


Environmental and Social Impact Assessment for Proposed Golomoti Solar Project, Dedza

Final Report

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Environmental and Social Impact Assessment for Proposed Golomoti Solar Project, Dedza

Final Report

Emlen Myers
Partner

Environmental Resources Management (ERM)
1776 I Street, NW, Suite 725
Washington, DC 20006

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Acronyms and Abbreviations

AC	Alternating current
AIDS	Acquired Immune Deficiency Syndrome
AoI	Area of Influence
AST	Above-ground Storage Tank
CBO	Community Based Organisation
CESMP	Construction Environmental and Social Management Plan
CFP	Chance Find Procedure
CHAM	Christian Association of Malawi
CHSMP	Construction Health & Safety Management Plan
CLO	Community Liaison Officer
DAoI	Direct Area of Influence
DC	Direct Current
DC	District Commissioner
EAD	Environmental Affairs Department
EGENCO	Electricity Generation Company of Malawi
EHS	Environmental, health, and safety
EIA	Environmental Impact Assessment
EMA	Environmental Management Act
ERM	Environmental Resources Management
ESCOM	Electricity Supply Corporation of Malawi Limited
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
FGD	Focus ground discussion
GASO	Golomoti AIDS Support Organisation
GHG	Greenhouse gas
GVH	Group Village Headman
HIV	Human immunodeficiency virus
HR	Human Resources
HVDC	High voltage direct current
IAoI	Indirect Area of Influence
IESC	Independent Environmental and Social Consultant
IFC	International Finance Corporation
ILO	International Labour Organisation
IPP	Independent power producer
IUCN	International Union for Conservation of Nature
KII	Key informant interview
KOP	Key observation point
LRP	Livelihood Restoration Plan
MBS	Malawi Bureau of Standards
MDHS	Malawi Demographic and Health Survey
MERA	Malawi Energy Regulatory Authority
MRA	Monuments and Relics Act
MW	Megawatt
MWac	Megawatt alternating current
MWK	Malawian kwacha
NCLS	National Child Labour Survey
NEAP	National Environmental Action Plan
NEP	National Environmental Policy
NGO	Non-Governmental Organisation
O&M	Operations and maintenance
PAP	Project-affected people
PPA	Power Purchase Agreement
PS	Performance Standard
PV	Photovoltaic
RET	Renewable Energy Technology
SADC	Southern African Development Community
SEP	Stakeholder Engagement Plan
SME	Small and medium enterprise
STI	Sexually transmitted infection
TA	Traditional Authority
ToR	Terms of Reference
UNESCO	United Nations Educational, Scientific and Cultural Organisation
USD	United States dollar
USTDA	United States Trade and Development Agency
VSL	Village Savings and Loans
WHO	World Health Organisation
WRA	Water Resource Area
WRI	World Research Institute
WWEC	Water Waste and Environmental Consultants

EXECUTIVE SUMMARY

Introduction

This report presents the results of an Environmental and Social Impact Assessment (ESIA) of the proposed Golomoti Solar Project, Dedza District. The Project proponent is Golomoti JCM Solar Corporation Limited (JCM). Project sponsors include JCM Power, InfraCo Africa, and the Project's development partner is Matswani Capital (PTY). JCM Power is an independent power producer (IPP) dedicated to accelerating social, economic, and environmental sustainability in growth markets through the development, construction, and operation of renewable energy facilities and high voltage direct current (HVDC) transmission lines. InfraCo Africa seeks to alleviate poverty by mobilising private sector expertise and finance to develop infrastructure projects in sub-Saharan Africa.

The Project will take approximately 10 months to construct, and construction is expected to start in April 2020. It is anticipated that the Project will require approximately 200 workers (skilled and unskilled) during the construction phase and 20 workers (skilled) during the operation phase. The Project has an investment value of USD 35,000,000 and will be operational for a minimum of 20 years, with possible extension by mutual agreement. JCM has a Power Purchase Agreement (PPA) with the Electricity Supply Corporation of Malawi Limited (ESCOM) to deliver the power from the Project directly into the national grid through the 0.5 km transmission line to the Golomoti Substation.

Nature of the Project

The proposed Project is a 20-megawatt (MW) alternating current solar photovoltaic (PV) plant to be constructed on a 92 hectare (ha) parcel (Solar Plant Site) located approximately 0.5 km from the Golomoti Substation and less than 1 km from Golomoti Trading Centre in Dedza District. It is located within the Kachindamoto Traditional Authority. The Project will also include the construction of a short (approximately 0.5 km) transmission line from the Solar Plant Site to the Golomoti Substation, as well as a short (approximately 80 m) access road extending from the highway to the northeast (M5) to the Solar Plant Site. A detailed Project description is provided in Section 2 of this report.

Project Justification

This Project is an investment in renewable energy and will help with the diversification of the energy sector, as well as add to increased capacity for the national grid. In addition, the Project is part of the government IPP process and is part of sector reform development.

ESIA Process

JCM submitted a Project Brief to the EAD in November 2018 in compliance with Malawi's Environmental Management Act of 1996 and the EAD's Guidelines for Environmental Impact Assessment (www.sdnp.org.mw/enviro/eia). The EAD responded in a letter dated December 14, 2018. The letter states that the Project is "required to conduct an Environmental and Social Impact Assessment (ESIA) before implementation of the proposed activities on the site." The letter also includes the EAD's Terms of Reference (ToR) for the ESIA (Appendix A).

This ESIA Report was prepared in compliance with the Environmental Management Act of 1996, EAD's Guidelines for Environmental Impact Assessment, and other applicable Malawian laws and regulations, as detailed in Section 4. The report was also prepared in compliance with the EAD's ToR for the Project.

ESIA Methodology

The purpose of the impact assessment process is to identify any likely significant impacts on environmental or social receptors as a result of the Project and to develop appropriate mitigation measures to effectively manage these impacts. To determine the significance of potential impacts, this ESIA considers two main factors: impact magnitude and receptor sensitivity/vulnerability. Magnitude is a measure of the changes to a receptor that will potentially result from the Project, while sensitivity/vulnerability is a measure of how sensitive or vulnerable a receptor (e.g., people, flora, or fauna) is to these changes.

There is no statutory or internationally agreed upon definition of significance; however, this assessment will use the following practical definition:

> An impact will be judged significant if, in isolation or in combination with other impacts, it will cause a notable change from baseline conditions and may require mitigation to manage the effects on/risks to a receptor from this change.

Evaluating impact significance is an iterative process and follows the following cycle: identify potential impacts; evaluate receptor sensitivity/vulnerability; evaluate magnitude of potential impacts; determine significance of potential impacts; and determine significance of residual impacts. Additional details regarding the ESIA methodology are provided in Section 6.1.

The potential impacts assessed in the ESIA were determined based on the results of a scoping exercise, which is described in Section 6.2. The assessment of positive impacts is presented in Section 6.3, and the assessment of potential negative impacts is presented in Section 6.4.

