management of the underground water resources?

The area is covered under MARUWASCO However, the current water supplies are provided through community-based water projects.

4. In the event abstraction of underground water and connections to NAWASCO supplies to meet the plants' water needs, what is the foreseen net impact of this to the

(a) Underground water resources in the area?

There is likely to be pressure on existing community water supplies.

(b) Community living around an using the underground water resources

5. What corrective measure should be adopted to solve or enhance the above?

- GDC and IPP should monitor their impacts of their activities on water supply to the community.
- There should be a link between the community and GDC eg to facilitate regular meeting with water users and service providers.

6. Do you foresee any positive impacts from the proposed Geothermal Power Plant development?
   Yes ✓ or No, if yes what impacts do you see
   i. During construction

- Can affect environment through emission of smoke and dust. Can lead to respiratory related diseases
- Creation of employment to the community
- Community benefits from community water supply

   ii. During operation

- Increased power supply to the national grid hence Reduced power interruptions.
- Eventual reduction of power cost, further improving living standards and industrial production.
- Cost of living will come down.

7. Do you foresee any negative impacts from the proposed Geothermal Power Plant development to the environment and water resources around the project area?
   Yes or No, if yes what impacts do you see
   i. During construction

ii. During operation

- Likelihood of environmental degredation if the resultant waste is not handled with Care. This can lead to water pollution.
- Noise pollution from plant operations

8. If your answer No. 7 is yes, please suggest how the anticipated negative impacts can be mitigated.
   i. During construction

- Necessary precautions be put in place to manage emissions of smoke and dust

ii. During operation

Precautionary measures on waste management

Stakeholder Contacts:

Name:	NICHOLAS KIMANYWA		
Contacts:	**Tel:** 0722465644	**Mobile:**	**e-mail:** NICKimanya@yahoo.com
Organization Represented:	WATER DEPARTMENT - RONGAI SUB-COUNTY.		
Designation:	SENIOR CLERICAL OFFICER		
Locality:	KAMPI YA MOTO		
Date:	22-11-2014		
Signature:			
Official Stamp: (if available)	RONGAI SUB COUNTY WATER OFFICER P.O. BOX 179-77 NAKURU		

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UPDATING THE ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT REPORT FOR 1x30 MW MENENGAI POWER PLANT

STAKEHOLDER CONSULTATION GUIDE

NON GOVERNMENTAL ORGANIZATIONS AND CBOs

Introduction Friends of Menengai Crater (FOMEC) 10/11/14

GDC has entered into an agreement with Quantum Power East Africa (QPEA) GT Menengai Limited as one of the Independent Power Producers for Menengai Geothermal Power Plants. QPEA is applying for funding from international lenders to finance the development of the proposed 1x30MW power plant. One of the expected pre-requisites to funding is compliance with the specific lender's environmental and social safeguards. Based on the findings of the preliminary review and gap analysis of the existing project Environmental and Social Impact Assessment (ESIA) report, Licence from NEMA and Environmental and Social Management Plan (ESMP) it was determined that for the project to comply with MDBs and IFIs requirements, additional inputs to the Report will be required.

To achieve this QPEA which is to implement the project on behalf of GDC has contracted GIBB Africa to update the project ESIA and where necessary, undertake RAP to mitigate on impact on property.

The aim of this study is to collect information at household and institutional stakeholders for the purposes of impact analysis and development of mitigation measures.

Kindly assist by answering the following questions

1. What activities does the organization involve itself in?

- Support 35 Community Based Groups in undertaking various initiatives covering development and Environment.
- Environmental initiatives cover: planning
  - Education and awareness
  - Conservation

2. What geographical areas do the operations of the NGO / CBO cover?

Entire Menengai area and immediate neighborhoods

3. What projects have you undertaken in the project area

Environmental monitoring in partnership with GDC through an agreement

Development projects include: Soil & water Conservation
~~Tree Nursery~~ • bee keeping
• dairy goats and
• Energy Conservation (adoption of energy conserving devices

4. What projects are you currently running in the project area?

- Monthly Biannual environmental monitoring in Menengai Caldera focusing on existing geothermal wells and associated operations in drilling works.
- Biannual monitoring of birds (April & August) coordinated with Nature Kenya, KFS

5. What challenges do you face in the implementation of past projects?

- KFS has inadequate capacity at the Menengai forest station and cannot stem ~~existing~~ existing challenges of illegal wood collection, illegal grazing and charcoal burning within the Caldera

6. What lessons were learnt in the past projects with regard to the involvement of community, specifically in the project area?

- Training of casuals on forest fire management is necessary to help manage this common phenomenon.

7. What is the organizational structure of the organization highlighting roles of each person? And how many staff do they have?

- Board of Trustees
- Chairman
- Secretary
- Office Staff

Secretariat

8. What are the socio-cultural norms regarding the gender division of labor, rights and responsibilities, access to and control over resources in the project area?

9. In your opinion, what is the community perception on the proposed Geothermal Power Plant in the area?

Engagement of GDC in raising tree seedlings for sale and own planting is killing local groups engaged in the same. Instead, GDC should buy seedlings from local groups engaged in tree nursery business.

10. Are you aware of any sites of historical / archaeological importance in the project area?

Yes there are sacred caves within the Caldera which are regularly patroned by a traditional/local seats. These (pictures show) should be preserved.

11. In case proposed to assist in oversight of direct implementation of the project, is the organization in a position to take part? If NO, why

Yes

12. Do you foresee any positive impacts from the proposed Geothermal Power Plant development?

✓Yes or No, if yes what impacts do you see

i. During construction

ii. During operation

- GDC had experimental plots for agricultural production for brine. These should be enhanced.
- Positive reserve harnessing for clean power production

13. Do you foresee any negative impacts from the proposed Geothermal Power Plant development?
Yes ✓ or No, if yes what impacts do you see

iii. During construction

- Power plant staff will add pressure on already existing bad waste management system within the Caldera
- Use of poor quality brine sump lining materials which later break down
- Improper waste management. This has been rampant in the GDC operations, eg. waste oil & spillages

iv. During operation

- Erosion from accidental brine spillage. Current activities have also opened up the area to livestock keepers and has led to - over grazing in the area, promoting erosion.
- devegetation
- Uncontrolled leakages from GDC pipelines also attract livestock. These have led to community who initially ~~sold~~ cut & sold grass from the Caldera losing out.
- Poor quality of sump lining materials have been used leading to pollution &

14. If your answer No. 13 is Yes, please suggest how the anticipated negative impacts can be mitigated.

i. During construction

- IPPs should know that pollution is a real issue in Menengai and proper waste management should be instituted
- Some impacts could be localised ~~to~~ but exposed workers need adequate protection measures eg. ~~ear~~ against noise, dust and smell

ii. During operation

- At times, smell of H_2S could be felt in Kiamunyi area and serious study should be done and people informed truthfully of the findings. Mitigation measures should be very specific
- Recommend independent audits on environmental concerns

- Light pollution will especially affects insects survival. Light attract many insects which are then killed by heat.
- Recommend an Environmental Emergency Management Plan to arrest/manage any accidental spillage & ~~es~~ associated erosion in a timely manner

15. Please include any other comments you may have below

- Following own review of the existing ESIA study report currently under updating, alot of information was borrowed from audit reports of 2012 and covers wells 4, 8, 6, 1, 7 & 3 but was not specific to the proposed powerplant site near well 11. The information provided should be site-specific including identification of species and their conservation status and endimicity.
- Need to create awareness among the communities especially on likely exposure to burst brine pipes and sump linings.
- Assist KFS to put a well equipped outpost within boundary of the Caldera.

Stakeholder Contacts:

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Organization Represented:	FRIENDS OF MENENGAI		
Designation:	CHAIRMAN		
Locality:	NAKURU		
Date:	10/11/2014		
Signature:	FRIENDS OF MENENGAI CRATER P. O. Box 13493-20100 NAKURU, KENYA TEL: 0712-165699, 0725-777475 0720-703606 Email: info@friendsofmenengai.org		
Official Stamp: (if available)			

Consultation Meeting with KFS, Menengai Forest Station on 11 November 2014 at Menengai Forest offices, Nakuru

Attendance

James I. K. Mbuthia-	Forest station manager, Menengai forest
Aggrey Kwadha	Environmentalist, Gibb Africa Ltd

Introduction and Project brief

After introduction, the consultant gave a brief on the proposed project in two broad areas as follows:

- Energy sector players involved in the Menengai geothermal power production and their roles including GDC, Independent Power Producers (Quantum Power EA, Ormat and Sosian), KETRACO and Kenya Power ; and
- Description of the proposed power plants including installation of turbines and generators, connection via surface pipeline networks to the existing GDC production wells, generation of 30-35MW of power for connection to the national grid and reinjection of brine from into the underground.

Forest species of Menengai

The available information on the forest is mainly on plantation species which include Eucalyptus, Pine, Cedar and *Acacia mearnsii.*
Little information is available on indigenous trees within the caldera section of the forest. History has it that natural vegetation if of tropical savanna type. The caldera area has also not been under any strict protection before due to earlier lack of economic value attached to it. This exposed it to unchecked firewood collection, charcoal burning and grazing (especially by the Maasai communities for quite a long period)

Forest management plans

Currently, KFS is embarked on formulation of Participatory Forest Management Plan for the entire forest station including the caldera. This will form the basis on how the caldera site will be considered for future vegetation development and GDC is one of the stakeholders apart from the local communities. We foresee a situation where all the stakeholders will complement one another through a project implementation committee

Challenges

The area is naturally prone to wildfires (even in the absence of human interventions like charcoal burning). This implies that even any indigenous vegetation survival is difficult due o the natural conditions: stony surfaces and low water retention capacity, making dry vegetation a good conduit for wildfires.

Electric fencing of all forest areas (both plantation and in the caldera) should be enforced together with conditions limiting entry and controlling grazing. The surrounding communities currently access the forest area from any point leading to overgrazing. Part of Menengai forest association will allow grazers to be identified

Likely impacts

During construction:

No major impacts are anticipated since the area for the power plant development is very small

Element of overexposure to degradation is very minimal and with proper management, the area can be suitable for reclamation via massive tree planting. Promoting rejuvenation of natural vegetation should be done through self adaptation by planting of exotic trees species considered suitable for various management aims e.g.

- *Croton megalocarpus*- suitable for direct seeding
- Mexican greenash, Fraxinus valarman- fire resistant
- *Cassia semae* not preferred by livestock
- *Acacia melanoxylon*- easy propagation by seeds
- *Markhamia lutea*- wide dispersal characteristic
- *Acacia mearnsii*- propagation enhanced by fire
- *Psidium guajava*- wild fruits

These species will improve the diversity of flora and fauna, increase biomass production and benefit the local community through firewood and livestock forage

During operation:

- Any transmission line must be cleared of vegetation. The existing vegetation is mainly shrubs and therefore limited clearance is expected only for pylon sites
- Participatory Forest Management Plan (PFMP) advocates for management of areas on sustainable yield basis and hence no adverse impacts are expected
- Introduce fruit trees like *Psidium guajava*, to contain monkeys and baboons and reduce existing huma-wildlife conflicets with farmers.
- Pollution related issues are expected to be managed by the expertise available at GDC

Compiled by Aggrey Kwadha

Consultation Meeting with Nakuru Water and Sanitation Services Company (NAWASCO) on 11 November 2014 at NAWASCO offices, Nakuru

Attendance

James N. Gachuthi	Managing Director
Aggrey Kwadha	Environmentalist, Gibb Africa Ltd

Introduction and Project brief

After introduction, the consultant gave a brief on the proposed project in two broad areas as follows:

- Energy sector players involved in the Menengai geothermal power production and their roles including GDC, Independent Power Producers (Quantum Power EA, Ormat and Sosian), KETRACO and Kenya Power ; and
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Comments

NAWASCO sources water supply from Olbanita boreholes near the Menengai geothermal fields. Since GDC commissioned its geothermal wells, NAWASCO has been recording increased borehole water temperatures. Though the Olbanita area is under the jurisdiction of Nakuru Rural Water and Sanitation Company (NARUWASCO), NAWASCO has supply points along its transmission line as part of its CSR to the community from which its gets water. The hot water cannot be used for livestock and to directly meet some of domestic water needs that do not require hot water. NAWASCO has received complaints from its customers and has also had to frequently replace the borehole pumps and motors since the installed Borehole pumps and motors can only operate well in temperatures less than 30^{o}C. This has led to increased maintenance and operation costs.

The MD informed the consultant that the issue of increased boreholes water temperature has been raised with GDC who promised to undertake studies and share feedback.

Other concerns

There is fear that borehole water levels may be lowered to deeper aquifers since the geothermal wells have been sunk deeper than boreholes
Quality of environment may deteriorate from hydrogen sulfide gas and associate acid rain. This may corrode exposed water infrastructure like air valves, sluice valves and metallic pipelines

Aggrey informed the respondent that part of the study entail air modeling which will be able to predict likely concentrations levels of the hydrogen sulfide gas and inform formulation of appropriate mitigation measures.

Follow up

The Managing director referred the consultant to Production Superintended for further consultations. This was done and a questionnaire duly filled is separately attached.

Compiled by Aggrey Kwadha

Notes of meeting with Youth Development Officer, Ministry of Devolution and Planning, Planning department held on 5 November at Ministry offices in Bahati town, Nakuru North Sub County

Attendance

1. Keziah Mwaura – Youth Development Officer, Nakuru North Sub County
2. Mary Wambui – Secretary, Youth Development Office, Nakuru North Sub County
3. Aggrey Kwadha – Environmentalist, GIBB Africa Ltd

Project brief

After introduction, the consultant gave a brief on the proposed project in two broad areas as follows:

- Energy sector players involved in the Menengai geothermal power production and their roles including GDC, Independent Power Producers (Quantum Power EA, Ormat and Sosian), KETRACO and Kenya Power ; and
- Description of the proposed power plants including installation of turbines and generators, connection via surface pipeline networks to the existing GDC production wells, generation of 30-35MW of power for connection to the national grid and reinjection of brine from into the underground.

