Approved Report on Solar Ground Mounted Project for Galkayo Electric Company

Introduction

This report encompasses the outcomes derived from our preliminary investigation, on-site surveys, and geotechnical laboratory analyses. Additionally, we present our conclusions regarding the prevailing geotechnical conditions at the site, along with recommendations for the project's design and construction.

The intention behind the proposed solar ground-mounted project is to efficiently utilize renewable energy sources while also advancing sustainable development objectives. This report outlines the examinations undertaken to evaluate the geotechnical and topographical appropriateness of the site, alongside the chemical analysis of soil and water. These assessments are suitable for guaranteeing the project's viability.

Geotechnical Studies

Geotechnical assessments were executed to appraise soil characteristics and determine optimal foundation designs for the solar project. The collection of soil samples facilitated the analysis of various parameters including grain size, moisture content, and bearing capacity. Additionally, soil quality tests were conducted to evaluate soil stability and propose suitable foundation options.

Vegetation at the site consist of a moderate growth of brush without large trees and may require bush clearing for the alignment of the site.

Topographical Studies

Topographical surveys were undertaken to comprehend the terrain of the site and aid in efficient site planning and design. Contour plans were prepared at designated intervals. These surveys provided valuable information on elevation changes, permanent landmarks, and magnetic alignments, all of which are fundamental for enhancing the arrangement of solar panels and associated infrastructure.

Soil and Water Chemical Analysis

Chemical analyses were performed on both soil and water to evaluate their appropriateness for the solar project and to gauge potential environmental impacts. Soil analyses evaluated factors such as sulphate, phosphate, and chloride levels to ascertain the likelihood of corrosion and provide insights into foundation design deliberations. Similarly, water assessments encompassed parameters such as pH, total dissolved solids, and turbidity to gauge water quality and its adequacy for diverse project requirements, including irrigation and construction activities. The findings indicate the stability and viability of ground-mounted structures within the proposed site.

Conclusion

After thoroughly reviewing the background data, conducting subsurface investigation, geotechnical laboratory tests, and surveys was considered at the proposed solar farm is viable from a geotechnical perspective, provided that the recommendations outlined in this report are integrated into the project's design and implementation. In essence, the following conclusions have been drawn:

- Field and laboratory assessments indicate that the site predominantly consists of topsoil.
- field observations suggest that by blending granular rocks with the topsoil, its structural integrity can be significantly enhanced.
- Groundwater is only encountered at considerable depths, approximately 250-400 meters below the ground surface.
- The site is not deemed corrosive based on evaluations.

In our recommendation, it is important to consider concrete structures to be mounted the solar structures.

APPOVED BY

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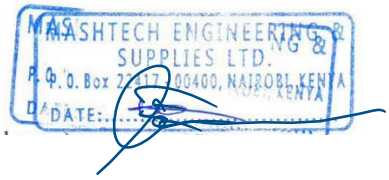
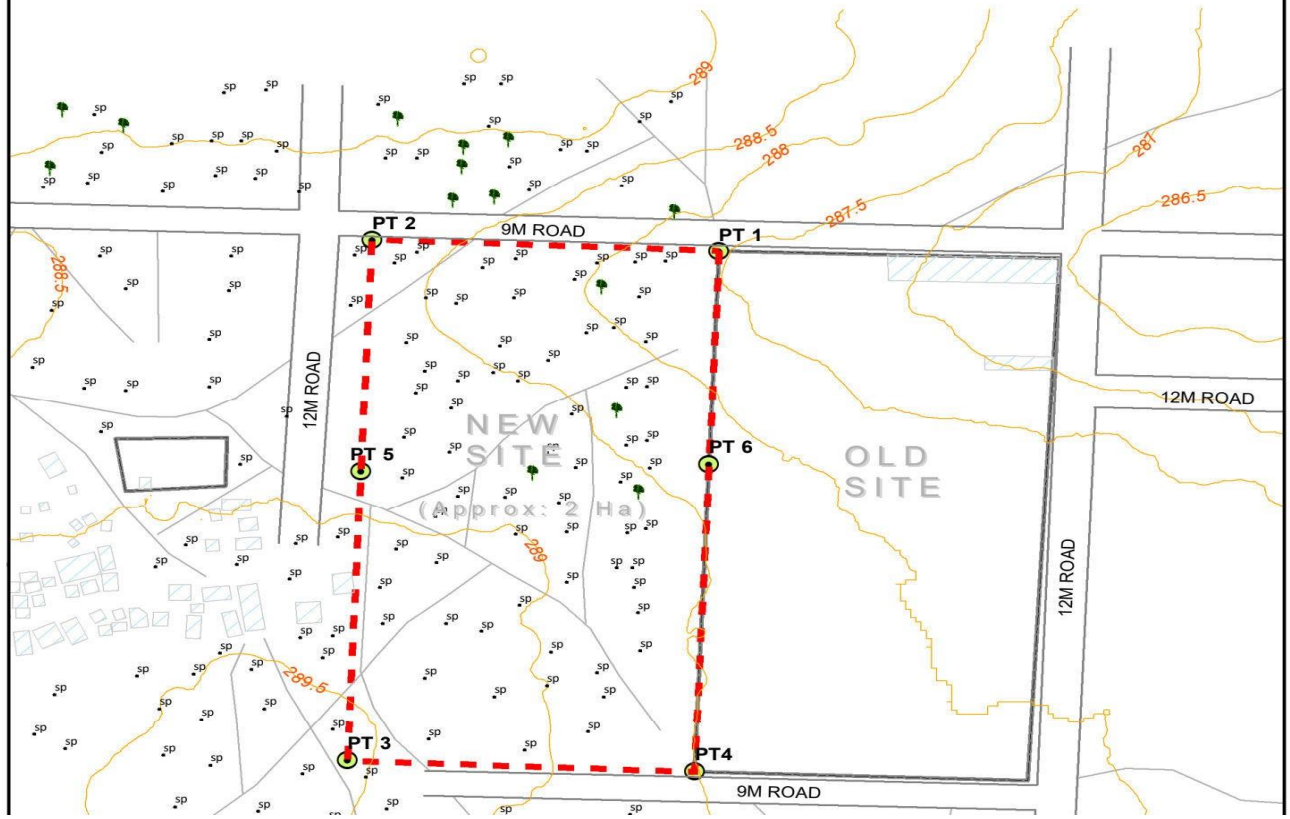