Summary of Impacts

The key positive and potential negative impacts identified in the ESIA and a summary of their proposed enhancement and mitigation measures, respectively, are provided below. The only potential negative impact assessed to be major was economic displacement. All other potential negative impacts listed below were assessed to be moderate or minor. In terms of unplanned events, the impact of spills was assessed to be major for both construction and operation, and the impact of traffic accidents was assessed to be major for construction.

Positive Impacts

- Generation of Electricity: The generation of 20 MW of power will lead to a 7.4% increase in the generation capacity of Malawi, representing a significant benefit to the macro economy of the country. The distribution of electricity in Malawi falls within the remit of ESCOM. Given this, JCM does not have any authority with regard to the distribution of power, thus no enhancement measures are proposed
- Job Creation: The employment of approximately 200 people is anticipated for the construction phase and approximately 20 people for the operation phase. Proposed enhancement measures include a recruitment strategy, training

opportunities, a Gender Development Plan, and local sourcing of goods and services.

Negative Impacts

- Dust Emissions: Dust emissions would arise during construction from site clearance and grading, traffic and movement of vehicles over open ground and on unpaved roads, and material stockpiles from clearance and related site preparation activities. Proposed mitigation measures include minimizing removal of vegetation, sequential land clearance, not stripping topsoil until required, enforced speed limits, covering transported materials, use of surface binding agents, covering exposed ground and earthworks, covering stockpiles, wind breaks, regular vehicle maintenance, minimizing idling engines, and implementation of a Community Grievance Mechanism.

- Noise Emissions: Noise emissions would arise from construction machinery and vehicles. Proposed mitigation measures include regular maintenance and inspection of machines and equipment, selection of equipment and vehicles for noise reduction, minimization of vehicle movement, local screening/site hoardings, and implementation of a Community Grievance Mechanism.

- Soil Erosion: Site preparation and construction activities would include earthworks and site clearance that could lead to loss of topsoil, soil compaction and rutting, and soil erosion from wind and water runoff. Proposed mitigation measures include erosion control measures such as intercept drains and toe berms and construction of well-drained access roads. Mitigation measures for dust emissions (see above) are also applicable to this impact.

- Groundwater Abstraction: A borehole would be drilled to abstract water to use during construction (for concrete mixing and sanitary facilities) and operation (for panel cleaning and sanitary facilities). Proposed mitigation measures include utilization of water storage solutions (e.g., tanks) and regular monitoring of affected village supplies.

- Biodiversity: Clearing of vegetation would result in loss of habitats and fauna disturbance, risk of increased invasive alien species, and loss or reduction of biodiversity ecosystem services. Proposed mitigation measures include prohibiting hunting, avoidance of unwanted vegetation clearance, gradual removal of some vegetation to provide wildlife a chance to exit the site, minimization of vegetation clearing, prompt rehabilitation of cleared areas (e.g., temporary access roads and laydown areas) with native species, rehabilitation of disturbed areas (e.g., temporary access tracks and laydown areas), planting of seedlings in adjacent areas, removal, containment, and onsite burning of invasive plant species, regular washing of vehicles and construction equipment, cleaning of parking areas and construction camps, regular monitoring of the presence of alien invasive species in construction and rehabilitated areas, donation of woody vegetation cleared for construction to communities, and ongoing engagement with local communities in advance of vegetation clearing. Mitigation measures for loss of livelihoods as a result of land acquisition (see below) are also applicable to this impact.

- Landscape and Visual Changes: The visual character of the landscape would be impacted during construction by clearance of vegetation, presence of large construction vehicles and equipment, fencing of works and access restrictions, and construction of the plant. The visual character of the landscape during operations would be impacted by the colour change and a massing effect created by the PV panels covering a large area, limited early morning glare, and some security lights at night. Proposed mitigation measures include minimization and rehabilitation of cleared areas, shaping of excavated and cut and fill areas to allow revegetation, no debris or waste material left at work sites, and appropriate directional and intensity settings for lighting.

- Land Acquisition and Displacement: Approximately 154 residents from six villages in Group Village Pitala are expected to be directly affected by the land acquisition for the Project. Proposed mitigation measures include implementation of a Livelihood Restoration Plan and an inclusive and participatory consultation process.
- Walking Paths: During construction, safety fencing, security, and equipment would block access to several walking paths that transect the current agricultural fields. Once such fields are no longer utilized for agriculture, it is likely that they would no longer be needed by local villagers, with the exception of the pathway that is used to travel from Thondoya to the villages in Group Village Pitala. Proposed mitigation measures include consultation with communities to assess the possibility/need for an alternative walking path.
- Vector Borne and Communicable Diseases: The presence of non-local skilled workers (approximately 30-35% of the workforce) could be susceptible to communicable diseases or bringing communicable diseases into the area that are currently not prevalent. Proposed mitigation measures include training of workers, gender considerate sanitary facilities designed to prevent contamination, a waste handling system developed to avoid creation of new vector breeding grounds, reduction of the presence of standing water on site, clean work areas, an on-site first aid area, pre-employment screening, and a worker Code of Conduct.
- STI/HIV Transmission: Increased income due to job opportunities for locals and the influx of non-local workers has the potential to create an increase in STI/HIV prevalence due to worker-community interactions, with young women seeking to exchange sexual favours for payment or valuables, and through other relationships with the workforce (expatriates or Malawians). Proposed mitigation measures include implementation of an STI/HIV Management Plan, support for a women’s NGO that is addressing gender and gender-based violence (GBV) issues in Golomoti, work camp control protocols, and monitoring of GBV and sexual abuse through general stakeholder engagement and grievance management.
- Community Health and Safety: Project safety hazards may arise from the presence of construction equipment and activities, infrastructure, and traffic. The presence of such equipment and infrastructure may trigger risk/temptation of theft due to high levels of poverty in communities in the area. Incidents may also arise as a result of worker-community interactions with security guards or other staff. Proposed mitigation measures include training of security personnel, security measures to minimize safety risks and the possibility of theft, clear and visible signage to warn of risks and hazards, no firearms for and vetting of security personnel, a community engagement programme to provide information about safety hazards and their management, and community awareness of the Project’s Community Grievance Mechanism.

- Labour and Working Conditions: Improper management of labour and working conditions could affect the Project workforce, and improper management of occupational health and safety can cause injuries and even fatalities, as well as affect relationships with the workforce. Proposed mitigation measures include a Human Resources Policy, implementation of a Gender Development Plan, training of contractors, implementation of a Worker Grievance Mechanism, vetting of contractors and suppliers, monitoring compliance of contractors, development and implementation of a health and safety programme, and a non-discriminatory hiring mechanism.
- Cultural Heritage: Project activities would damage an archaeological site and result in the loss of a baobab tree identified as culturally significant to the local community. Proposed mitigation measures include limited archaeological excavation of the site prior to construction activities, additional stakeholder engagement to develop a plan to transfer the cultural significance/value of the tree to another location, if feasible, or compensation for the loss of the resource, and implementation of a Chance Find Procedure.