Activities in which the area youth are involved include:

Small microenterprises e.g. shops, motorcycle taxi *boda boda* (mainly by males), table banking, farming, quarry activities, IT and value addition in farming through hatching eggs and running posh mills.

Major issue with the area youth is unemployment. Youth have inadequate access to youth-friendly funding/credit

The area youth are considered vulnerable group. Though they constitute the majority, majority are unemployed and lack technical skills. With time, there will be a youth bulge.

Current activities by the youth department to support youth include capacity building in entrepreneurship and life skills, Uwezo fund, youth funds and creation of awareness on the 30% government procurement allocated to the women and youth.

Likely Impacts of the project

- With the project, the area youth will benefit if given a chance since unemployment common in the area
- However, there have been issues between GDC and local youth on employment. The youth claim that they have not been given enough opportunities, especially on casual labour, yet the project is within their area. In meetings the department has attended with the youth, they claim that thy also have educated locals and that a certain percentage of positions should be allocated to the locals

Recommendations

- If the local youth feel represented in the development activities, they will continue to appreciate the project. However, a problem will arise when they feel short-changed;
- When allocating jobs, it should be done based on the local administrative units for a feeling of well and fair representation; and
- GDC and Independent Power developers should liaise with the local department of youth affairs whenever engaging the youth as opposed to the youth themselves inviting the department.

Compiled by Aggrey Kwadha

Notes of Meeting with Olbanita Water Resource Users Association (Olbanita WRUA) held at their Office in Bahati town on 7 November 2014

Attendance

1. Peter Waweru Mwangi -Chairman
2. Jethro Karanja Isaac - Treasurer
3. Joseph Mwangi - Ass. Secretary
4. Aggrey Kwadha – Environmentalist, GIBB Africa Ltd

Signed attendance list is attached

Project brief

After introduction, the consultant gave a brief on the proposed project in two broad areas as follows:

- Energy sector players involved in the Menengai geothermal power production and their roles including GDC, Independent Power Producers (Quantum Power EA, Ormat and Sosian), KETRACO and Kenya Power ; and
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Roles of Olbanita WRUA

- Management of all rivers and underground water resources in Nyandarua catchment area drained by Olbanita River and its tributaries up to its confluence with Molo river. Areas covered include both Nakuru North and Rongai sub counties and measures approximately 263 km2;
- Facilitate permit acquisition by water users in liaison with WRMA;
- All consumers, projects and large scale farmers and institutions within the area should be members of the WRUA. Current membership for both individuals and institutions stands at 120. Membership registration fee is KSh 1000 and Ksh 15,000 for individuals and institutions respectively.

Current issues affecting Olbanita WRUA

- There are inadequate water storage tanks for water from rivers, the main sources of water in the rural areas under Olbanita WRUA;
- Available underground water has problems with high fluoride content and requires to be blended with river water (from Olbanita River) for improved quality like it is done with borehole water supplies to Nakuru town with water from Malewa river in Gilgil;
- Sometimes, boreholes production in Wanyororo, Banita and Ndugiri reduce in dry seasons. These areas thus face water problems and need assistance;
- Pollution of water resources is common at the catchment due to farms in upstream areas but not in the lower areas like near the proposed power plants site. Recommend that NAWASCO liaises with Olbanita WRUA to blend the water supplied by NAWASCO to the locals to improve its quality and hence health among the locals

Likely Impacts of the project

- We do not foresee any problem with the implementation of the proposed geothermal power plants since the resources used will be mainly underground-based.

Concerns

- The project might also lead to increased school dropout cases which is common in the area;

Questions asked

- Since the project is in our area, how will the local community and Olbanita WRUA benefit from it?
- The consultant responded that the local community already enjoys some water supply from NAWASCO following arrangements made by GDC as a CSR. GDC has contributed through community water tanks which facilitate local water supplies.

Recommendations

- GDC and partners should always invite Olbanita WRUA to any stakeholders meetings with the locals, especially on water resources management and all should register with the WRUA to promote management of water resources in the area;
- GDC and partners should consider putting up a water storage tank for Olbanita WRUA to facilitate supplies;
- There are many unemployed youth in the area that can benefit from the project. These include drivers, electricians who should be considered for employment in the power plant construction and operation

Compiled by Aggrey Kwadha

Notes of Meeting with Education Officer, Nakuru North Sub County Ministry of Education, held at Maili Sita on 7 November 2014

Attendance

1. William Kodeny – Education Officer, Bahati Zone, Nakuru North Sub county
3. Aggrey Kwadha – Environmentalist, GIBB Africa Ltd

Project brief

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Educational institutions within the project area in Nakuru North sub county

Educational institutions are organised into zones. The zones in the area covered by the project are Bahati and Solai zones. The number of various institutions and enrolment by third term (as at November 2014) are as indicated below.

Category	No.	Students			Teachers		
		M	F	Total	M	F	Total
Public ECD	24						
Private ECD	45						
Public Primary	20	7469	7363	14832	117	276	393
Private Primary	45	1538	1899	3437	109	112	221
Public Secondary	16						
Private Secondary	16						
Tertiary (Public Polytechnic)	1						

Likely positive Impacts of the project

- Quite a number of youth in the area are jobless. This makes them go into crime at very tender age. Using guns in robberies is common in the area including theft of books in schools. Most of the youth are likely to seek employment in the power plant project thereby reducing this menace. Alcoholism is also common among the local youth;
- The project is likely to enhance eco-tourism around Menengai. This is a new concept that is being adopted in the area;
- In the long run, schools in the locality will benefit through:
    - Parents who have employment
    - Schools working with GDC and power producers as in the case in Naivasha e.g. through supply of tree seedlings by GDC;
    - GDC will bring in other players e.g. in road development which improves access to the schools

Concerns

- Existing quarries in the area have caused problems in Kagoto primary school. When blasting, cracks have developed in the school buildings and even a fatal accident from

blasted rocks involving a pupil in the school has been reported. There is a new Heshima secondary school with a storey building next to the Kagoto primary school. Due to fears on structural failure from cracks caused by blasting at the quarries, it has led to use of very stringent quality standard materials which are very costly. Further, the cost of maintaining the institutional buildings is his high. These are likely to increase if the project sources materials from these quarries;

- The consultant however informed the respondent that in such projects, use of materials from NEMA licensed quarries is usually recommended and whenever the contractor has to establish a new quarry, a separate ESIA is usually undertaken;
- The project might also lead to increased school dropout cases which is common in the area;
- Bahati has fertile land but over the years, increased sub divisions and sale has occurred with people moving to Nakuru town after selling their lands. There are many single mothers in the area most of whom leave their homes in the evening to move to town. The project may switch this movement to town and instead encourage spread of HIV/AIDS locally;

Recommendations

- The whole Bahati Zone and even Nakuru North Sub County has no educational/social hall within which educational functions can be conducted. This is an area where GDC and partners can consider to support local education in addition to facilitating tree planting in the schools; and
- Ensure strict observation of labour laws to ensure that children remain in school with the help of local leaders.

Compiled by Aggrey Kwadha

Notes of Meeting between Agricultural Officer of Nakuru North Sub countyand GIBB International held on 4 November2014 atthe Sub County AgricultureOffices, Bahati

Attendance

Peris N. Ngatho - Deputy Sub County Agriculture Officer, Nakuru North Sub County
Aggrey Kwadha - Environmentalist, GIBB Africa Ltd

Introduction and Project brief

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Agricultural activities in Bahati and Kiamaina divisions

Within the areas in Menengai crater, Kiamaina, Kabatini and Engarusha the key agricultural activities include:

- Planting of cereals (mainly beans and maize) and potatoes
- Livestock husbandry in small scale levels
- In Ndugiri, farmers grow Mangoes, paw paws, Butternuts, coffee, potatoes and tubers (cassava, sweet potatoes and yams).

Average farm sizes and prices

- Average farm size in these areas is 1.5 acres but in Wanyororo, there are farms less than .25 acres in size
- Average land price ranges between KSh 250,000 to 300,000 per acre

Issues facing farming in the area

- There is an outbreak of Maize Lethal Necrosis Disease (MLND) in the Rift Valley region. The disease is multi-viral but spread by insects. Farmers are currently being encouraged to do crop rotation and not to do maize crops in successive seasons, instead plant tuber crops like potatoes
- There are challenges of soil erosion in the area
- Soil tests carried out country-wide in 2013 established that soils in Nakuru North area are acidic attributed mainly to over use of DAP fertilizers. It is recommended that farmers use NPK instead.

Positive Impact due to the Geothermal Power Plants Project

- Will bring development of infrastructure which will improve marketing of agricultural produce and even improve prices;
- Employment opportunities created through the plants will reduce incidences of unemployment and alcoholism in the area which even affect agriculture
- The ministry hopes to have well-endowed stakeholders within the area including GDC which will boost agricultural activities as well

Concerns raised by the Agricultural officer

- If hydrogen sulfide (H_2S) is not contained, it will affect crops and also contaminate soils by making it more acidic;
- Quarries within the project area have been associated with structural issues affecting houses and masonry tanks through development of cracks. E.g. the Kagoto quarry next to Kagoto primary school; and
- Farmers in Menengai crater area (Kiamaina division) have already complained of acidic rain affecting their roofs and crops and that the rain water harvested from roof catchments is yellow and cannot be used

Recommendation

- Proper management measures should be put in place to avoid soil and water pollution

Compiled by Aggrey Kwadha

Consultation Meeting with Directorate of Occupational Safety and Health, on 10 November 2014 at DOSH offices, Nakuru town

Attendance

SYLVIA GITONGA-	Principal Occupational Safety and Health Officer, DOSH
Aggrey Kwadha	Environmentalist, Gibb Africa Ltd

Introduction and Project brief

After introduction, the consultant gave a brief on the proposed project in two broad areas as follows:

- Energy sector players involved in the Menengai geothermal power production and their roles including GDC, Independent Power Producers (Quantum Power EA, Ormat and Sosian), KETRACO and Kenya Power ; and
- Description of the proposed power plants including installation of turbines and generators, connection via surface pipeline networks to the existing GDC production wells, generation of 30-35MW of power for connection to the national grid and reinjection of brine from into the underground.

Comments

- DOSH enforces Occupational Safety and Health Act (OSHA), 2007
- In case of mishaps/accidents, DOSH also enforces Workers Injury and Benefits Act (WIBA). Currently a process is underway to review WIBA into Workers Injury compensation Act (WICA).
- Registration of work place, ensuring workers is safe, have well access to work and are trained and instructed on safety
- GDC is registered with DOSH and is regarded as the occupier of the Menengai power plant site. It is an occupier's responsibility to ensure that any contractors adhere to its safety and health policy
- The department conducts routine inspection of workplaces.

Compiled by Aggrey Kwadha

Consultation Meeting with Director-Environment, Nakuru County Government on 13 November 2014 at Nakuru County Government offices, Nakuru

Attendance

Timothy K Murithi	Director-Environment, Ministry of Environment, Natural Resources, Energy and Water
Aggrey Kwadha	Environmentalist, Gibb Africa Ltd

Introduction and Project brief

After introduction, the consultant gave a brief on the proposed project in two broad areas as follows:

- Energy sector players involved in the Menengai geothermal power production and their roles including GDC, Independent Power Producers (Quantum Power EA, Ormat and Sosian), KETRACO and Kenya Power ; and
- Description of the proposed power plants including installation of turbines and generators, connection via surface pipeline networks to the existing GDC production wells, generation of 30-35MW of power for connection to the national grid and reinjection of brine from into the underground.

Comments

The Nakuru county government embraces the project.

There is a wide stakeholder's consortium recently constituted by the county government which brings together various government agencies and private businessmen in Nakuru County. GDC is already a member of this stakeholders group. The county director of environment is the chairman of this group but it is yet to hold its first meeting. This group will facilitate communication sharing among the various development partners in the county. The other members include:

- County director of environment-Chairman
- MCA in the county environment committee
- Other county directors
- Kenya Forest Service
- Water Resources Management Authority
- Nakuru Business Association
- LENAMADUBA, an NGO

The county government will also help a lot in ensuring that the project implementation conforms to the approved ESMP

The project will attract more investment into Nakuru County

It will also create more employment and investment opportunities for people in Nakuru County.
Other concerns

Concerns

The initial ESIA report was not shared with the county government of Nakuru as one of the lead agencies for comments. However, it was noted that the first report was done in 2012 when the county government was still not in place. The consultant agreed to share the report under update via mail.

Compiled by Aggrey Kwadha

Consultation Meeting with state Department of Agriculture, Rongai Sub County on 17 November 2014 at Ministry of Agriculture offices, Kampi Ya Moto

Attendance

Lynnette Echessa	Chief Agriculture Officer, Rongai Sub County
Aggrey Kwadha	Environmentalist, Gibb Africa Ltd

Introduction and Project brief

After introduction, the consultant gave a brief on the proposed project in two broad areas as follows:

- Energy sector players involved in the Menengai geothermal power production and their roles including GDC, Independent Power Producers (Quantum Power EA, Ormat and Sosian), KETRACO and Kenya Power ; and
- Description of the proposed power plants including installation of turbines and generators, connection via surface pipeline networks to the existing GDC production wells, generation of 30-35MW of power for connection to the national grid and reinjection of brine from into the underground.