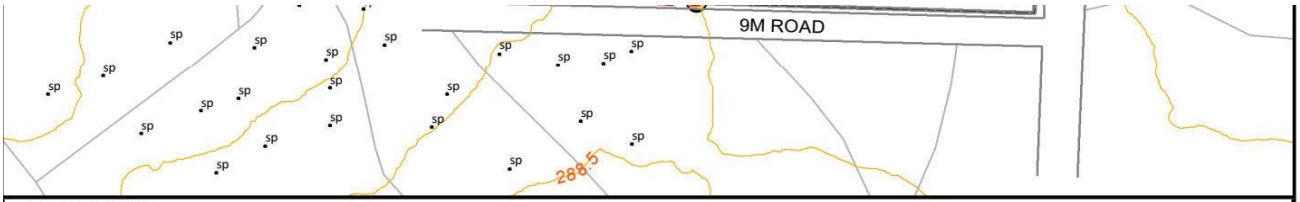
Geotechnical, Topographical Studies and Soil Chemical Analysis

A topographical survey was conducted to define the distinctive features and geographic attributes of a new land slated for acquisition during the project implementation phase. Situated adjacent to the existing plant, this additional parcel spans an area of 20,000 square meters. Notably, the land stands vacant, devoid of any existing structures or occupancy. Prior to finalizing the acquisition, a preliminary geological survey was conducted, accompanied by comprehensive chemical testing of both the soil and water samples at a reputable laboratory. This thorough assessment aimed to ascertain the suitability of the land for the intended project purposes and to identify any potential environmental or geological concerns.

The analysis of the land's terrain provided valuable insights into its topographical characteristics, laying the groundwork for informed decision-making during the acquisition and subsequent development phases. Additionally, basic characteristics of the land, crucial for its integration into the project scope, were thoroughly evaluated to ensure compatibility with the intended development objectives. Furthermore, the topographical map generated from the survey serves as a visual representation of the land's geographic layout and physical attributes. This detailed mapping not only aids in understanding the spatial relationships within the site but also facilitates effective communication among project stakeholders.

TOPOGRAPHICAL SURVEY OF GECO ELECTRIC PROJECT





LEGEND

- Tree
- Spot height
- Corner Pickings
- Contour line
- Road Network
- Footpath
- Structure
- Wall Fence
- New Site

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Survey Methodology

The topographical survey conducted for the GECO Electric Project utilized a Total Station Machine (TS) to aid in the planning process. The survey comprehensively considered various features, including mature trees, fence lines, structures, footpaths, spot heights, existing roads, and neighboring boundaries. Notably, the land's boundary was clearly demarcated, and both Magnetic North and True North were accurately fixed, as depicted on the plan. A contour plan was prepared at intervals of 0.5 meters, and precise measurements of magnetic inclination and declination were determined.

The survey data was compiled into a plan showcasing cross-sections at 50-meter intervals along the East-West and North-South directions, which are editable in ArcGIS (AutoCAD Software). However, it's worth noting that the coordinates of the area of interest were randomly selected at labelled corners, denoted as PT1 through PT6 on the Topographical Plan. The surveyed area was estimated to be approximately 5 acres (2 ha) for the new site and 5 acres (2 ha) for the old (existing site) with observations indicating a generally flat terrain across the site.