Unplanned Events

- Spills: Spills and improper disposal of waste have the potential to affect terrestrial environments and could lead to the deterioration of soil and groundwater quality. This could lead to impacts on flora and fauna and local community users. Proposed mitigation measures include implementation of a Hazardous Spill Resource Plan, implementation of a Waste Management Plan, refuelling of equipment and vehicles in a designated area on hard standing ground, and storage of hazardous materials on an impermeable surface in a bunded storage facility.
- Traffic Accidents: Increased traffic and presence of heavy vehicles on local roads as a result of Project development increases the risk of road traffic accidents involving members of the community. Proposed mitigation measures include implementation of a Traffic Management Plan, planning of traffic routes to avoid high traffic periods (including pedestrian traffic), assessment of local road conditions and road maintenance, collaboration with relevant local and regional governments, engagement with local communities and authorities, awareness campaigns, and driving training.

A more detailed identification and assessment of the Project’s positive impacts and potential negative impacts, as well as more detailed descriptions of the proposed measures to enhance and mitigate these impacts, respectively, are presented in Section 6 of this report.

Conclusion and Recommendations

JCM is committed to working with the local community and authorities during the construction and operation of the Project and will maintain open dialogue as part of their ongoing stakeholder engagement activities. JCM is also committed to implementing the management procedures (i.e., enhancement, management, mitigation, and preventive measures) detailed in Table 8-1 (construction) and Table 8-2 (operation) of the ESMP, as well as the monitoring procedures detailed in Table 8-3 (construction) and Table 8-4 (operation) of the ESMP. As a result, it is recommended the Project be approved and proceed as planned.

1. INTRODUCTION

1.1 BACKGROUND

This report presents the results of an Environmental and Social Impact Assessment (ESIA) of the proposed Golomoti Solar Project, Dedza District. The Project will take approximately 10 months to construct, and construction is expected to start in April 2020. It is anticipated that the Project will require approximately 200 workers (skilled and unskilled) during the construction phase and 20 workers (skilled) during the operation phase. The Project has an investment value of USD 35,000,000 and will be operational for a minimum of 20 years, with possible extension by mutual agreement. JCM has a Power Purchase Agreement (PPA) with the Electricity Supply Corporation of Malawi Limited (ESCOM) to deliver the power from the Project directly into the national grid through the 0.5 km transmission line to the Golomoti Substation.

Environmental Resources Management (ERM) conducted the ESIA and prepared this ESIA Report as part of a larger Feasibility Study being conducted by Power Engineers. Power Engineers is conducting the Feasibility Study under a grant from the United States Trade and Development Agency (USTDA). This ESIA Report is designed to comply with Malawian laws and regulations, specifically the Environmental Management Act of 1996 and the Environmental Affairs Department (EAD) Guidelines for Environmental Impact Assessment (www.sdnp.org.mw/enviro/eia). It is also designed to align with international lender standards, specifically the International Finance Corporation (IFC) Performance Standards on Environmental and Social Sustainability (2012). This is because: 1) the ESIA is being funded by the USTDA; and 2) the Project proponent is committed to aligning with the IFC Performance Standards in its Environmental and Social (E&S) Policy. Baseline studies for the ESIA were conducted by Geoconsult Limited (Geoconsult) and Water Waste and Environment Consultants (WWEC), both based in Lilongwe, under subcontract to Power Engineers and ERM, respectively.

1.2 NATURE OF THE PROJECT

The proposed Project is a 20-megawatt (MW) alternating current solar photovoltaic (PV) plant to be constructed on a 92 hectare (ha) parcel (Solar Plant Site) located approximately 0.5 km from the Golomoti Substation and less than 1 km from Golomoti Trading Centre in Dedza District. It is located within the Kachindamoto Traditional Authority. The Project will also include the construction of a short (approximately 0.5 km) transmission line from the Solar Plant Site to the Golomoti Substation, as well as a short (approximately 80 m) access road extending from the highway to the northeast (M5) to the Solar Plant Site.

1.3 PROJECT PROPONENT

The Project proponent is Golomoti JCM Solar Corporation Limited (JCM). Project sponsors include JCM Power, InfraCo Africa, and the Project's development partner is Matswani Capital (PTY). JCM Power is an independent power producer (IPP) dedicated to accelerating social, economic, and environmental sustainability in growth markets through the development, construction, and operation of renewable energy facilities and HVDC transmission lines. InfraCo Africa seeks to alleviate poverty by mobilising private sector expertise and finance to develop infrastructure projects in sub-Saharan Africa.

The contact details of the Project Proponent/Applicant are listed below.

Golomoti JCM Solar Corporation Limited (JCM)
Jonas Sani
CC Patrick Godfrey
Plot 3/306, Sharp Avenue
Lilongwe, Malawi
Tel: +265 999 4150 49

1.4 PROJECT JUSTIFICATION

Malawi has an installed generation capacity of 363 MW, with a large reliance on hydropower.[1] Over 95% of Malawi's electricity is generated from hydropower, with the Shire River as the main source. In the last few years, electricity generation has been reduced by up to 40% due to dwindling water levels caused by drought and low rainfall.[2] There is a high potential for solar energy development in Malawi to offset this reduction and to increase electric capacity.

Malawi's energy sector has gone through important sector reform efforts recently, including the partial unbundling of the national utility ESCOM.[3] The restructuring of Malawi's power market is underway, with strong investor interest and political will for Independent Power Producers (IPPs) to enter the market.[4]

The Golomoti Solar Project is an investment in renewable energy. It will help diversify the energy sector in Malawi and increase the capacity of its national grid. The Project is part of the government IPP process and is part of sector reform development.

There is also currently a global drive towards the generation and implementation of affordable clean energy. One of the UN Sustainable Development Goals is "Affordable Clean Energy." This goal recognises that the global economy is currently over reliant on fossil fuels, and that increasing greenhouse gas emissions are creating drastic changes to our climate system.[5] Expanding infrastructure and upgrading technology to provide clean energy in all developing countries is a crucial goal that can both encourage growth and help the environment.[6] The Golomoti Solar Project aligns with this global initiative to develop renewable energy resources in developing countries.