Comments

Agricultural activities in Kampi Ya Moto and Soin divisions/wards

Small scale farmers

- Food crops production: maize, beans and drought tolerant crops like cassava, sweet potatoes, sorghum and millet
- Small scale Livestock and poultry keeping
- Average farm sizes- 2 acres

Large scale farmers

- Grow wheat, canola (oil crop), sunflower and sisal plantations
- Fodder production – mainly Rhodes grass and practice conservation agriculture
- Average farm sizes- 1,000 acres

Current key issues affecting crop production in the area

- Pests and diseases, mainly Maize Lethal Necrosis Disease (MLND)
- Poor market prices
- Erratic weather patterns
- High input prices
- Poor infrastructure

Concerns on the proposed power plant project

- GDC already has plans to set up a warehouse and offices outside the caldera. This will likely reduce land available for agriculture. GDC has been buying land from farmers
- Labor used in the farms is mainly from young people. The project may reduce labor available to farmers and increase the labor cost
- Erosion from trucks moving to and from the project site
- Social issues: increased incidence of HIV/AIDS as experienced in Rongai flower farms
- What kind of pollution is likely from the project? Pollution from acid rain is likely to impact crops while that of underground aquifer will impact people since most people in the area rely on borehole water

Potential positive impacts

- Power plants workers will provide ready market for food (farm produce). Local farmers can benefit from increased capital for crop production
- Increased power availability will increase crop production e.g. via irrigation

Recommendations

- Developers should have a CSR activity for the community like tree planting, promoting 4K clubs and soil conservation activities

Compiled by Aggrey Kwadha

Notes on Consultative Meeting with KWS on 14 November 2014 at KWS offices, Nakuru

Attendance

Christine Mwinzi	Researcher, KWS, Rift Valley Region
Aggrey Kwadha	Environmentalist, Gibb Africa Ltd

Introduction and Project brief

After introduction, the consultant gave a brief on the proposed project in two broad areas as follows:

- Energy sector players involved in the Menengai geothermal power production and their roles including GDC, Independent Power Producers (Quantum Power EA, Ormat and Sosian), KETRACO and Kenya Power ; and
- Description of the proposed power plants including installation of turbines and generators, connection via surface pipeline networks to the existing GDC production wells, generation of 30-35MW of power for connection to the national grid and reinjection of brine from into the underground.

Comments

The project area is not protected by KWS but known to be inhabited by small mammal like vervet monkeys and baboons. Leopard's presence cannot be ruled out due to their hunting behavior.

Detailed comments can be given after site visit. GDC contacts were shared with the KWS officer to allow KWS make arrangements for site visit

Compiled by Aggrey Kwadha

Aggrey Kwadha

From: jackson@friendsofmenengai.org
Sent: Tuesday, November 11, 2014 12:53 PM
To: Aggrey Kwadha
Cc: jraini2002@yahoo.com
Subject: Comments on the 2013 Menengai 30x3 MW Modular Power Plant

Dear Aggrey,
It was a pleasure meeting with you yesterday. As promised, pls see below some of the comments we raised with GDC regarding the proposed power plant project:.

Dear Mr. Kubo,
FOMEC received a hard copy the "Upgraded Study Report- for the Proposed Installation of 3x30MWe Menengai Modular Power Plants Projects in Nakuru County".

I was surprised that the EIA was submitted to NEMA in September 2013, by the ESIA team from the University of Eldoret; presumably the same team of experts that conducted the Environmental audit for Year 2012 (NEMA/NKR/EA/1796).

However, concerns are as follows:

1. The ESIA team seems to downplay some of the environmental impacts that a project would have. It is clear that the EIA project report weaved its way through the NEMA review process without much scrutiny or critical review.

2 Much of the information contained in Chapter 1 to 4 and the appendices is copied material artfully disguised as new. The major cut & paste job is from the initial ESIA and the EA conducted by the ESIA team from the University of Eldoret in 2012. For example, information on Biological Environment -Page 24 (sub-title 4.3) claims that a "survey covering flora and fauna was carried out". The same material presented as new information in the EIA is what is contained in the EA report (appendix V1) submitted to NEMA in 2012 (Ref: NEMA/NKR/EA/1796). The flora survey conducted in the EA -2012 covered only MW4 & 8, MW6, MW1, MW7 and MW3 and that what is presented in the EIA report. There is no flora & fauna study at the proposed project sites near MW11.

3. Regarding public participation, the EIA experts held the public consultative meeting at Land Mawe and Kabarak area on 18th and 19th Sep. 2013. Both sites that are far from any direct project impacts. It is interesting that in the public comments section of the EIA, all participants seem to be singing the new project's praises.

4. Chapter 7 contains information on Impact identification, Cumulative Impact Risk analysis. The modified Leopold Matrix is used. The particulars of "how" and the "what" should be outlined before the project begins or else it is impossible for policy makers, stakeholders, and NEMA to adequately understand the environmental, impacts that will accompany such a large project.
5. When the specific mitigation techniques are missing from an EIA, monitoring can also be stifled since not even the project proponent knows exactly what mitigations measures should be undertaken. It is therefore impossible for monitoring agencies to hold project proponents accountable because the project proponent has only committed to non-specific goals.
Furthermore, without baseline data it is almost impossible to conduct effective monitoring to ensure those mitigation measures are effective.

6. Public comments constitute the final check on the accuracy of the

EIA report. The EMCA EIA Regulations of 2003 require NEMA to solicit the comments of the public via newspaper and radio advertisements. FOMEC was unable to get a newspaper call for public comments on the proposed project.

7. The EIA document generally has several citations, diagrams and photos whose source is not acknowledged. Plagiarism is a serious crime. The sources should be included in the reference section and photo credits and data sources be provided.

Kind regards,
Jackson Raini

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ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT FOR THE DEVELOPMENT OF 1X30 MW GEOTHERMAL POWER PLANT IN MENENGAI NAKURU COUNTY

ACTIVITY STAKEHOLDERS CONSULTATIONS **VENUE** NAKURU NORTH SUB COUNTY **DATE** .....

NAME	ORGANIZATION	DESIGNATION	MOBILE NO.	SIGNATURE
Peris - N. Ngatho	State department of Agric	Deputy SCAO	0720255526	
Mary Wambui	Youth development	SEC	0720980140	
Lilian Koriuki	Gender & Social Development	Sub County Social Devt Officer	0724 017 908	
Kezian Mwaura	Youth Development	Sub-County Youth Dev. Officer	0720423690	
MARGIN OBILLO	PUBLIC HEALTH	SubCounty P.H. Officer	0726793347	
WILLIAM KODENY	- EO. BAHATI ZONE MINISTRY OF EDUCATION.	- EO. OFFICER BAHATI ZONE	0720926626	

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ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT AND RESETTLEMENT ACTION PLAN (RAP) DEVELOPMENT OF 1X30 MW GEOTHERMAL POWER PLANT IN MENENGAI NAKURU COUNTY

KEY INFORMANTS INTERVIEWED — RONGAI SUB COUNTY

ACTIVITY ..... **VENUE** ..... **DATE** .....

NAME	ORGANIZATION	DESIGNATION	MOBILE NO.	SIGNATURE
LUCY KIPROTICH	MINISTRY OF HEALTH	PUBLIC HEALTH OFFICER	0729280278	14/11
Gitonga N. Mutiga	MIN. LABOR (SOCIAL DEV)	SOCIAL DEV. OFFICER	0722550243	17/11
LYNNETTE ECHESSA	STATE DEPARTMENT OF AGRICULTURE	CHIEF AGRICULTURE OFFICER/ CCROPS OFFICER - RONGAI	0105687264	17/11
NICHOLAS OTIENO	MOLEST – RONGAI	EDEO	0720983468	18/1

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ACTIVITY KEY INFORMANTS INTERVIEWED **VENUE** NAKURU **DATE** .....

NAME	ORGANIZATION	DESIGNATION	MOBILE NO.	SIGNATURE	
LUCY MBURU	RVWSB	Senior Supt Water	0722576305		10/11
Cosmas Ikiugu	KFS	Senior Assistant Director	0728302257		10/11
ALFRED ARONGO	KFS	FORESTER (ATHI RIVER)	0722727486		10/11
James N. Gachathi	NAWASSCO	Managing Director	0722227570		10/11
James. I.K Mbuthia	KFS - Menengai	Forester/Menengai	0720548815		11/11
Lawrence Thooko	WRMA, RVCA	Regional Technical Manager	0716749522		12/11
JOSEPH MUNYOKI	WRMA, RVCA	Assistant Technical mngr.	0724169534		12/11
Sylvia Gitonga	DOSHS	Principal OSHO	0728530935		13/11
Timothy K. Murethi	Nakuru County Government	Director - Environment	0721117441		13/11

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ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT FOR THE DEVELOPMENT OF 1X30 MW GEOTHERMAL POWER PLANT IN MENENGAI NAKURU COUNTY

ACTIVITY Meeting with Olbanita WRUA **VENUE** Bahati town, Nakuru North. **DATE** 07/11/16

NAME	ORGANIZATION	DESIGNATION	MOBILE NO.	SIGNATURE
Aggrey Kwadha	Gibb Africa	Environmentalist	0724 700 276	
PETER WAMBUGU MWANGI	CHAIRMAN OLBANITA	WRUA	0721 803 260	
JETHRO KARANJA ISAAC	TREASURER OLBANITA	WRUA	0723 564 709	
Joseph Mwangi Mukui	Asst Secretary of Finance	WRUA	0726 696592	

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WRUA = Water Resource Users Association

Appendix IV: Records of Public Meetings

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ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT FOR DEVELOPMENT OF 1X30 MW GEOTHERMAL POWER PLANT IN MENENGAI

ACTIVITY PUBLIC MEETING AT REHEMA CHURCH VENUE REHEMA CHURCH AT AHERO DATE 11/11/2014

NAME	VILLAGE	DESIGNATION	MOBILE NO.	SIGNATURE
PAUL MBUTHIA KARUKI	NJUNJKANIO	CHIEF I	0723853341	
Pst Robert Mungai	"	PASTOR	0723944746	Mungai
FRANCIS NJUITHIGA	KARUNGA	C.H.C	0727830849	
James K. Njoroge	Wanyororo	Framer	0728765639	Njoroge
JOHN NJOROGE	KARUNGA	CHW	0723583813	
David Kiriny u	KARUGA	FARMER	0720842902	
ALICE W KARIMI	KARUNGA	CHW	0721776270	
PETER KARANJA	Land Mawe	CHC	0721588007	
Douglas Gitiga	Land mawe	farmer	0702068[illegible]	
Joseph W. Gitahi	Land-mawe	Farmer	0727 140306	
BENSON KINYUA	LAND MAWE	PASTOR	0717680627	
MARY WAMBUI	~~LAND~~ MA. KARUNGA	FARMER	0713 082575	
Peter Mwaura	LAND MAWE	CHAIRMAN WRUA	0721503260	
JAMES K MWANGI	LAND MAWE	WRUA	- 0722232045	
MARGERET W. MWANGI	- KARUNGA	FARMER	- 0728637717	
EUNICE N. NJOGU	- LAND MAWE	- FARMER	0702915219	

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ACTIVITY..PUBLIC MEETING AT REHEMA CHURCH..**VENUE**..REHEMA CHURCH AT AHERO..**DATE**..11/11/2014..

NAME	VILLAGE	DESIGNATION	MOBILE NO.	SIGNATURE
PHILIP K. NJINDO	AHERO	V. CHAIRMAN BUSINESS PEOPLE	0722734400	
Kingati Mbungi	Land Mawe	Ahero Chairman	0723465576	
Paul Gachunga	Land Mawe	Business man	0723546249	
F. M. Muchai	MALI KUMI	BUSINESSMAN	0711757729	
Adamson Mukunja	Ahero	" "	0720987953	
PATRICK N MWANIKI	MALI KUMI	"	0720459197	
ISAAC M. NJUGUNA	LAND MAWE	"	0720265752	
PAUL MUTITO	"	"	0721973764	
SIMON M. KARIRI	KARUNGA	"	0722550978	
JANE N. WANJIKU K	AHERO	"	0720079900	
BETH WANJIKI	LAND MAWE	"	0725924056	
LABAN KARIUKI	LANAI MAWE	YOUTH	0725814467	
ANN WANJA	LANAI MAWE	FARMER	0725519626	

JECNTA	WANJIKN	KARUNGA	FARMER		
ANN	MUTHONI	LANDMAWE	BUSSINESS		0712838896
JOAN	KUMANI	KARUNGA	B		0705277277.