This comprehensive topographical survey provides essential insights into the terrain and features of the GECO Electric Project site. The diligent use of advanced surveying equipment and techniques, such as the Total Station Machine, ensured accuracy and reliability in data collection.

The detailed plan, including contour lines and cross-sections, offers valuable information for project planning and design. This report serves as a vital foundation for further project development and implementation, aiding in informed decision-making and efficient resource allocation.

Soil Tests

Soil Chemical Analysis

Soil chemical test was performed at material testing and research division headquarters in Nairobi, Kenya. Sample was collected from the sites and transported to Nairobi Kenya for accurate information as this was the only laboratory neighboring the country that is widely used and give accurate information. The sample result took a week, and the result certificate is attached in the appendix. The result shows PH, Chlorides, Sulphates, and organic content percentages as follow 6.84, 0.60, 1.81, 0.19 respectively. The land is considered for construction. A pH value of 6.84 falls within the neutral to slightly acidic range. This pH level is generally suitable for construction, as it indicates soil conditions that are not excessively acidic or alkaline.

The percentages of chlorides and sulphates are within acceptable limits for construction materials. The values (0.60% for chlorides and 1.81% for sulphates) are not considered problematic and are typically well below the threshold where adverse effects are a concern.

The organic content percentage of 0.19% suggests that the soil has a low organic matter content. This is generally favorable for construction, as excessive organic content can lead to settlement issues and reduced stability in engineered structures.

Geophysical investigation methods

Several geophysical techniques can aid in evaluating subsurface geological conditions. In this survey, resistivity measured with an earth resistance tester, was employed. The process included positioning four electrodes at a 2-meter interval. The readings were directly retrieved from the digital display of the earth resistance tester. Five tests were conducted, yielding resistivity values ranging from 35 to 60 ohms.

This data can be interpreted into the subsurface characteristics. For instance, lower

resistivity values may indicate the presence of materials with higher conductivity, such as water-saturated sediments or rocks, whereas higher resistivity values may suggest the dominance of less conductive materials like dry soil or bedrock. The variation in resistivity across the tests can also provide information about changes in subsurface composition or structure.

Water Chemical Test

Water testing is crucial when doing project construction and for this case water sample was taken to the same laboratory of material testing and research division in Nairobi-Kenya. The result is attached in the appendix.

During the water testing, pH, alkalinity, total dissolved solids, sulphates, and chlorides were tested and investigated. The result shows that the pH is within the required limit. Alkalinity was confirmed to be 70ppm, while sulphates, chlorides and total dissolved solids are 412.8ppm, 56.8ppm and 1100 respectively.

A value of 70 ppm suggests moderate alkalinity, which is typically considered acceptable for most uses but not direct drinking. It was also confirmed that the water is heavy and can only be used for construction purposes, but direct drinking is not viable.

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Ref No. **M.1387/35/F/82/2211**

Date: 23 February, 2024

Laboratory Test Report

1. Customer's Name: **Mohamed Diyad Elmi (Geco Representative Consultant)**
   E-mail: **mohamedelmi18@gmail.com**
2. Customer's Address: **P.O. Box 85055-00200, Nairobi** Phone: **0724355163**
3. Sample Description: **Soil** 6. Job Card No:
4. Sample Submitted by: **Client** 7. Date fee paid: **19/02/2024**
5. Date of Sample receipt: **19/02/2024** 8. GOK MR No: **SBK8MO4CXI**
9. Date Analysis started: **19/02/2024**
10. Additional information provided by the customer: **Geco-Plant Hybridization**

RESULTS FOR CHEMICAL ANALYSIS OF SOIL SAMPLE

Our Ref.	473/Ch/23/24
Your Ref.	Galkayo Town Soil
pH	6.84
Chlorides as Cl^-, %m/m	0.60
Sulphates as SO_3, %m/m	1.81
Organic content, %m/m	0.19

NB: The test results are specific for sample tested.

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2. Customer's Address: **P.O. Box 85055-00200, Nairobi** Phone: **0724355163**
3. Sample Description: **Water** 6. Job Card No:
4. Sample Submitted by: **Client** 7. Date fee paid: **19/02/2024**
5. Date of Sample receipt: **19/02/2024** 8. GOK MR No: **SBK8MO4CXI**
10. Additional information provided by the customer: **Geco-Plant Hybridization** 9. Date Analysis started: **19/02/2024**

RESULTS FOR CHEMICAL ANALYSIS OF WATER SAMPLE

Our Ref.	471/Ch/23/24	BS 3148 Specifications
Your Ref.	Galkayo Town Water	
pH	6.80	4-10
Chlorides as Cl^-, ppm	56.8	500 Max
Sulphates as SO_3, ppm	412.8	1,000 Max
Alkalinity as $CaCO_3$, ppm	70	1,000 Max
Total dissolved solids, ppm	1100	2,000 Max

NB: The test results are specific for sample tested.

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