1.5 PURPOSE OF THE ESIA

The purpose of the ESIA was to identify and assess and develop measures to mitigate and manage the Project's environmental and social impacts in compliance with Malawian laws and regulations and in alignment with international standards. The main objectives of the ESIA are to:

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[1] USAID (2018), Malawi Power Africa Factsheet Accessed at: https://www.usaid.gov/powerafrica/malawi

[2] ESCOM (nd) An Update On The Current Water Levels And The Energy Situation In Malawi Accessed at: http://www.escom.mw/waterlevels-energysituation-malawi.php

[3] USAID (2018), Malawi Power Africa Factsheet Accessed at: https://www.usaid.gov/powerafrica/malawi

[4] USAID (2018), Malawi Power Africa Factsheet Accessed at: https://www.usaid.gov/powerafrica/malawi

[5] UNDP (nd) Sustainable Development Goals Accessed at: http://www.undp.org/content/undp/en/home/sustainable-development-goals/goal-7-affordable-and-clean-energy.html

[6] UNDP (nd) Sustainable Development Goals Accessed at: http://www.undp.org/content/undp/en/home/sustainable-development-goals/goal-7-affordable-and-clean-energy.html

- Define the scope of the Project and the potential interactions of Project activities with the natural and human (including socio-economics and health) environments;
- Review national legislation and international standards and guidelines and ensure that all stages of the Project consider the requirements of Malawian legislation, internationally accepted environmental management practices and guidelines, and Project-related environmental and health and safety (EHS) policies and standards;
- Provide a description of the proposed Project components and activities and the existing physical, chemical, biological, socio-economic, and human environments with which these activities may interact;
- Assess the potential environmental and social impacts resulting from Project activities and identify viable mitigation measures and management actions designed to avoid, reduce, remedy, or compensate any significant adverse environmental and social impacts and, where practicable, maximize potential positive impacts and opportunities that may arise due to the Project; and
- Provide the means by which the mitigation measures will be implemented and residual impacts managed, through the provision of an Environmental and Social Management Plan (ESMP).

1.6 SUMMARY OF THE ESIA PROCESS

The process utilised for this ESIA is consistent with the specifications of Malawian legislation, further described in Chapter 3 of this report. The ESIA process includes the following key steps:

- Screening;
- Scoping;
- Baseline data collection;
- Project planning and design;
- Stakeholder engagement;
- Impact assessment;
- Management and mitigation plans; and
- Reporting and disclosure.

1.6.1 Screening

The screening phase of the ESIA process is intended to identify what impact assessment requirements apply to the Project. This involves having an understanding of the Project activities and components, as well as the environmental and social context in which it will be realized, to a degree sufficient to identify any “applicability triggers” that are pertinent in the Project’s administrative framework.

In the case of the Golomoti Project, the screening phase occurred concurrently with the scoping phase, consisting of a site visit to better understand the Project context and consultation with EAD to confirm impact assessment requirements (the EAD required an Environmental and Social Impact Assessment per a letter to JCM dated December 14, 2018).

1.6.2 Scoping

The aim of scoping is to identify environmental and social sensitivities and Project activities with the potential to contribute to, or cause, impacts to environmental resources and social receptors. At the scoping stage, it is necessary to identify and understand the key issues to a level that allows the remainder of the impact assessment to be planned. An important part of this process is identifying and consulting with a range of stakeholders including representatives of government, civil society groups, and communities to identify key issues and sources of information. The results of scoping for the Golomoti ESIA are described in Section 6.2 of this report.

1.6.3 Baseline Data Collection

The ESIA provides a description of the existing environmental and socio-economic conditions as a basis against which the impacts of the Project can be assessed. The baseline includes information on environmental and social receptors and resources that were identified during scoping as having the potential to be affected by the proposed Project.

The objectives of baseline data collection are to:

- Identify the key environmental and socio-economic resources and conditions in areas potentially affected by the Project and highlight those that may be vulnerable to aspects of the Project;
- Describe, and where possible quantify, their characteristics (i.e., their nature, condition, quality, and extent);
- Provide data to aid the prediction and evaluation of possible impacts; and
- Inform judgements about the importance, value, and sensitivity or vulnerability of resources and receptors.

Baseline data was collected by a team of WWEC environmental and social specialists in March and April of 2019. The team included six social specialists, two biodiversity specialists, and two cultural heritage specialists. The ESIA also utilized the results of a Hydrology and Flood Risk Assessment and a Geotechnical Study conducted by Geoconsult in support of the Project's Feasibility Study. The technical reports for these baseline studies are provided in the following appendices:

- Appendix B – Geoconsult Hydrology and Flood Risk Assessment;
- Appendix C – Geoconsult Geotechnical Study;
- Appendix D – WWEC Household Survey;
- Appendix E – WWEC Biodiversity Survey; and
- Appendix F – WWEC Cultural Heritage Survey.

1.6.4 Stakeholder Engagement Activities

Stakeholder engagement for the ESIA started during the scoping stage of the Project. The objective is to ensure that sources of existing information and expertise are identified, legislative requirements are met, and stakeholder concerns are addressed. Stakeholder engagement activities conducted for the ESIA to date are described in Chapter 7 of this report.

1.6.5 Impact Assessment

Impact assessment and development of mitigation measures is an ongoing process that begins during the project planning stage and continues as the Project progresses. The key objectives of the impact assessment process are to:

- Analyse how the Project may interact with resources and receptors identified during baseline studies in order to define, predict, and evaluate the likely extent and significance of environmental and social impacts that may be caused by the Project;
- Develop and describe effective, realistic, and practical mitigation measures that avoid, reduce, control, remedy, or compensate for negative impacts and enhance positive benefits;
- Evaluate the predicted positive and negative residual impacts of the Project; and
- Develop a system whereby mitigation measures are integrated into Project activities and become Project commitments. This is achieved through the development of an Environmental and Social Management Plan (ESMP).

The impact assessment and development of mitigation measures was undertaken between March and June 2019.

1.7 ESIA METHODOLOGY

The purpose of the impact assessment process is to identify any likely significant impacts on environmental or social receptors as a result of the Project and to develop appropriate mitigation measures to effectively manage these impacts. To determine the significance of potential impacts, this ESIA considers two main factors: impact magnitude and receptor sensitivity/vulnerability. Magnitude is a measure of the changes to a receptor that will potentially result from the Project, while sensitivity/vulnerability is a measure of how sensitive or vulnerable a receptor (e.g., people, flora, or fauna) is to these changes.

There is no statutory or internationally agreed upon definition of significance; however, this assessment will use the following practical definition:

> An impact will be judged significant if, in isolation or in combination with other impacts, it will cause a notable change from baseline conditions and may require mitigation to manage the effects on/risks to a receptor from this change.

Evaluating impact significance is an iterative process and follows the following cycle: identify potential impacts; evaluate receptor sensitivity/vulnerability; evaluate magnitude of potential impacts; determine significance of potential impacts; and determine significance of residual impacts. Additional details regarding the ESIA methodology are provided in Section 6.1.

The potential impacts assessed in the ESIA were determined based on the results of a scoping exercise, which is described in Section 6.2. The assessment of positive impacts is presented in Section 6.3, and the assessment of potential negative impacts is presented in Section 6.4.

1.8 STRUCTURE OF THE ESIA REPORT

The structure of this ESIA Report is summarised in Table 1-1.

Table 1-1: Structure of the ESIA Report.