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ACTIVITY PUBLIC MEETING FOR KAMPI YA MOTO | MOROP | **VENUE** G.D.C FARM KABARAK. **DATE** 30/10/2014

NAME	ORGANIZATION	DESIGNATION	MOBILE NO.	SIGNATURE
JOSHUA KANDIE	MOROP/RAFIKI	ELDER	0723703666	
STEPHEN KARICHI	JACK EVANS	ELDER	0719673883	
Gichuru John	—"—	ELDER	0713620104	
JOB KINYANJUI	"	"	0729608952	
JOSEPH NDUNG'U	"		0721646802	
Clara L. Ngetich	MOROP	Elder	0721768989	
Felix KIPKANIN	MOROP	Elder	0718 765 786	
WILLIAM KEITANY	Rafiki	ELDER	0717418323	
PATRICK WARUERU	JACK EVANS		0705248665	
David Kiprotich	[illegible]		0726393142	
Angeline J. Kiptoo	MOROP / RAFIKI		0728214052	
Lino K. GIDEON	MOROP/Rafiki	Youth	0720 516155	
TIMOTHY K KOMEN	MOROP / Rafiki	Youth	0705954465	

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ACTIVITY PUBLIC MEETING (KAMPI YA MOTO/ MOROP SUB-LOC) **VENUE** G.D.C FARM SITE KABARAK **DATE** 30/10/2014

NAME	Sublocation ORGANIZATION/location	DESIGNATION	MOBILE NO.	SIGNATURE
SHAGES ASZED	LOWLING FARM	MANAGER	0735780058	
MALCOLM BELL	" "	OWNER	"	
PATRICK N. MBUGUA	CHIEF / K/MOTO	ADMINISTRATION	0722947002	
JOSEPH KITHIATA	MOROP	ELDER		
SUSAN SOI	MOROP	Administration	0725995871	
DENNIS KIBIWOT	K/moto		0700047365	
PIUS MITEI	K/Moto	community	0722114355	
FELIX KEBENET	K/moto	Community	0727 852 150	
KEVIN K. ROTTO	K/MOTO	COMMUNITY	0716 338 035	
ANGELINE J. KIPTOO	K/MOTO	community	0728214052	
Susan Chelgi	Rafiki	community	0721422570	
Amos Kiger	K/moto	Community	0724-837715	
Eric Kimani	K/Moto	Community	0710 355559	

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ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT FOR THE DEVELOPMENT OF 1X30 MW GEOTHERMAL POWER PLANT IN MENENGAI NAKURU COUNTY

ACTIVITY PUBLIC MEETING (KAMPI YA MOTO | MORDP) **VENUE** GDC FARM SITE KABARAK **DATE** 30/10/2014

	NAME	ORGANIZATION	DESIGNATION	MOBILE NO.	SIGNATURE
1	CHARLES NAMBOSI	~~H/S~~ MOROP	~~H/S~~ EVANS	0710-786637	
2	~~JOAKIM~~ K. ARUSEI	NIL MOROP	NIL	0724776706	
3	JOHN MWCHO	H/S MOROP	H/S	0702226111	~~MWCHO~~
4	JENIFFER KIMENGICH	NIL MOROP	NIL	0715736415	
5	Grace Chebii	N/A MOROP	N/A	0707695800	
6	Janet J KIPSANG	N/A MOROP	N/A	0721617170	~~KIPSANG~~
7	EULITA CHEPKURUI	N/A MOROP	N/A	0725808594	~~EULITA~~
8	Teresia Nyambura	N/A MOROP	N/A	0727782350	
9	Godfrey Cicheba	N/A JEG	N/A	0702274012	

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ACTIVITY PUBLIC MEETING- KAMPI YA MOTO/MOROP **VENUE** GDC FARM KABARAK **DATE** 30/10/2014

NAME	ORGANIZATION	DESIGNATION	MOBILE NO.	SIGNATURE
JOSEPH AIUSE	LENGINET		0703520274	
KENETH KIPCHUMBA	MOROP		0720 955 705	
Martin K. Maina	EX EVAN SCH		0720459220	
PETER MGANGA KIHARA	EX JACK EVANS SCH		0715 298000	
KEVIN . E. RUTTO	KLMOTO		0716 338 035	
Mengich L. Elvis	Rafiki		0727 440 602	

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ACTIVITY PUBLIC MEETING - KAMPI YA MOTO | MOROP **VENUE** GDC FARM KABARAK **DATE** 30/10/2014

NAME	ORGANIZATION	DESIGNATION	MOBILE NO.	SIGNATURE
JANE MATHAI	EX JACK EVANS	YOUTH	0713815999	
JOYCE BOSIRE	EX JACK EVANS	YOUTH	0714334055	
CAROLYNE CHEBET	MOROP	YOUTH	0716954073	
ABIGAEL JEPCHIRCHIR	EX JACK EVANS	YOUTH	0729574239	
DAMARIS WANGARE	EX JACK EVANS		0711761159	

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ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT FOR THE DEVELOPMENT OF 1X30 MW GEOTHERMAL POWER PLANT IN MENENGAI NAKURU COUNTY

ACTIVITY PUBLIC MEETING - KAMPI YA MOTO | MOROP SUB LOCATION **VENUE** GDC FARM KABARAK **DATE** 30/10/2014

NAME	ORGANIZATION	DESIGNATION	MOBILE NO.	SIGNATURE
Alfred Rotich		Elder	0729095909	
Veronica N. Mburu	~~SUB~~ K.Y. Moto.	Farmer	0718847555	
Kelly M. Giathi	Kampi ya moto	Farmer	0720 707 599	
Emily Kendui Twa	Rafiki Farm	FARMER	0720292606	
Margaret Chelangat	" "	YOUTH	0729147002	
Daniel Kihara Wahinya	Jack Evans Scheme	Youth	0711 418 706	
Beatrice Towett C.	Lengeret	Youth	0716 817 469	
Nancy Kibet	Rafiki Farm	FARMER	0722583188	
Kiptum Koibarak	Morop	Hustler/Youth	0700 373 009	
Kenneth Kibet	Morop	Youth	0723920785	
Peter Lekamparish	Morop	Youth	0721130104	
Simon B. Kiplagat	Morop	Youth	0727246389	
Samuel Kandie	Morop	Sufferer	0721221817	

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ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT FOR DEVELOPMENT OF 1X30 MW GEOTHERMAL POWER PLANT IN MENENGAI

ACTIVITY PUBLIC MEETING FOR KIRIMA SUBLOCATION VENUE KIRIMA POLICE POST NEXT TO SUB CHIEF'S OFFICES DATE 4/11/2014

	NAME	VILLAGE	DESIGNATION	MOBILE NO.	SIGNATURE
1	EVANS K. MURIU	KIRIMA		0724339631	
2	PAUL WANGAI	"		0720677822	
3	JOHN MWANGAI	"		0721393433	
4	STEPHEN WAKOMO	"		0753234125	
5	JOHN KAHONO	"		0723634634	
6	Joel Thuo Josephat	"		0725719281	
7	JOHNSON MWAMIKI	"		0788747232	
8	EVANS MWANGI	"		0705827334	
9	Samuel Karanja	"		0717664932	
10	Evelyn Mwei	"		0717664932	
11	GEOFFREY GATHIOMI	KIRIMA		0739746069	
12	JOHN NJOROGE	"		0724922444	
13	Joseph Maingi	Kirima		0725692192	

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ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT AND RESETTLEMENT ACTION PLAN (RAP) DEVELOPMENT OF 1X30 MW GEOTHERMAL POWER PLANT IN MENENGAI NAKURU COUNTY

ACTIVITY PUBLIC MEETING AT KIRIMA SUBLOCATION **VENUE** KIRIMA POLICE POST NEXT TO ASSISTANT CHIEFS OFFICE **DATE** 4/11/2014

NAME	~~ORGANIZATION~~ VILLAGE	DESIGNATION	MOBILE NO.	SIGNATURE
WAMBUGU SAMWEL	ARAUKA	Elder		
Tobias Ndiritu	Kirima	Farmer	0728630597	
Eduard Odunga	Arahuka	Farmer	0723-174844	
James Raman	Kirima	Farmer	0721280255	
James Kinyanjui	Arahuka	Farmer	0726840001	
Simon Ngatia	Arahuka	Farmer	0715028888	
CHIEF Ranto	KAPNGOCHOCH	CHIEF	0723[illegible]674	
Stephen K. Mungai	ARAHUKA	FARMER	0721696425	
Duncan M. Waiaina	ARAHUKA	Farmer	0721-836197	
George Ogigi	Arahuka	Farmer	0707478880	
John Kimwagi	Rigoge	Business	0710717143	
Grace Waithira Njoroge	Arahuka	Farmer	0710439969	
Nancy Wanjiru Chege	Arahuka	Farmer	0712465099	

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ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT FOR DEVELOPMENT OF 1X30 MW GEOTHERMAL POWER PLANT IN MENENGAI

ACTIVITY PUBLIC MEETING FOR MENENGAI SUB LOCATION VENUE KIRIMA POLICE POST NEXT TO SOB-CHIEF'S OFFICE DATE 4/11/2014

	NAME	VILLAGE	DESIGNATION	MOBILE NO.	SIGNATURE
1	ELIUD K. GAICHE	KIAMAINA	VILLAGE ELDER	0725645131	
2	FREDRICK Maina	KIAMAINA	VILLAGE	0727728449	
3	DAVID MGAMGA	KIAMAINA	VILLAGE ELDER	0725370070	
4	SULEIMAN MWANGI	KIAMAINA	Mwenyenji	0728730311	
5	DAVID WAITHAKA	KIAMAINA	MWONGOJI	0700 715497	
6	PHILIP MUCHENJU	KIAMAINA	VILLAGE ELDER	0722265607	
7	SAMSON WAMBUGU.	KIAMAINA	MWENYENJI	0718708710	
	WAMAMA KIMANI	KIAINA	MWENYENJI	—	WAMAMA
	SAMMY NJORUGE	KIAMAINA	MWENYEJI	0702633268	
	Samuel mwangi	KIAMAINA	mwenyeji	0714037318	
	PETER NGUGI NDUNGU	KIAMANA	MWENYENI, Carpenter	0726704905	
	Stanley M. Wakoma	Kiamaina	Social Radio/worker	0727122390	
	JOEL NJOGU	Kiamaina	MOTORMARE	072 3051607	
	Peter Mwangi	Kiamaina	driver	070 3296500	

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ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT FOR DEVELOPMENT OF 1X30 MW GEOTHERMAL POWER PLANT IN MENENGAI

ACTIVITY PUBLIC MEETING AT MENENGAI SUB LOCATION VENUE KARIMA PRIMARY SCHOOL NEXT TO SUBCHIEFS OFFICE ~~MENENGAI TRADING CENTRE~~ DATE 6/11/2014

NAME	VILLAGE	DESIGNATION	MOBILE NO.	SIGNATURE
Jane Njeri	Menengai			
Mary W. Kimuyu	Creator		0725 533 207	
Beatrice Wanjiru	Creator		0715 48 42 43	
Monica Njeri	Menengai		0735917684	
Tabitha Wandia	MENENGAI		0711850153	
Grace Nyambura	Menengai		0702-170744	
GRACE NGUNGIRI	MENENGAI		0717511 244	
Tabitha Nambura	MENENGAI		0721529485	
Florence Njeri mwangi	MENENGAI			Njeri
Margret Gathima	MENENGAI			
Hannah Wangui	MENENGAI		0715050322	
Penina Ikuna	MENENGAI		0723753422	
Lucy Kabui	MENENGAI		0720021863	

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ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT FOR DEVELOPMENT OF 1X30 MW GEOTHERMAL POWER PLANT IN MENENGAI

ACTIVITY PUBLIC MEETING AT MENENGA SUB-LOCATION **VENUE** MENENGA TRADING CENTRE **DATE** 6/11/2014

NAME	VILLAGE	DESIGNATION	MOBILE NO.	SIGNATURE
ESTHER WANGUI	Menengai		0724703478	
John Wathuta Ndegwa	Menengai		0727102894	
Jeeitta Muiangi	MENENGAI		0713893377	
Racheal Ndeta	Menengi		0720246669	
MYAMBURA MARY	MENENGAI		0707023048	
HANNA muthoni	MENENGAI		0720318349	
MILIKA NYAMBURA	MENENGAI		0720318349	
Peter Chege Maina	MENENGAI		0727050066	
MAURA KARANJA	MENENGAI		0726282587	
REV J.M. KAMAU	Menengai		0723537305	
EVANTAS KINGORI	Menengai		—	
Gathumbi Ngaruiya	Menengai		0705536560	
David muranga muigai	Menengai		0716885227	

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ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT FOR DEVELOPMENT OF 1X30 MW GEOTHERMAL POWER PLANT IN MENENGAI

ACTIVITY PUBLIC MEETING AT MENENGA SUB-LOCATION **VENUE** MENENGA TRADING CENTRE **DATE** 6/11/2014

NAME	VILLAGE	DESIGNATION	MOBILE NO.	SIGNATURE
JOHN MUTANGI ROI	Crater	Community Policing	0724681576	
DANIEL KIMANI	Kirima	CDF REP ISIRAINA	0724921430	
CAROLINE MWAURA	CRATER	C/Person	0734991504	
EDWARD NJURAI	RURII	A/CHIEF	0720987926	
MUGO TITUS	MENENGAI	A/CHIEF	0720254273	
MARY KAMAU	RURII LOC	CHIEF	0721224380	
NEWTON N. KARANJA	Rurii Loc	Community Policing	0727483449	
DANIEL N. MUCHENGU	KIAMAINA	A/CHIEF	0722265607	
Bernard T Kabue	Kiamaina	Agriculture officer	0722793988	
Mambura Mwalolo	KIRIMA		0728782875	
TIMOTHY MATHARIA NJOROGE	Kirimaina		0723577844	
Joseph ngure	Kirima	Resident.	0725888260	
James wawere	Kirima	Resident	0720409563	
Moses Ndungu	Kirima	Resident	0700 907039	
- Amos M. Kuhu	KIRIKO Central	Resident	0710213865	

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ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT FOR DEVELOPMENT OF 1X30 MW GEOTHERMAL POWER PLANT IN MENENGAI

ACTIVITY PUBLIC MEETING AT MWAKI MUGI SUB LOCATION VENUE CHIEF OFFICE KABATINI DATE 7/11/2014.