Section	Title	Content
-	Executive Summary	Summary of the ESIA for the benefit of decision makers and the public.
Section 1	Introduction	Describes the Project's background, type, proponent, and justification, as well as the purpose of the ESIA, summary of the ESIA process, and structure of the ESIA Report.
Section 2	Project Description	Technical description of the Project schedule, facilities, and activities.
Section 3	Project Alternatives	Presents the results of an alternatives analysis.
Section 4	Policy and Legal Framework	Describes the environmental and social legislation applicable to the Project, as well as applicable international standards.
Section 5	Environmental and Social Setting	Describes the relevant environmental and social existing conditions and review of sensitive resources that may be affected by the Project.
Section 6	Impact Identification and Analysis	Describes the impact assessment methodology utilized and outcome of the scoping process. Evaluation of positive impacts. Evaluation of potential negative impacts, description of proposed mitigation measures, and evaluation of residual impacts.
Section 7	Public Consultation/ Stakeholder Engagement	Describes stakeholder engagement national and international requirements, identification and mapping, and activities conducted as part of the ESIA.
Section 8	Environmental and Social Management Plan	Compilation of the Project's mitigation and compensation measures in the form of a detailed plan to ensure that they are implemented at each stage of the Project.
Section 9	Conclusion and Recommendations	Summarizes the results of the ESIA.
Appendix A	EAD Terms of Reference	Terms of Reference for the Golomoti ESIA as set forth in an attachment to a letter from the Environmental Affairs Department (EAD) to JCM dated December 14, 2018.
Appendix B	Hydrology and Flood Risk Assessment	Baseline report prepared by Geoconsult.
Appendix C	Geotechnical Study	Baseline report prepared by Geoconsult.
Appendix D	Household Survey Report	Baseline report prepared by WWEC.
Appendix E	Biodiversity Baseline Report	Baseline report prepared by WWEC.
Appendix F	Cultural Heritage Baseline Report	Baseline report prepared by WWEC.

Section	Title	Content
Appendix G	List of Stakeholder Engagement Activities	General list of stakeholder engagement activities.
Appendix H	Stakeholder Engagement Plan.	Stakeholder Engagement Plan for the Project.
Appendix I	Technical Memo: Golomoti Protected Trees	Alternatives analysis for Project impacts to protected trees.
Appendix J	Environmental and Social Impact Assessment Team	Qualifications and roles of the team that prepared this ESIA Report.
Appendix K	Customary Land Consultation with Chief	Record of customary land consultation with Senior Chief Kachindamoto and Group Village Headman
Appendix L	National Level Baseline Information	Baseline information at a district and national level for broader context.
Appendix M	Maps	All report Maps in A3 full size

2. PROJECT DESCRIPTION

This Chapter provides a description of the proposed Project and presents an overview of the key elements and activities involved in the planned construction, operation, and decommissioning phases based on available design information.

2.1 PROJECT OVERVIEW AND LOCATION

Golomoti JCM Solar Corporation Limited (JCM) proposes to construct and operate a 20 megawatt alternating current (MWac) solar photovoltaic power plant near Golomoti, Dedza District, Malawi (Figure 2-1). The Project will also include the construction of a short (approximately 0.5 km) transmission line to connect the solar power plant to the existing Golomoti Substation, as well as a short (80 m) access road extending from the highway to the northeast (M5). The Golomoti Substation is operated by the Electrical Supply Corporation of Malawi Limited (ESCOM). The electricity generated by the solar power plant will be sold to ESCOM and will be transferred to the national grid via the Golomoti Substation. The estimated cost of the project is USD 35,000,000.

An Implementation Agreement between JCM and the Government of the Republic of Malawi, as represented by the Minister of Finance, Economic Planning, and Development and the Minister of Natural Resources, Energy, and Mining, was signed on August 23, 2018. The Implementation Agreement states that JCM “proposes to develop, design, engineer, procure, finance, construct, commission, own, insure, maintain and operate a solar photovoltaic generating power plant of up to twenty (20) Megawatts (alternating current) at Golomoti in Dedza District in the Republic of Malawi.” The Implementation Agreement further states that “Subject to and in accordance with the terms and conditions of the Power Purchase Agreement, the Company [JCM] shall generate and sell to ESCOM the energy generated at the Facility, and ESCOM shall purchase and pay for the energy made available to ESCOM from the Facility.” Finally, the Implementation Agreement states that the “Company and the Government (acting through the Ministry of Lands, Housing and Urban Development) are in the process of entering into the Land Lease Agreement in respect of the Project Site.”

The Power Purchase Agreement (PPA) between JCM and ESCOM was signed on September 13, 2018. Clause 2.1 of the PPA states that “the Seller [JCM] shall deliver and sell exclusively to the Buyer [ESCOM] the Net Electrical Output, and the Buyer shall accept and purchase the Net Electrical Output from the Seller.” The term of the PPA is 20 years from the commercial operation date, but may be extended pursuant to Clause 3.3 of the PPA.

JCM is currently drafting a Connection Agreement based on the signed PPA. The Connection Agreement will be signed upon completion of feasibility studies and ESCOM’s internal connection impact assessment.

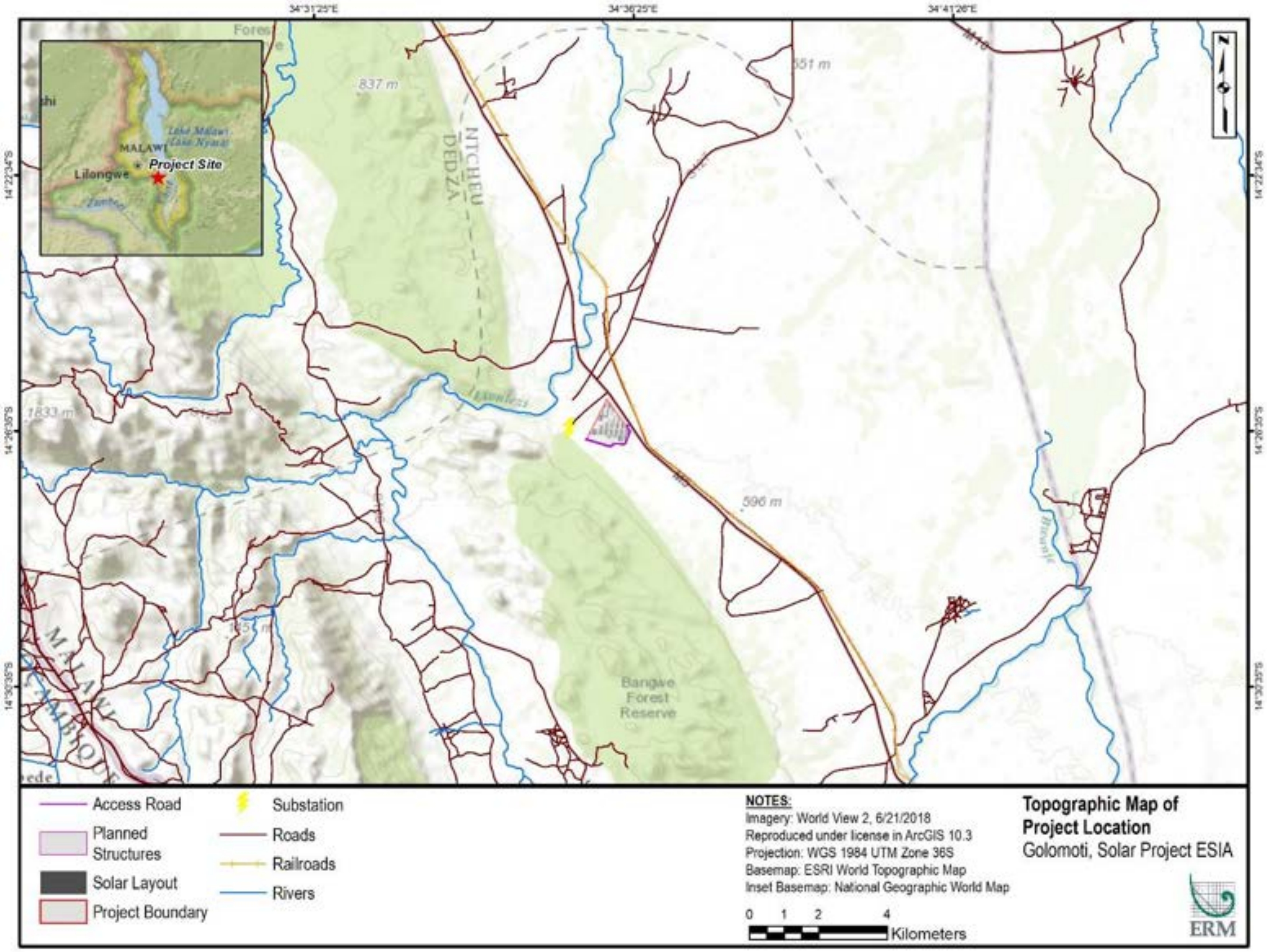
The layout for the Project is shown in Figure 2-2. Under this design, the Project will have a maximum alternating current (AC) output of 20 MWac with an expected annual generation in the range of 47,000 MW hours per year, considering a P90 probability of 0.5% degradation. The design maximizes use of the Solar Plant Site and will ensure that the Project can meet the power generation requirements in the PPA with ESCOM.

2.2 PROJECT SITE

The solar plant will be constructed on a 92 ha parcel (Solar Plant Site) located approximately 0.5 km from the Golomoti Substation and less than 1 km from Golomoti Trading Centre in Dedza District (Figure 2-1). It is located within the Kachindamoto Traditional Authority. The Project will also include the construction of a short (approximately 0.5 km) transmission line from the Solar Plant Site to the Golomoti Substation, as well as a short (80 m) access road extending from the highway to the northeast (M5). The Solar Plant Site and transmission line wayleave are collectively referred to herein as the Project Site.

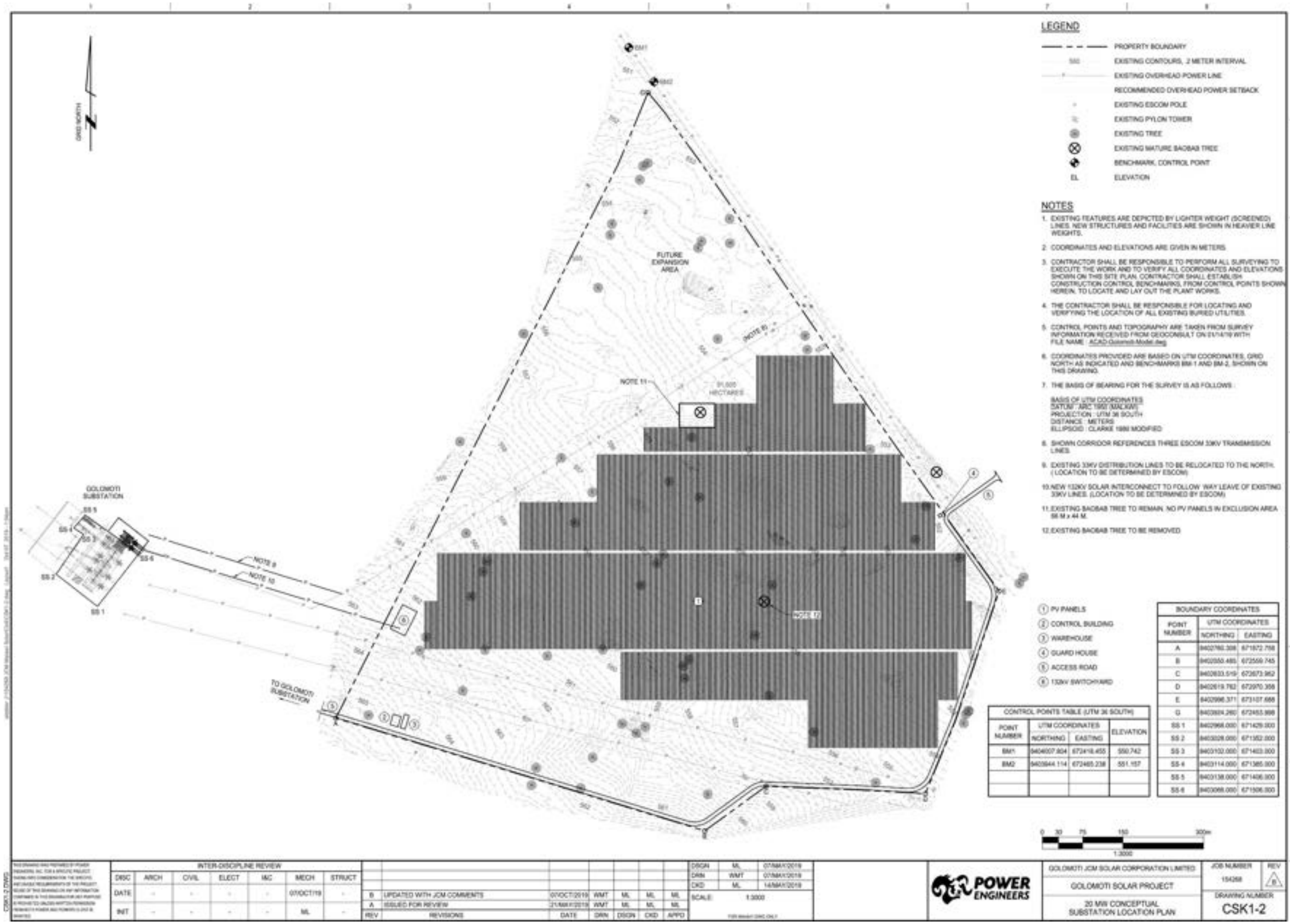
The Project Site is generally flat land and is predominantly used for subsistence agriculture. Local residents report that crops cultivated on the Project Site include maize, cotton, soy, cowpeas, and sweet potatoes. Trees on the Project Site include natural and planted trees, including mango, acacia, and baobab trees. Local residents report that medicinal plants are collected from the Project Site, although these plants can be collected elsewhere. There are also several footpaths that traverse the Project Site.