NAME	VILLAGE	DESIGNATION	MOBILE NO.	SIGNATURE
JOHN WAMBUGU WACHIRA	MWAKI MUGI	DRIVER		
ELIJAH KUNGU KAHINYA	TEACHERS MWANGI MUGI	ELECTRICAL TECHNICIAN	0724740310	
PENINAH WAITHIRA KIMANI	MYATHUMA	MEMBER	0727399399	
Margaret Wagio Kabugu	Maili Saba	MEMBER	0727723431	
Joyce Njeri Wabuga	Maili Saba	MEMBER	0712040333	
Lydia Wanjiru Mugunga	Maili Saba	Business	0725491869	
Susan Wairimu Karanja	Maili saba	FARMER	0728040867	
Jacinta Gathoni	Maili saba	FARMER	—	
JOHN MUGO	MAILI SABA	BUSINESSMAN	0727587808	
PAUL M. KARIUKI	MAIH SABA	B/MAN	0721-800172	
ANNE W. KIIRU	J.C.	FARMER	0711187690	
Lydia Wambui	Maili Saba	Business lady	0726688916	
Rachel Nyamburia	Maili Sita	Secretary	0726822801	

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ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT FOR DEVELOPMENT OF 1X30 MW GEOTHERMAL POWER PLANT IN MENENGAI

ACTIVITY PUBLIC MEETING for MWAKI MUGI SUB LOCATION VENUE CHIEF OFFICE KABATINI DATE 7/11/2014

NAME	VILLAGE	DESIGNATION	MOBILE NO.	SIGNATURE
PAUL THUO MWANG.	KABATINI	Member of County Assembly Kabatini.	0722-911096	
ARISTIDES K NGUGI	MWAKI MUGI	ASSISTANT CHIEF MWAKI MUGI	0722261927	
JOHN MBUGUA ELIUD	KABATINI	ACTING CHIEF KABATINI LOCATION	0722795140	
PAUL MACHARIA NGOIYA	KABATINI	CHAIR DEV-KABATI-SUB	0723910758	
JOSEPH NGARI MURITH	MWAKIMUGI-TEACHERS	MWAKI MUGI.	0720649937	
JESSE K. CHEGE	MWAKI MUGI	CHAIRMAN CBO	0722268711	
JOSEPH R.M. KIMANI	MWAKI MUGI	MEMBER	0721654141	
Raphael Kiame	Mwaki Mugi	Chairman unit	0725344644	
Ken Kibaara	Mwaki Mugi	Secretary Mwaki Mugi Sub-location CBO.	0722969626	
Gabriel Mwaura	Mwaki Mugi	Member Kabatini CBO	0717733528	
PETER KUNGU	Kabatini	M.C.A's office Kabatini	0720789489	
JOHN N. NGANGA	MWAKI MUGI	MEMBER	0715556578	
JOSHUA NJENGA	MWAKI MUGI	Member	0726747958	

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ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT FOR DEVELOPMENT OF 1X30 MW GEOTHERMAL POWER PLANT IN MENENGAI

ACTIVITY PUBLIC MEETING AT MWAKI MUGI SUB LOCATION **VENUE** CHIEF'S OFFICE KABATINI **DATE** 2014/11/7.

NAME	VILLAGE	DESIGNATION	MOBILE NO.	SIGNATURE
Peter Kimani	Mwaki Mugi	Chairman	0725412316	
BLASIO MWAMUI	AMOS		0712500843	
GEOFFREY NGANGA GITAU	Mwaki Saba	Farmer	0721753602	
CHARLES MATHENGE KAMAU	MWAKI MUGI	ELECTRICAL INSTALLATION	0727268950	
Pauline Wangui	MWAKI MUGI	Farmer	0727920284	Pauline
STEPHEN MUTURI KAMAU	MWAKI MUGI S	DRIVER	0713389217	Stephen
JOAN M. NDUNGU	J. C.	FARMER	0718250312	

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT AND RESETTLEMENT ACTION PLAN (RAP) DEVELOPMENT OF 1X30 MW GEOTHERMAL POWER PLANT IN MENENGAI NAKURU COUNTY

ACTIVITY PUBLIC MEETING AT NDUNGERI SUB-LOCATION **VENUE** NDUNGERI CATTLE DIP **DATE** 3/11/2014

NAME	~~ORGANIZATION~~ VILLAGE	DESIGNATION	MOBILE NO.	SIGNATURE
JAMES M. MACHORIA	MUTUKANIO C.	BUSINESS MAN	0713806583	
PAUL C. KURIAI	OLBONATA	ASSISTANT CHIEF	0727846000	
Paul Njoroge M.	NDUNGIRI	YOUTH REP.	0727 091 671	
Martha Nyeri K	Ndugiri	Member	0721610814	
EMILY NJOKI K	Ndugiri	Member	0717178433	
Benson Njuguna	Ndungiri	Electrician	0700636281	
Betrice Nyambura K.	Ndungiri	Member	0727609555	
TONY KIPKURUI	Mangat (NDUNGIRI LOC.)	SNR. CHIEF	0722525258	
JOHN MACHORIA MUGO	MUTUKANIO C	Member	0723257394	
Harrison K. Wachira	Mutukanio (C)	Electrician	0711409245	
Peter Kamau	Mutukanio B	Peasant	—	
JOSPHAT WACHIRA	Mutukanio B	Farmer	—	
KEFA. M. NGUGI	IMC	Farmer	0713020854	

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ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT AND RESETTLEMENT ACTION PLAN (RAP) DEVELOPMENT OF 1X30 MW GEOTHERMAL POWER PLANT IN MENENGAI NAKURU COUNTY

ACTIVITY PUBLIC MEETING AT NDUNGIRI SUB LOCATION **VENUE** NDUNGIRI CATTLE DIP **DATE** 3/11/2014

NAME	~~ORGANIZATION~~ VILLAGE	DESIGNATION	MOBILE NO.	SIGNATURE
HARRISON MACHARIA	MUTUKANIO C	FARMER	0720478556	
John Rugio	IME	"	0726901154	
Francis Macharia	Mutukanio C	"	0725070418	
Nathaniel Kigia	Mutukanio C	"	0717623293	
BILHAH NYAMBURA	Mutukanio B	"	0707780151	

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ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT AND RESETTLEMENT ACTION PLAN (RAP) DEVELOPMENT OF 1X30 MW GEOTHERMAL POWER PLANT IN MENENGAI NAKURU COUNTY

ACTIVITY PUBLIC MEETING AT OLBANITA SUB LOC. **VENUE** FULL GOSPEL CHURCH [redacted] **DATE** 3/10/2014

NAME	~~ORGANIZATION~~ VILLAGE	DESIGNATION	MOBILE NO.	SIGNATURE
ROSE WANJIKU MWANGI	AMPIVA	VILLAGE RESIDENT	0711545491	Rose
Dickson Ngugi Murungi	OLBANITA.	Village Resident	0700409789	
PETER KAMAU NJUGUNA			0717832743	
EVALINE ACHIENG			0711611119	
DAVID KIKUI			~~0715978053~~	
Johson ABENYO			0715978053 ~~0722 234487~~	
PETER DATHUGU			0722334487	
MONICAH ATIENO A.			0711-624597	
PETER GATHOGO			—	
Mana Akali			0718 04 81 04	
Rosemary Nyambura			0725128985	
Anna Akaru			—	
Mary Wyeri Beth Wangi			— 0708 495993	

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ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT AND RESETTLEMENT ACTION PLAN (RAP) DEVELOPMENT OF 1X30 MW GEOTHERMAL POWER PLANT IN MENENGAI NAKURU COUNTY

ACTIVITY PUBLIC MEETING AT OLBANITA SUBLOCATION **VENUE** FULL GOSPEL CHURCH VILLAGE **DATE** 3/11/2016

NAME	~~ORGANIZATION~~	DESIGNATION	MOBILE NO.	SIGNATURE
JAMES GICHINGIA		Village resident	0724058052	
CRISTINE NJERI			0712145459	
JOHN KAMAU			0713432318	
MOSES MWANGI		Village Resident	0702 891854	
[illegible]			0717413[illegible]	
NG'ANG'A NJUGUNA			0716531 6	
PETER ERE			0715-075-889	
DAVID NGANGA			0721855177	
[illegible]			0721 [illegible]	
DANIEL NJUGUNA			0724830760	
JANE WAMBUI			0728496237	
KENEDY OTIENO			0710 255 189	
JOSEPH IRUNGU			0770505410	

Margaret Songora

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ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT FOR THE DEVELOPMENT OF 1X30 MW GEOTHERMAL POWER PLANT IN MENENGAI NAKURU COUNTY

ACTIVITY PUBLIC MEETING AT OL BANITA SUB LOC **VENUE** FULL GOSPEL CHURCH **DATE** 3/11/2014

NAME	ORGANIZATION	DESIGNATION	MOBILE NO.	SIGNATURE
Miriam Wangeci	AMPIVA		0710 1016 19	
Paulina Akatsa			0723 142264	
Julius Mwagi Chege			07	
Mary Muthami			0710174841	
PAUL CHURIAT		ASS-CHIEF	0727846000	
WILLIAM NDUNGU			0723397608	
TONY KIPKURUI	CHIEF NAUNGURI LOC	SNR CHIEF	0722252518	
FREDRICK BWIRO	AMPIVA			
George olhiambo	Ampiva		0718984920	
Aggrey Kwacha	Gibb Africa		0724700276	
Alfred Mumnga	Gibb Africa	Environmentalist	0721926132	

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ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT DEVELOPMENT OF 1X30 MW GEOTHERMAL POWER PLANT IN MENENGAI NAKURU COUNTY

ACTIVITY PUBLIC MEETING FOR WANYORORO SUB LOCATION **VENUE** WANYORORO TRADING CENTRE **DATE** 5/11/2014

NAME	ORGANIZATION	DESIGNATION	MOBILE NO.	SIGNATURE
JOHN NJOGU KIMANI	Wanyororo -B		0724-281190	
HENRY OMOR OMINGA	Wanyororo B		0718707881	
DENIS CHINCHIN	Wanyoro		0711310924	
JOSEPH NDERITU GITHINJI	"		0714358833	
PATRICK KARIUKI	"		0703684569	
Charles Muigai Mwangi	"		0722328987	
	"		0724890804	
ANN Mwangi	"		0715152538	
SAMSON K. CHEGE	"		0713466917	
Tom M. Mwangi	"	Welder	0725974236	
Bernard Muigai	"	Welder	0719683334	
Joseph Isigoni	"		0727703 45	
DAVID NJUGUNA	"		0712681971	
James Mwaura	"	MECH	0726474212	

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Solomon Kamau P 0713268274

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT ... DEVELOPMENT OF 1X30 MW GEOTHERMAL POWER PLANT IN MENENGAI NAKURU COUNTY

ACTIVITY PUBLIC MEETING AT WANYORORO SUB-LOCATION VILLAGE **VENUE** WANYORORO TRADING CENTRE **DATE** 5/11/2014

NAME	ORGANIZATION	DESIGNATION	MOBILE NO.	SIGNATURE
SAMUEL GACIBE	WANYORORO "B"	DRIVER	0723879146	
SAMUEL MWANGI	"	PLANT OPERATOR	0701367505	
JOSEPH NDUNGU	WANYORORO	WELDER	0726 905488	
MARY NYAMBURA	"	STILL DIXER	0725538302	
STEPHEN KARIUKI	"	DRIVER	0726955994	
GEOFREY M. KANJA	"	DRIVER	0726011855	
SOLOMON MAINA	"	DRIVER	0712148158	
JAMES KARIUKI	"	FARMER	0701800499	
MOSES N GACIBE	"	PLANT OPERATOR	0720106947	
BEN MWANGI	"	FARMER	0708258473	
PAUL MBAE	"	FARMER	07	
JOSEPH NJUMGUNA	"	DRIVER	0728082909	
DENIS KIPROP	"	FARMER	0711297272	
Margaret Wanjiku Mogusu	"	Computer	0720439750	

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JAMES NDIRITU	"	0710415279		
CHARLES MBURU		6711358		
Kinau	Kagu Gichuhi	0		
Tom M. Mwangi	Wangoroo	Welder	0725974236	
WILSON KIOKO WAMBUA	"	"	DRIVER. 0723584026	
Benjamin Thuo	Kamau	"	0721613232	Mechanical engineering
Patrick	Githaiga	"	0723724285	Mason

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ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT [illegible] DEVELOPMENT OF 1X30 MW GEOTHERMAL POWER PLANT IN MENENGAI NAKURU COUNTY

ACTIVITY PUBLIC MEETING AT WANYORORO SUB-LOCATION **VENUE** WANYORORO TRADING CENTRE **DATE** 5/11/2014

NAME	~~ORGANIZATION~~ VILLAGE	DESIGNATION	MOBILE NO.	SIGNATURE
RONALD K ISIAHO			0727550293	
JOEL MUYA			0724318830	
JAMES KHHARA			0723746804	
PAUL Mbugua			0704169518	
MILTON KURIA			0728507988	
SIMON CHARAGU			0700327847	
ABRAHAM G. NDEDITO			0726510834	
ISAAC GITAU M			0717211706	
FRANCIS THUKURI			0728882019	
JOSEPH KABIRU			0726928436	
SAMUEL MERIA			0712154503	
ZAKAYO AI'WANJOH	WANYORORO		0702431392	
David Mwaji Kamau			0701254726	

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GEOFFREY KIHUHA 0715 922269

JAMES GATHIMBA 0713 47230
DANIEL MBUGUA 0704 818031

Michael engai 0723 843756

Daniel Njuguna 0728 179287

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT
GEOTHERMAL POWER PLANT IN MENENGAI NAKURU COUNTY

DEVELOPMENT OF 1X30 MW

ACTIVITY PUBLIC MEETING AT WANTORORD SUB. LOCATION **VENUE** WANTORORO TRADING CENTRE **DATE** 5/11/2014

NAME	~~ORGANIZATION~~ VILLAGE	DESIGNATION	MOBILE NO.	SIGNATURE
PAULINE WAWERU	WANTORORO B'	YOUTH (Driver)	0708389935	
MIRIAM WANJIRA G	"	"	0724611348	
VERONICAH NYANGICHU	"		0724466077	
STEVEN GITUATHI	"		0714665456	
Frechia W. Rachan	Wanyororo 'B'	plant operator	0710710228	
Johannah Rachan	Wanyororo 'B'	Driver	0720338189	
CAROL MUNYIRA	" "	YOUTH (CATERER)	0723912794	
SAMMY CHEGE	" "	WIRING	0723912794	
LUCY WANGARE	// //	DRIVER	0713652065	
JOHN NWANGI	// //	WELDER	0725155075	
GRACE WAMBUI	// //	PHARMACIST	0710340370	
ELIZABETH WANJIRU	// //	PLANT operator	0714974693	
ANTHONY NDUMBO	// //	ELECTRICIAN	0724107232	

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- George Mwangi	Wanjoroia	Mason / 0729268467 — George
- Eliud Ndungu	MASON	
- Denis Kipkop	Wanjoroian	Driver/Mech 0712145178 —
- Jane Wairimu	Wanjoroia 'B'	Tout 0711 297272 —
- Peter Karanja K.	Wanjoroia 'F'	- Tout - 0713652060 —
- Michael Ikai	Wanjoroia 'A'	- Tout - 0724235308 —
- Kamau Muhoro	Wanjoroia 'B'	Mason — — —
- John Mwangi	Wanjoroia 'B'	- Painter - 0718446502 —
- Denmark Kiboru	"	Member — 0715593346
Joseph M. Githanga	"	Driver — 0701496279 —
		ASST. CHIEF 0712253548

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT
GEOTHERMAL POWER PLANT IN MENENGAI NAKURU COUNTY

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DEVELOPMENT OF 1X30 MW

ACTIVITY ....PUBLIC MEETING AT WANYORORO SUB. LOCATION..... **VENUE** ....WANYORORO TRADING CENTRE..... **DATE** ..5/11/2014..