Figure 2-1: Topographic Map of the Project Location.



Source: ERM, 2019.

Figure 2-2: Site Layout.



NOTES

1. EXISTING FEATURES ARE DEPICTED BY LIGHTER WEIGHT (SCREENED) LINES. NEW STRUCTURES AND FACILITIES ARE SHOWN IN HEAVIER LINE WEIGHTS.
2. COORDINATES AND ELEVATIONS ARE GIVEN IN METERS.
3. CONTRACTOR SHALL BE RESPONSIBLE TO PERFORM ALL SURVEYING TO EXECUTE THE WORK AND TO VERIFY ALL COORDINATES AND ELEVATIONS SHOWN ON THIS SITE PLAN. CONTRACTOR SHALL ESTABLISH CONSTRUCTION CONTROL BENCHMARKS, FROM CONTROL POINTS SHOWN HEREIN, TO LOCATE AND LAY OUT THE PLANT WORKS.
4. THE CONTRACTOR SHALL BE RESPONSIBLE FOR LOCATING AND VERIFYING THE LOCATION OF ALL EXISTING BURIED UTILITIES.
5. CONTROL POINTS AND TOPOGRAPHY ARE TAKEN FROM SURVEY INFORMATION RECEIVED FROM GEOCONSULT ON 01/14/19 WITH FILE NAME : ACAD-Golomoti-Model.dwg
6. COORDINATES PROVIDED ARE BASED ON UTM COORDINATES, GRID NORTH AS INDICATED AND BENCHMARKS BM-1 AND BM-2, SHOWN ON THIS DRAWING.
7. THE BASIS OF BEARING FOR THE SURVEY IS AS FOLLOWS :

   BASIS OF UTM COORDINATES
   DATUM : ARC 1950 (MALAWI)
   PROJECTION : UTM 36 SOUTH
   DISTANCE : METERS
   ELLIPSOID : CLARKE 1880 MODIFIED
8. SHOWN CORRIDOR REFERENCES THREE ESCOM 33KV TRANSMISSION LINES.
9. EXISTING 33KV DISTRIBUTION LINES TO BE RELOCATED TO THE NORTH. (LOCATION TO BE DETERMINED BY ESCOM)
10. NEW 132KV SOLAR INTERCONNECT TO FOLLOW WAY LEAVE OF EXISTING 33KV LINES. (LOCATION TO BE DETERMINED BY ESCOM)
11. EXISTING BAOBAB TREE TO REMAIN. NO PV PANELS IN EXCLUSION AREA 56 M x 44 M.
12. EXISTING BAOBAB TREE TO BE REMOVED.

CONTROL POINTS TABLE (UTM 36 SOUTH)

POINT NUMBER	UTM COORDINATES		ELEVATION
	NORTHING	EASTING	
BM1	8404007.804	672418.455	550.742
BM2	8403944.114	672465.238	551.157

BOUNDARY COORDINATES

POINT NUMBER	UTM COORDINATES	
	NORTHING	EASTING
A	8402760.308	671872.758
B	8402550.485	672569.745
C	8402633.519	672673.962
D	8402619.762	672970.358
E	8402996.371	673107.688
G	8403924.260	672453.998
SS 1	8402968.000	671429.000
SS 2	8403028.000	671352.000
SS 3	8403102.000	671403.000
SS 4	8403114.000	671385.000
SS 5	8403138.000	671406.000
SS 6	8403068.000	671506.000

REV	REVISIONS	DATE	DRN	DSGN	CKD	APPD
B	UPDATED WITH JCM COMMENTS	07/OCT/2019	WMT	ML	ML	ML
A	ISSUED FOR REVIEW	21/MAY/2019	WMT	ML	ML	ML

DSGN	ML	07/MAY/2019
DRN	WMT	07/MAY/2019
CKD	ML	14/MAY/2019

Source: Power Engineers, 2019.

2.3 LAND OWNERSHIP

The predominant land ownership in the Project Site is customary. Customary land falls within the jurisdiction of a Traditional Authority (TA), which has been granted to a person or group and used under customary law. This land is held in trust and administered by traditional leaders (chiefs) on behalf of people in a community. The TA is mandated by the government to distribute land to individuals as well as address land disputes and report to the government through the office of the District Commissioner (DC).

JCM understands that it must consult with the Ministry of Lands on land issues, including land acquisition, and is in the process of doing so.

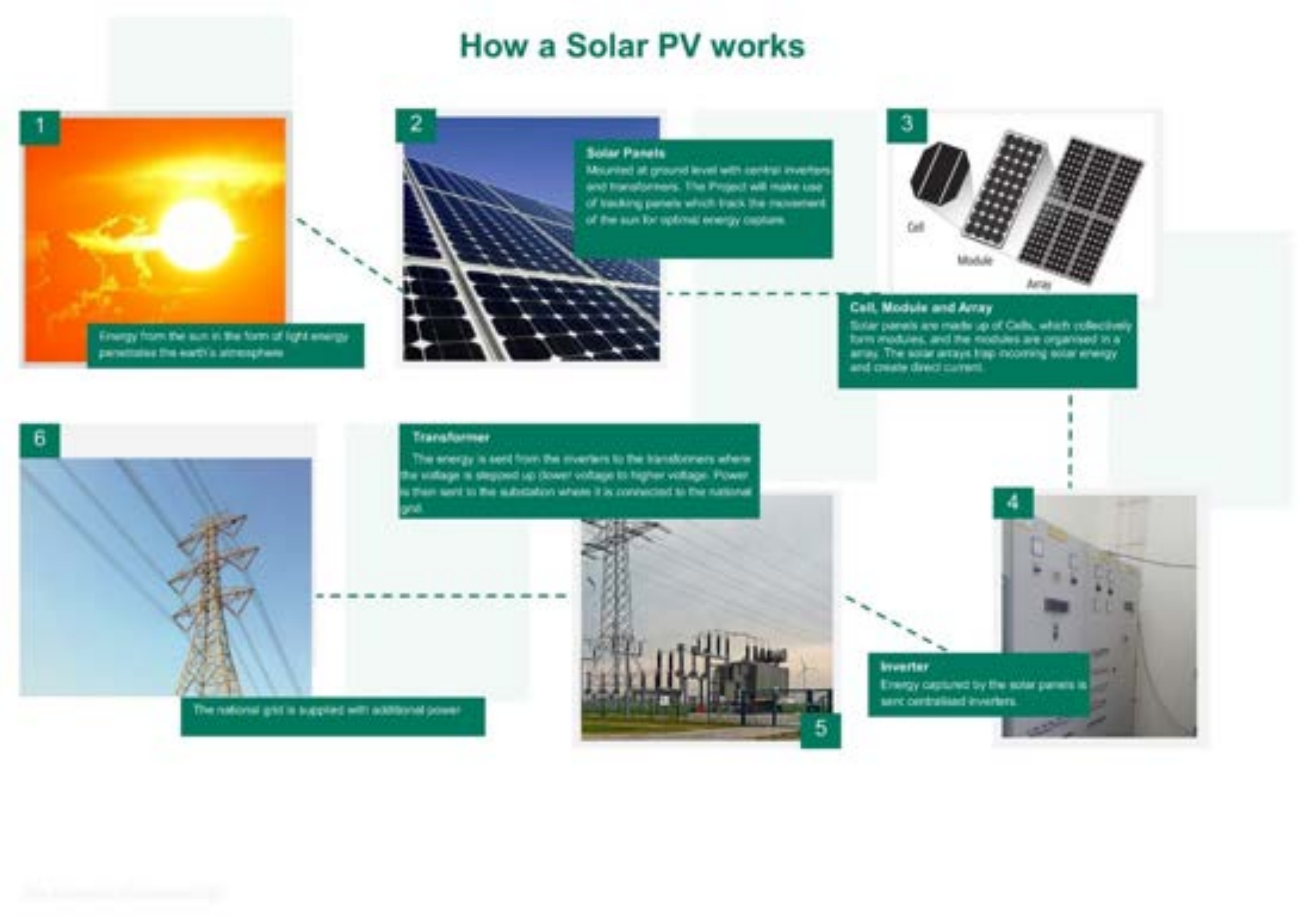
Additional information regarding the land ownership system and land uses in the Project Site is described in Chapter 6. The land acquisition for the Project is described in Section 6.4.9 and in the LRP.