NAME	ORGANIZATION	DESIGNATION	MOBILE NO.	SIGNATURE
JOEL MANJA	WANYORORO		0725501685	
SIKPITEN MBUGO	WANYORORO		0722 674646	
JOHN NDONGO	WANYORORO		0722 247531	
PETER KAMAU TITO	11		0729 995982	
BADA NJENGA	11			
SILOMON GICHANGO	11	plant operator	0715 855 366	
DAVID K. NJENGA	11		0721 336 154	
Joseph Mwnere	11		0724 070233	
BARTHLOMEW NDIRANGU	11		0729761539	B. Ndirangu
JAMES NDIRITU	11		0704220230	
JOHN KAIIGE	11		0711350377	
WILL MINAJ	11		0714 981967	
Henry Odhor Odinga	11		0718 707881	
JAMES KAMAU	11	DRIVER	0723 859 799	

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JANE	MAIRIMU		FARMER	0717053851
SAMUEL	MWANGI	NJOROGE	11	07
PETER	NGURE		DRIVER	0789[illegible]8228855
JOSEPH	KIMANI		SECURITY	0718124103
GEORGE	GICHUKI		DRIVER	0724863902
GILBAT	KARANJA		FARMER	0722186187
FREDICK	MAINA			0702752241
JAMES	MWAURA		MECHANIC	0726474212
JAMES	MBUGUA		FARMER	

Appendix V: EIA License

Application Reference No: EIA/827

Certificate No: 0000406

For official use

THE ENVIRONMENTAL MANAGEMENT AND COORDINATION ACT

CERTIFICATE OF VARIATION OF ENVIRONMENTAL IMPACT ASSESSMENT LICENCE

This is to certify that the Environmental Impact Assessment Licence No: **0014205**

Issued on **28th November, 2012** (date) to **Geothermal Development Company.** (name of individual/firm) of **P. O. Box 100746 - 00101, Nairobi.** (address) regarding **Proposed installation of 5-10 MW Modular Geothermal Power Plant** (title of project) whose objective is to **Construction of 10x5-10 MW Modular Geothermal Power Plant.**

(briefly describe purpose) located at **Menengai Caldera, Nakuru County** (locality and district) has been varied to **Change of the Modular Plants installed capacity to 3x30-35 MW.**

(nature of variation) With effect from **2nd October, 2013** (date of variation) in accordance with the provisions of the Act.

Dated this **7th** day of **Oct.** 20**13**

Signature .....

(SEAL)

Director General
The National Environment Management Authority

GPK (L)

Application Reference No. EIA/827

Registration No: 0014205

For official use

nema

mazingira yetu | uhai wetu | wajibu wetu

NATIONAL ENVIRONMENT MANAGEMENT AUTHORITY (NEMA)

THE ENVIRONMENTAL MANAGEMENT AND CO-ORDINATION ACT

ENVIRONMENTAL IMPACT ASSESSMENT LICENSE

This is to certify that the Project Report/Environmental Impact Assessment Study Report received from ....Geothermal Development Company.....(Name of of individual/firm) of P. O. Box 17700-20100, Nairobi..... (Address submitted to the National Management Environment Authority (NEMA) in accordance with the nvironmental Impact Assessment and Audit Regulations regarding ....Proposed Installation of 5-10 ....MWE Modular Geothermal Power Plants at Menengai Drilling Project.....(title of project) whose objective is to carry on ..... (briefly describe purpose) located at ....Menengai Caldera, Nakuru County.....(locality and district) has been reviewed and a licence is hereby issued for implementation of the project, subject to attached conditions.

Dated this.....28th.....Day of .....Nov 2012.....

Signature.....

(SEAL)

Director General
The National Environment Management Authority

CONDITIONS OF LICENSE

1. This licence is valid tor a period of.....(time within which the project should commence) from the date hereof.
2. The Director-General shall be notified of any transfer/variation/surrender of this license.

P.T.O.

ISO 9001 BUREAU VERITAS Certification

1.0 General Conditions

1.1 This approval is for the proposed installation of 5-10 modular geothermal power plants at Menengai Drilling Project, costing KShs.637,500,000/=.

1.2 The license shall be valid for 24 months from the date of issue.

1.3 Without prejudice to the other conditions of this license, the proponent shall implement and maintain an environmental management system, organizational structure and allocate resources that are sufficient to achieve compliance with the requirements and conditions of this license.

1.4 The Authority shall take appropriate action against the proponent in the event of breach of any of the conditions stated herein or any contravention to the Environmental Management and Coordination Act, 1999 and regulations therein.

1.5 This license shall not be taken as statutory defence against charges of environmental degradation or pollution in respect of any manner of degradation/pollution not specified herein.

1.6 The proponent shall ensure that records on conditions of licenses/approval and project monitoring and evaluation shall be kept on the project site for inspection by NEMA's Environmental Inspectors.

1.7 The proponent shall submit an Environmental Audit report in the first year of occupation/operations/commissioning to confirm the efficacy and adequacy of the Environmental Management Plan.

1.8 The proponent shall comply with NEMA's improvement orders throughout the project cycle.

1.9 The proponent shall provide the final project accounts (final project costs) on completion of the construction. This should be done prior to project commissioning/operation/occupation.

2.0 Construction Conditions

2.1 The proponent shall put up a project signboard at the project office as per the Ministry of Public Works standards showing the NEMA EIA license number among other details.

2.2 The proponent shall ensure that adequate and appropriate sanitary facilities are provided for the workers during construction phase and that proper decommissioning of the facilities is carried out once construction is complete.

2.3 The proponent shall ensure that the cooling systems fitted have zero ozone depleting potential as per the Environmental Management and Coordination (Controlled Substances) Regulations of 2007.

2.4 In the event that the project site borders a river to a stream, the proponent, pursuant to Regulation 6 (c) of the Water Quality Regulations of 2006, shall protect the riparian reserve by ensuring that **NO** development activity is undertaken within the full width of the river or stream to a minimum of six (6) meters and a maximum of 30 meters on either side, based on the highest recorded flood level.

2.5 The proponent shall ensure that all potentially affected households are fully informed and involved in the development and implementation of the Resettlement Action Plan (RAP).

2.6 The proponent shall ensure that authorization of the Kenya Civil Aviation Authority is acquired before the Lattice Street self-supporting towers are installed.

2.7 The proponent shall obtain a transmission license from Energy Regulatory Commission in accordance with Section 27 of the Energy Act No. 12 of 2006.

2.8 The proponent shall ensure that the transformer plinths are surrounded by bund walls and potential spillages drained into sumps for recovery.

2.9 The proponent shall ensure that adequate surge and lightning protection and mitigation against bird electrocution is incorporated in the construction works.

2.10 The proponent shall ensure that adequate access control measures and safety signage are provided for throughout the project phases.

2.11 The proponent shall ensure that clearing of trees and vegetation for the erection of towers and overhead distribution lines is done as per approvals from the local authority and Kenya Forest Service.

2.12 The proponent shall ensure that the design of the equipment and site comply with the Environmental Health and Safety Policy for the electric power sector.

2.13 The proponent shall ensure that all excavated material and debris is collected, re-used and where need be, disposed off as per the Environmental Management and Coordination (Waste Management) Regulations of 2006.

2.14 The proponent shall ensure strict adherence to the provisions of Environmental Management and Coordination (Noise and Excessive Vibrations Pollution Control) Regulations of 2009.

2.15 The proponent shall ensure strict adherence to the Occupational Safety and Health Act (OSHA), 2007.

2.16 The proponent shall ensure that construction workers are provided with adequate personal protection equipment (PPE) as well as adequate training.

2.17 The proponent shall ensure that construction activities are undertaken during the day (and not at night) between 08.00 hrs and 17.00 hrs; and that transportation of construction material to site are undertaken during off peak hours.

2.18 The proponent shall ensure strict adherence to the Environmental Management Plan developed throughout the project cycle.

2.19 The proponent shall ensure that the development adheres to zoning specifications issued for development of such a project within the jurisdiction of the Municipal Council of Nakuru, with emphasis on approved land use for the area.

3.0 Operational Conditions

3.1 The proponent shall ensure proper signage and containment is maintained throughout the project cycle.

3.2 The proponent shall ensure that all waste water is disposed as per the standards set out in the Environmental Management and Coordination (Water Quality) Regulations of 2006.

3.3 The proponent shall ensure that rain water harvesting facilities are provided to supplement surface and ground water.

3.4 The proponent shall ensure that all drainage facilities are fitted with adequate functional oil water separators and silt traps.

3.5 The proponent shall ensure that appropriate and functional efficient air pollution control mechanisms are installed in the facility to control all air emissions.

3.6 The proponent shall ensure that all equipment used are well maintained in accordance with the Environmental Management and Coordination (Noise and Excessive Vibration Pollution Control) Regulations of 2009.

3.7 The proponent shall ensure that all solid waste is handled in accordance with the Environmental Management and Coordination (Waste Management) Regulations of 2006.

3.8 The proponent shall ensure that all workers are well protected and trained as per the Occupational Safety and Health Act (OSHA) of 2007.

3.9 The proponent shall comply with the relevant principal laws, by-laws and guidelines issued for development of such a project within the jurisdiction of the Municipal Council of Nakuru, Energy Regulatory Commission, Water Resources Management Authority, Ministry of Public Health and Sanitation, Directorate of Occupational Health and Safety Services, Kenya Civil Aviation Authority, Ministry of Energy, Kenya Forest Service, Kenya Forest Service, Kenya Wildlife Service and other relevant Authorities.

3.10 The proponent shall ensure that environmental protection facilities or measures to prevent pollution and ecological deterioration such as observing and protecting riparian reserves, forest areas and any fragile ecosystems, anti-vibrating devices, taking precautions on electro-magnetic field risks mechanisms are designed, constructed and employed simultaneously with the proposed project.

4.0 Notification Conditions

4.1 The proponent shall notify the Energy Regulatory Commission in writing of any accident or incident causing loss of life, personal injury, explosion, oil spill, fire or any other accidents or incidents as per section 117 (1) of the Energy Act of 2006.

4.2 The proponent shall seek written approval from the Authority for any operational changes under this license.

4.3 The proponent shall ensure that the Authority is notified of any malfunction of any system within 12 hours on the NEMA hotline No. **020 6006041** and mitigation measures put in place.

4.4 The proponent shall keep records of all pollution incidences and notify the Authority within 24 hours.

4.5 The proponent shall notify the Authority in writing of its intent to decommission the facility **three (3) months** in advance.

5.0 Decommissioning Conditions

5.1 The proponent shall ensure that a decommissioning plan is submitted to the Authority fc approval at least three (3) months prior to decommissioning.

5.2 The proponent shall ensure that all pollutants and polluted material is contained and adequat mitigation measures provided during the phase.

nema

mazingira yetu | uhai wetu | wajibu wetu

NATIONAL ENVIRONMENT MANAGEMENT AUTHORITY(NEMA)

THE ENVIRONMENTAL MANAGEMENT AND CO-ORDINATION ACT

CERTIFICATE OF VARIATION OF ENVIRONMENTAL IMPACT ASSESSMENT LICENSE

Certificate No: **NEMA/EIA/VC/1149**

Application Reference No: **NEMA/EIA/VEIA/1745**

This is to certify that the Environmental Impact Assessment License No **0014205** issued on 11/28/2012

to **Sosian Menengai Geothermal Power Ltd.**

of **P.O Box 2548-00606, Nairobi.**

regarding **Proposed Installation of 5-10MWe Modular Geothermal Power Plants.**

whose objective is **Construction of a Modular Geothermal Power Plant with capacity of a 35MWe.**

located at **Menengai Caldera,Nakuru County.**

has been varied to **Extension of EIA License validity period by an additional twenty four (24) months subject to the condition on the EIA License No.0014205.**

with effect from **30 May, 2019** in accordance with the provisions of the Act.

Date: **30 May, 2019**

Signature

(Seal)

Director-General

The National Environment Management Authority.

P.T.O.

ISO 9001: 2008 Certified

Appendix VI: NMK Chance Find Procedure and Letter of No Objection

NATIONAL MUSEUMS OF KENYA

WHERE HERITAGE LIVES ON

National Museums of Kenya Chance Finds Management Plan

This Chance Finds Procedure defines requirements for the management of archaeological, palaeontological and other cultural deposits, finds and features encountered during construction and development activities in Kenya. The objectives of this document are to provide protocols that will minimize disruption to construction scheduling while promoting the preservation of prehistoric and cultural heritage.

This Procedure is defined in accordance with

- The National Museums and Heritage Act 2006,
- The International Finance Corporation Performance Standard 7 and 8 on Indigenous Communities and Cultural Heritage.
- UNESCO 1972 World Heritage Convention

1. Definitions

Cultural Heritage is defined as:

(i) **Tangible forms of cultural heritage**, such as tangible moveable or immovable objects, property, sites, structures, or groups of structures, having archaeological (prehistoric), paleontological, historical, cultural, artistic, and religious values;

(ii) **Unique natural features or tangible objects that embody cultural values**, such as sacred groves, rocks, lakes, and waterfalls; and

(iii) Certain instances of **intangible forms of culture** that are proposed to be used for commercial purposes, such as cultural knowledge, innovations, and practices of communities embodying traditional lifestyles.

(iv) Graves and places of burial.

2. Emergency Impact Management Guidelines for Intact or Disturbed Archaeological and Palaeontological Deposits

The following requirements are to be executed in the event that an unrecorded cultural heritage site is discovered during any phase of the Contractor's activities:

- All activity in the vicinity of the find/feature/site will cease immediately.
- The artefact shall not be moved from where it has been found, unless supervised by the on-site NMK advisor.
- The on-site NMK advisor, together with the contractor / project manager, will undertake an inspection of the cultural heritage site.
- The discovered cultural heritage site will be delineated by the on-site cultural/archaeology advisor.
- The on-site NMK advisor will assess, record and photograph the cultural heritage site as per the appropriate Chance Finds Report,
- In consultation with the project manager and Contractor, the onsite NMK advisor will determine the appropriate course of action to take.
- Sensitive sites defined in the Chance Finds Report shall be marked off with hazard tape, detour signs and if necessary the site secured as detailed in the chance finds report. The site will be secured to prevent any damage or loss of removable objects.

Management Options

In consultation with the developer or Project Manager, the following options should be considered when deciding on how to proceed:

- Avoidance through partial or complete project redesign or relocation. This ensures minimal impact to the archaeological site and is the preferred option from a cultural resource management perspective. When feasible, it can also be the least expensive option from a construction perspective. This option is preferred as it will allow the later excavation of the finds with due scientific care and diligence.
- Emergency archaeological excavation, if necessary. This "salvage recovery" option is required where it is not possible to relocate the development project.
- Application of site protection measures, such as erecting fencing or barricades to protect the site, or capping the site area with fill. Appropriate protection measures should be identified on a site –specific basis.

3. Emergency Impact Management for Burial Sites

If definite or possible human remains are encountered:

- Immediately stop construction in the vicinity of the remains.
- Contact the project archaeologist for further guidance

If it is determined that the remains are not archaeological, negotiations will follow to establish an appropriate procedure for handling the remains. An appropriate protocol for handling human remains will require consultation with local communities. A human remains protocol should be established prior to commencement of construction.

Management Options

- Avoidance through partial or complete project redesign or relocation. This would ensure that the remains are protected from further disturbance.
- Salvage or emergency excavation to respectfully remove the remains for reburial in a location chosen by local residents.

Should the developer / contractor encounter archaeological artifacts, fossils or human remains, the form below should be filled for every finding.

Chance Finds Report

Chance Find Report				
Date (xx / xx / 2014)	Time (xx:xx)	Site Name	GPS Coordinates (Northing)	GPS Coordinates (Easting)
Description of Find				
Proximity to Contractor Activity				
Sensitivity				
Vulnerability				
Recommended Action Description				

Site Checklist	Yes / No	Comment
Responsible persons notified		
Coordinates verified		
Site Marked		
Site Secured		
Photograph(s)		

Impacts Assessed		
Actions Agreed		
Authorised Instruction		
National Museums Kenya Representative	**Position**	**Signed (Name)**
Contractor / Project Manager		**Signed (Name)**

Signed.....18/2/15

Head, Archaeology Section

NMK Chance Find Procedures.

The following requirements are to be excuted in the event that an unrecorded cultural heritage site (i.e archeological sites, historical sites, remains and objects, including graveyards and/or individual graves) is discovered during any phase of the Contractor's activities:

- All activity in the vicinity of the find/site will cease immediately.
- The artefact shall not be moved from where it has been found, unless supervised by the onsite NMK advisor.
- The on-site NMK advisor, together with the contarctor/project manager, will undertake an inspection of the cultural heritage site.
- The discovered cultural heritage site will be delineated by the on-site cultural/archeology advisor.
- The on-site NMK advisor will assess, record and photogragh the cultural heritage site as per the appropriate Chance find Report,
- In consultation with the project manager and contractor, the on-site NMK advisor will determine the appropriate course of action to take.
- Sensitive sites defined in the Chance Finds Report shall be marked off with hazard tape, detour signs and if necessary the site secured as detailed in the Chance Finds Report. The site will be secured to prevent any damage or loss of removable objects.

Chance Finds Report.

Chance Find Report				
Date (xx/xx/2018)	**Time (xxx)**	**Site Name**	**GPS Coordinates (Northing)**	**GPS Coordinates (Easting)**
Description of find				
Proximity to Contractor Activity				
Sensitivity				
Vulnerability				
Recommended Action Description				

Site Checklist	**Yes/No**	**Comment**
Responsible persons notified		
Coordinates verified		
Site Marked		
Site Secured		
Photogragh(s)		
Impacts assessed		
Actions agreed		
Authorised Instruction		

National Museum Kenya Representative	**Position**	**Signed (Name)**
Contractor/Project Manager		**Signed (Name)**

NATIONAL MUSEUMS OF KENYA

WHERE HERITAGE LIVES ON

Ref: NMK/DMSM/STM/01/15

February 16, 2015

Mr. Paul Nguru,
The Director
QPEA GT Menengai Limited,
Apollo Centre, 2nd Floor, Wing A
Ring Road Parklands Westlands,
P.O Box 764 – 00606
Nairobi

Dear Mr. Nguru,

Re: Statement of No Objection – National Museums of Kenya

This is to certify Quantum Power East Africa in their development of a 35MW Geothermal Power Plant in the Menengai Crater in the Central Rift Valley following an archaeological and cultural site visit to assess the potential of the site on the same.

The findings of the visit indicate that the area within which the project is being undertaken has no archaeological objects, cultural or monuments above ground. It is however noted that the site lies in a region that is rich in Later Stone Age sites and there are possibilities that objects of archaeological or cultural interest including human burials may be uncovered during construction. The Developer is therefore requested to pay attention to the Chance Finds Procedures provided in the report to avoid damaging any such resources.

We wish Quantum Power EA success in their undertaking to provide energy to the people of Kenya.

Please find attached the site report and a manual on Chance Finds Procedure.

Yours sincerely,

Dr. Purity Kiura
Ag. Director, Museum Sites and Monuments

Address P.O. Box 40658 00100 GPO Nairobi Telephone 254 20 4448930/3 . 254 20 3742161/4 . 254 20 3742131/4 Fax 254 20 3741424 Website www.museums.or.ke

Appendix VII: Draft Grievance Redress Mechanism

DRAFT GRIEVANCE REDRESS MECHANISM

1.1 General

Anyone will be able to submit a grievance to the Project, if they believe any practise by the project is having a detrimental impact on the community, the environment, or on their quality of life. They may also submit comments and suggestions on how such issues can be handled or prevented.

Any comments or concerns can be brought to the attention of Sosian Power Plant Ltd either verbally or in writing (by post or e-mail) or by filling in a grievance form.

The steps taken for receiving and handling any comments pertaining to the Project are outlined below.

1.1.1 Management of Project Staff Grievances

Staff grievance management systems will be in compliance with the Sosian HR Policies and procedures as well as the Kenyan labour laws as well as International Labour Organisation (ILO) standards to which Kenya subscribe.

Sosian and GDC will pay special attention to the modalities provided for staff recruited from the local community as a means of managing social risks on the project that arise from poor management of employment of local labour.

Sosian will also review all the policies and procedures of appointed contractors and sub-contractors to ensure that they have the same values and requirements in line with Sosian policies and Kenyan law. Legal requirements will be entrenched in the contracts as per standard requirements for development projects. Sosian will also monitor the observance of employee freedoms and document the challenges faced by the employers in a bid to identify solutions for subsequent improvements on working conditions for all project staff.

Where there are gaps between the policies and procedures, Sosian will aim to influence the third parties to improve on them to promote equity in project standards toward all project staff.

1.1.2 Stakeholder Grievance Management Mechanism

(a) Objectives

The objectives of the grievance management mechanism are to:

- Provide stakeholders with a clear process for providing comment and raising grievances;
- Allow stakeholders to raise concerns without fear of retribution;
- Structure and manage the handling of comments, responses and grievances, and allow monitoring of effectiveness of the mechanism; and
- Ensure that comments, responses and grievances are handled in a fair and transparent manner in line with GDC policies, Kenyan laws, international best practice and lender expectations.

It is also understood that stakeholders may complain to other bodies other than GDC and the Geothermal Committee. Such bodies with a mandate on issues regarding land and environment are:

- The National Environment Management Authority (NEMA);
- The National Environment Tribunal;
- Land and Environment Court.

In consideration of the above, the assumptions adopted under this mechanism are as follows:

- These bodies be considered as a last resort by all the stakeholders;
- These bodies be approached only after all the other levels of grievance mechanism as proposed under this SEP have been exhausted.

This mechanism also recognises that the EPRA grievance management mechanism starts with confirmation of whether the project proponent has dealt with the grievance prior to their intervention.

As such, stakeholder buy-in and ownership into the mechanism is critical for the mechanism to function as expected.

STEP 1: Submission by Stakeholders

A comment/grievance can be submitted to Sosian in a number of ways either directly or through GDC;

- During regular public meetings held with the communities;
- Through Consultative Forums with stakeholders;
- Through the community thematic committees established with GDC:
- During any informal meetings;
- Through communication directly with management – for example a letter addressed to site management, or other operational offices;
- By telephone;
- Placing a comment in the community suggestion boxes at the HSE manager's office; and
- By registering a complaint in a Grievance and Concerns logging form.

For comments that have been submitted informally, the HSE Manager, in liaison with GDC community liaison officer, will arrange for a meeting where the comment can be explained in full and written down on a **Grievance/Concerns Register (See the Proposed Grievance Redress Mechanism forms)**. For all comments the HSE Manager will be the main point of contact, and will be responsible for making sure that response reach the commenter.

STEP 2: Logging the Comment

Complaints are received in the form of oral/written, mail and phone. All comments and concerns must be logged by using the **Grievance/Feedback form** and registered in the **Grievance/Concerns register** upon receipt **(See the Proposed Grievance Redress Mechanism forms).** HSE manager will handle the complaint where a decision is made to either process or reject the complaint.

STEP 3: Providing the Response

All grievances will be acknowledged within 5 days. If immediate corrective action is available, response will be made within the 5 days; if no immediate corrective action is available but no detailed investigations/hearings are required, a response will be provided within 14 days. This must be explained in writing to the aggrieved party.

Grievances will be categorized based on validity and risk level (Screening) jointly by both Sosian and GDC. Screening criteria will be jointly formulated with GDC team to define:

- External/Frivolous cases, having nothing to do with the project
- Urgent
- Important

Where investigations are required, relevant project staff and outside authorities where appropriate, will assist with the process.

Sosian will identify an appropriate investigation team with the correct skills to review the issue raised and to decide whether it is Project related or whether it is more appropriately addressed by a relevant authority outside the Project. This external team will work closely under supervision of the HSE Manager.

The HSE Manager will explain both in writing and orally the manner in which the review was carried out, the results of the review, any changes to activities that will be undertaken to address the grievance and how the issue is being managed to meet appropriate environmental and social management systems and requirements.

Where police investigation is required, the law will take its course. However, the project team will also monitor and document progress

STEP 4: Investigating the Grievance

If the grievance has to be investigated, then the HSE Manager in collaboration with GDC counterpart shall aim to complete investigation within two weeks after the grievance first log-in. Depending on the nature of the grievance, the approach and personnel involved in the investigation will vary.

The HSE manager will meanwhile continually update the aggrieved on the progress of the investigation and the timeline for its conclusion.

STEP 5: Concluding/resolving the root cause of the grievance

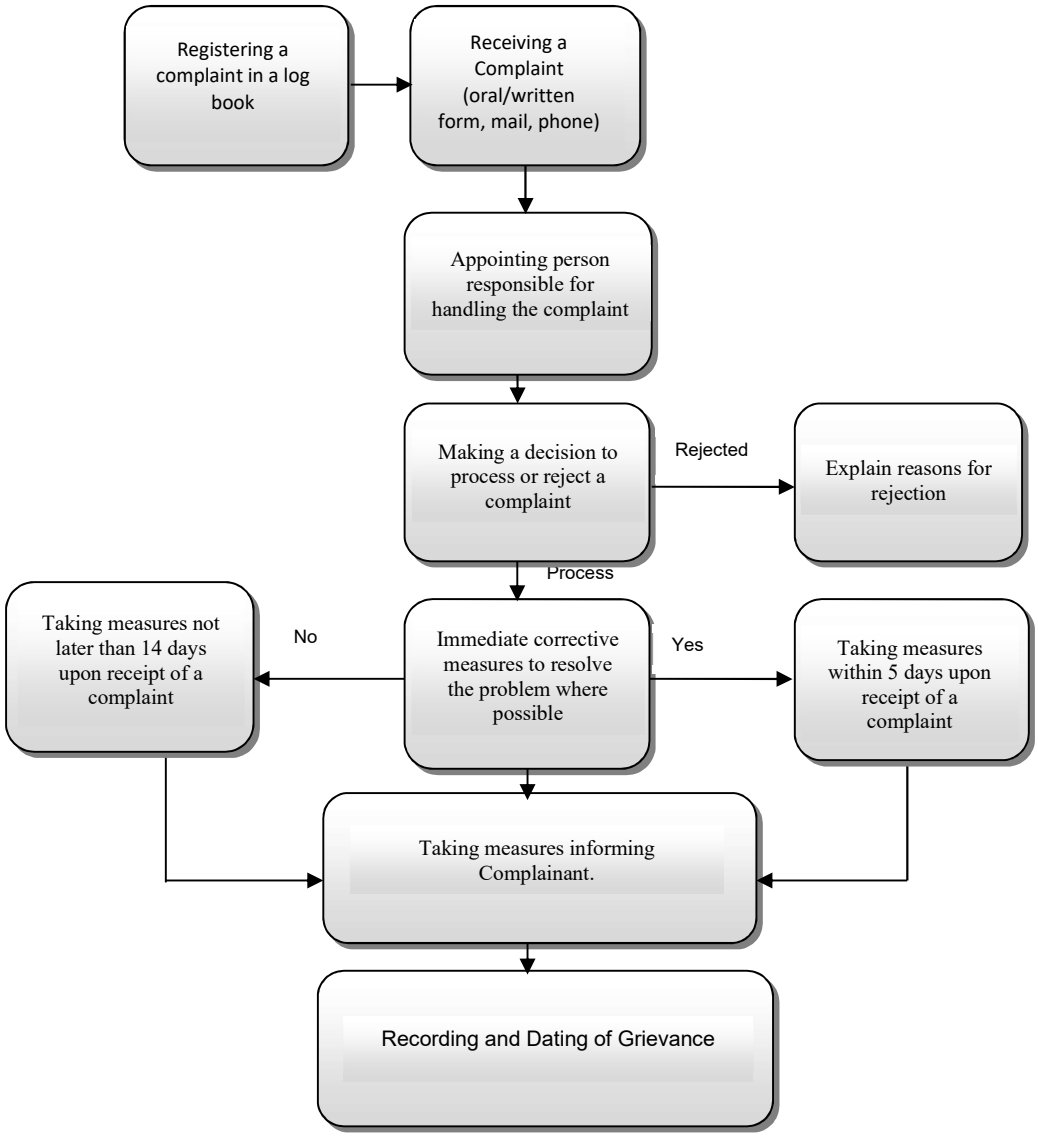
The HSE Manager will outline the steps taken to ensure that the grievance does not re-occur. This will ensure that lessons learnt through the process is considered and eliminated.

STEP 6: Taking further steps if the grievance remains open

If the grievance still stands, then the HSE Manager will initiate further investigation and determine the steps for future action. In the meanwhile, the community will be updated about the process through the area Chief/thematic committee/GDC/Sosian.

Figure 1 provides a framework of the response mechanism.

Figure 1: Grievance Response Mechanism



ESCALATION

Should one or all the parties not be satisfied with the resolutions, they will be free to pursue the avenues provided by the Laws of Kenya.

1.2 Record Keeping

All comments, responses and grievances will be logged by the HSE manager using the stakeholder engagement from and register. Hard copies of the form will be kept at the project site, whilst soft copies will be scanned and saved on the Sosian Power Plant Ltd server. Any accompanying documentation e.g. written statements, photographic evidence, or investigation reports are to be filed along with the grievance log both in hard and soft copies.

PROPOSED GRIEVANCE REDRESS MECHANISM FORMS.

Proposed Grievance/Feedback Logging Form.

Name of Commenter/Aggrieved		Comment/Grievance Log Ref. No.	
Name of Organisation/Position			
Physical Address		Mailing Address: P.O Box	
Telephone/Mobile:			
Email Address			
Most effective means to send a response	Official letter	Email	Physical Meeting
Date of Comment/Grievance			
Date Logged			
Nature and location of Comment/Grievance			
Recieved by: Name: _____ Designation: _____ Signature: _____			
Initial Response Details: Sent by: Name: _____ Designation: _____ Signature: _____			
Date of Submission of Response			
Resolved/Addressed by			
Nature of Resolution			
Date of Resolution			
Signed (DPM rep)			
Name: _____ Designation: _____ Signature: _____			

Any supporting/subsequent document to be appended to the form

PROPOSED GRIEVANCE REDRESS MECHANISM FORMS.

Proposed Grievance and concerns Register

Ref No.	Date	Name	Address	Description of grievance	Date of grievance	One time / Recurrent grievance	Resolution (Resolved/Ongoing/ escalceted)	Taken by whom	Resolurtion satisfactory	If no, why?

Appendix VIII: Registration of Work Place Certificate

DOSH 22

S. No. 42735

Certificate No. **NKU22231/02/17/00**

Date of Issue **01-Feb-17**

Date Of Expiry **01-Feb-18**

REPUBLIC OF KENYA

THE OCCUPATIONAL SAFETY AND HEALTH ACT, 2007

CERTIFICATE OF REGISTRATION OF A WORKPLACE

I hereby certify that the workplace named below has been duly registered in pursuance of sections 44/45(6) of the Occupational Safety and Health Act, No. 15 of 2007

Name of Occupier: **SOSIAN MENENGAI GEOTHERMAL POWER LTD**

Address: P. O. Box **2548** - **00606** **NAIROBI**

Plot No.: **L.R 119315** Street/Road: **MENENGAI CALDERA REGION**

Town: **NAKURU** County: **NAKURU** District: **NAKURU**

Nature of Work: **CONSTRUCTION OF POWER PLANT/ GROUND BREAKING**

Reg. Fee: KShs. **2000** **OSH Fund: KShs.** **3000**

Director of Occupational Safety and Health Services

NOTE

This Certificate is valid only in respect of the Occupier and Workplace named above

This Certificate is issued under, and solely for the purposes of the Occupational Safety and Health Act and is without prejudice to the requirements of any other legislation relating to the workplaces.

Appendix IX: TOR for Select Community Committee

MENENGAI PROJECT COMMITEES
TERMS OF REFERENCE

CATEGORIES OF COMMITEES	*Youth organization committees , Wanyororo Community water committee, St .John/Bahati hospital Commitee*
PARTIES INVOLVED	*GDC , Provincial Administration ,National Administration, County Administration ,Host community /other Govt. institutions*

Youth Committees

TORs

- Link between GDC and the youth within the host community
- Conduct quarterly youth review meetings
- Disseminate the information of the companies activities for youth in the community
- Liaise with other stakeholders on youth related matters ;Financial, and Technical support and any other necessary support
- Conflict resolution and management of local community matters that may affect GDC operations
- Ensure equal representation and distribution of arising job opportunities in Menengai project
- Establish a data base for unemployed youth in the project area

Wanyororo B Community Project Water Committee

TORs

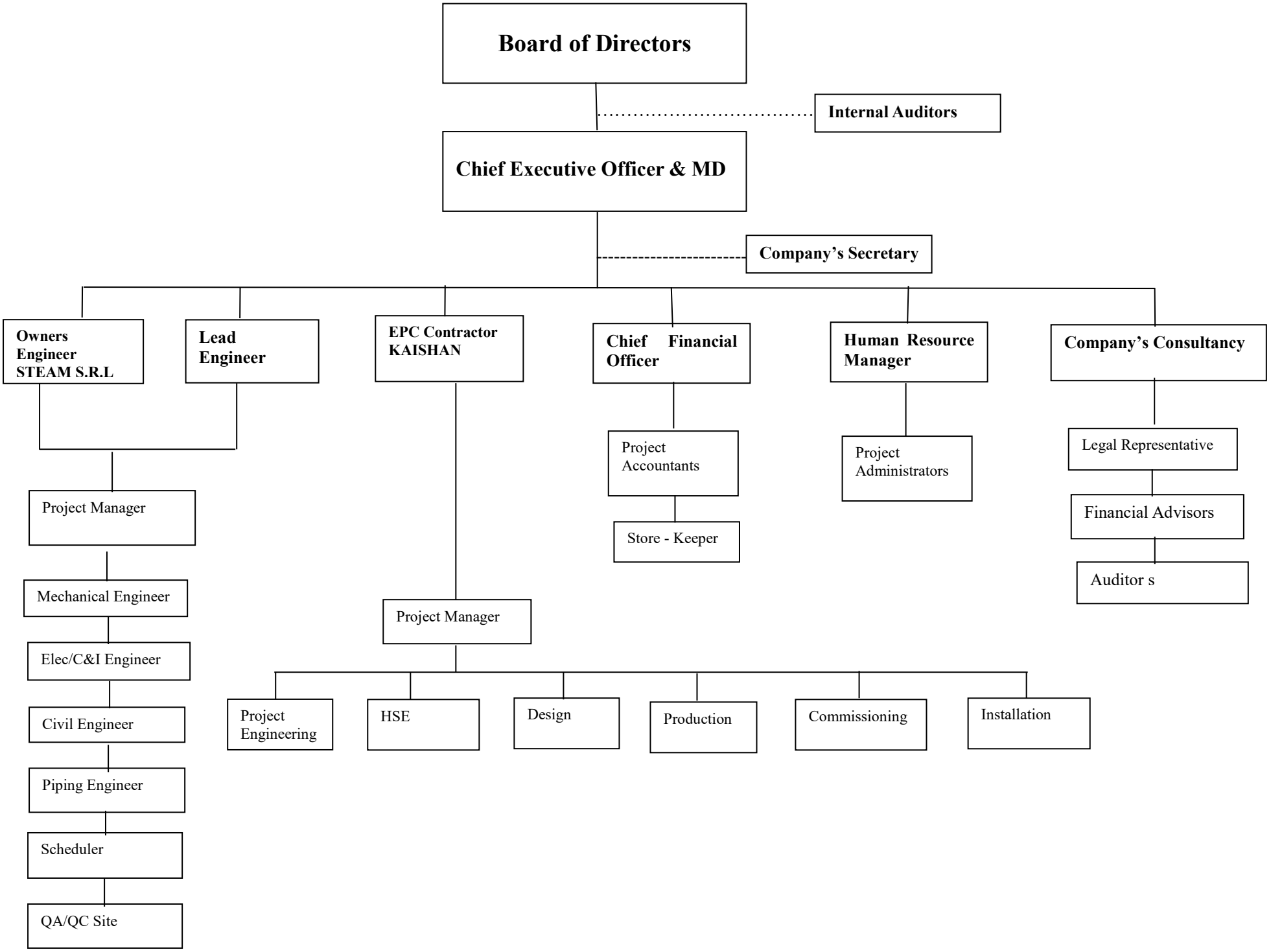
- Responsible for day to day operations of the Wanyororo B water project
- Participate in community sensitization meetings
- Repair and maintance of waterline in partnership with GDC
- Submit progress reports

ST John Dispensary / Bahati Hospital Committee

TORs

- Link between the health facilities in Menengai Project, GDC and other stakeholders
- Prepare and submit quarterly reports on operations of the donated ambulance and renovated hospital theatre.
- Managing the daily operations of the donated ambulance.
- Organize meetings for its members for regular updates from GDC and other stakeholders within its areas of operation
- Disseminate health related information /talks to the host community and GDC
- Mobilise for support from other stakeholders in support of health projects within Menengai project

Appendix X: Sosian Organogram


Board of Directors
Internal Auditors
Chief Executive Officer & MD
Company's Secretary
Owners Engineer STEAM S.R.L
Lead Engineer
EPC Contractor KAISHAN
Chief Financial Officer
Human Resource Manager
Company's Consultancy
Project Accountants
Store - Keeper
Project Administrators
Legal Representative
Financial Advisors
Auditor s
Project Manager
Mechanical Engineer
Elec/C&I Engineer
Civil Engineer
Piping Engineer
Scheduler
QA/QC Site
Project Manager
Project Engineering
HSE
Design
Production
Commissioning
Installation

GIBB International
CONSULTING · DESIGN · MANAGEMENT

DOCUMENT CONTROL SHEET

FORM MP180 / B

Project Name and Number	Environmental and Social Impact Assessment Report for The Development Of 1x35 Mw Geothermal Power Plant in Menengai, Kenya. JK-001089
Title of Report	Draft Final ESIA Report
Client	Sosian Power Plant Limited
Project Coordinator	Moses Mulwa / Tom Gomyo.
Project Reviewer	Aggrey Kwadha & Anastasia Ngatti
Quality Manager	Mercy Ogola
Task Leader	Aggrey Kwadha
Team Members	Maurice Namiinda, George Owuor, Anastasia Ngatti, Aggrey Kwadha, Paul Mwangi, Alfrick Murunga, and Rodrigues Nyandwaro
Sub Consultants	**N/A**

	Prepared by	**Reviewed by**	**Approved by**
ORIGINAL	NAME **Rodrigues Nyandwaro**	NAME **Aggrey Kwadha**	NAME **Anastasia Ngatti**
DATE 20 September 2019	SIGNATURE	SIGNATURE	SIGNATURE

UPDATED	NAME	NAME	NAME
DATE	SIGNATURE	SIGNATURE	SIGNATURE

REVISION	NAME	NAME	NAME
DATE	SIGNATURE	SIGNATURE	SIGNATURE

This report, and information or advice that it contains, is provided by GIBB Africa Ltd solely for internal use and reliance by its Client in performance of GIBB Africa Ltd duties and liabilities under its contract with the Client. Any advice, opinions, or recommendations within this report should be read and relied upon only in the context of the report as a whole. The advice and opinions in this report are based upon the information made available to GIBB Africa Ltd at the date of this report and on current international standards, codes, technology and construction practices as at the date of this report. Following final delivery of this report to the Client, GIBB Africa Ltd will have no further obligations or duty to advise the Client on any matters, including development affecting the information or advice provided in this report. This report has been prepared by GIBB Africa Ltd in their professional capacity as Consulting Engineers. The contents of the report do not, in any way, purport to include any manner of legal advice or opinion. This report is prepared in accordance with the terms and conditions of the GIBB Africa Ltd contract with the Client. Regard should be had to those terms and conditions when considering and/or placing any reliance on this report. Should the Client wish to release this report to a Third Party for that party's reliance, GIBB Africa Ltd may, at its discretion, agree to such release provided that:

(a) GIBB Africa Ltd written agreement is obtained prior to such release, and
(b) By release of the report to the Third Party, that Third Party does not acquire any rights, contractual or otherwise, whatsoever against GIBB Africa Ltd and GIBB Africa Ltd accordingly, assume no duties, liabilities or obligations to that Third Party, and
(c) GIBB Africa Ltd accepts no responsibility for any loss or damage incurred by the Client or for any conflict of GIBB Africa Ltd interests arising out of the Client's release of this report to the Third Party.

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