2.4 PROJECT COMPONENTS

Photovoltaic (PV) technology allows the direct conversion of sunlight (photon energy) to electricity using semiconductor devices called solar cells. Solar cells are almost maintenance free, because they have no moving parts and have a relatively long life span. The photoelectric conversion process produces no pollution and can make use of free solar energy. Overall, the longevity, simplicity, and minimal resources used to produce electricity via PV systems make this a highly sustainable technology.

The general process of how solar PV technology works is illustrated in Figure 2-3. Energy from the sun in the form of light energy penetrates the earth’s atmosphere. Solar arrays are mounted at ground level with trackers to follow the movement of the sun for optimal energy capture. Solar arrays are composed of modules, which are composed of PV cells. The PV cells generate direct current (DC) electricity when exposed to solar radiation. The energy is sent to inverters, which convert the DC electricity into usable alternating current (AC) electricity. The energy is and then sent to transformers, which increase the voltage. The energy is then sent to a substation, which is connected to the national grid. The national grid is therefore supplied with additional power.

Figure 2-3: How Solar Panels Work.



Energy from the sun in the form of light energy penetrates the earth's atmosphere

Solar Panels
Mounted at ground level with central inverters and transformers. The Project will make use of tracking panels which track the movement of the sun for optimal energy capture.

Cell, Module and Array
Solar panels are made up of Cells, which collectively form modules, and the modules are organised in a array. The solar arrays trap incoming solar energy and create direct current.

Inverter
Energy captured by the solar panels is sent centralised inverters.

Transformer
The energy is sent from the inverters to the transformers where the voltage is stepped up (lower voltage to higher voltage. Power is then sent to the substation where it is connected to the national grid.

The national grid is supplied with additional power

Source: ERM, 2018.

The PV solar technology chosen for the Project consists of the main components listed below.

- **PV cell**: The PV cell is the device that generates electricity when exposed to solar radiation. The absorbed solar energy excites the electrons inside the PV cell and produces electrical energy. All PV cells produce direct current (DC). There are three main types of solar cells:
  - Monocrystalline – Made from a single silicon crystal;
  - Polycrystalline — Made from multiple silicon crystals; and
  - Thin film — Common material used for thin film modules are cadmium telluride and copper indium gallium selenide.

  The Project will utilize polycrystalline cells.
- **PV module**: The PV module is a set of interconnected PV cells encapsulated between a transparent front (usually glass) and supporting framework in the back to allow for mounting. The modules will appear dark blue or black and will be mounted to an aluminium frame. The modules are designed to absorb solar radiation and are therefore not susceptible to reflection or glinting. The glare and reflectance levels from a given PV module are decisively lower than the glare and reflectance generated by standard glass.

  The Project will utilize PhonoSolar PS330P-24/TM (330 Wp) or similar modules, depending on market availability, best pricing, and final technical design. The Project will utilize 71,026 modules (i.e., panels). The panels will be installed in 4178 strings of 17 panels each.
- **Mounting structures**: To create a PV array, solar cells are mounted on a support system and arranged to receive solar radiation. The arrays can be “fixed” (simple stands mounted on the ground) or “tracking” (attached to a motorized apparatus that repositions the cell as the sun moves across the sky to receive maximum solar radiation). Tracking systems can be horizontal single axis, tilted single axis, or dual axis.

  The Project will utilize ArcTech Solar-Skyline mounting structures or similar with a single axis tracking system with backtracking capabilities. The backtracking operation mode is designed to reduce the shading losses during the first and last hours of the day. The Project will utilize 935 trackers with 3 m of tracker spacing.
- **PV array**: The PV array is the complete power generating plant consisting of multiple PV modules wired in series and in parallel. The PV modules will be connected by DC cables to combiner boxes mounted underneath the PV module mounting structures. Each combiner box will occupy an area of approximately one square metre. The power generated by many PV module strings is combined in the combiner box and transmitted via underground 400-1000 volt DC cables to an inverter and transformer enclosure.

  The PV array will consist of 71,026 panels installed in 4178 strings of 17 panels each, and will cover an area of 137,815 m^2. The Array Global Power Standard Test Conditions will be 23,439 kWp (panel output), and the Array Global Power Operating Conditions will be 21,295 kWp (50º Celsius).
- **Inverters**: Inverters will be utilized to convert DC energy created by the PV panels into useable alternating current (AC) energy. The voltage input for an inverter is a

function of how the PV panels are connected together and can vary from 12 volt DC to as high as 1500 volt DC. For large commercial applications such as the proposed Project, the design will call for connecting (or stringing) the PV array such that the higher voltages are utilized. The Project intends to utilize Huawei SUN2000-42 KTL (42 kW) or similar Smart String Inverters. The Project will utilize 465 inverters.

- **Plant Switchyard**: The plant switchyard receives all power from the inverters via underground cables and provides protection and control equipment required to safely manage the plant and to ensure grid code compliance regulations. The switchyard will include two 33kV:132kV transformers to increase the solar plant output to the same voltage as the grid. The primary and backup energy meters will be located in the plant switchyard to provide measurement of the plant electrical generation. The switchyard will consist of at least one small building, outdoor electrical plant and equipment, and the transformers, and will be approximately 2000 m^2.
- **O&M building, warehouse, and guardhouse**: The Project will include an operations and maintenance (O&M) building that will include a control room, offices, a meeting room, and restrooms. It will measure 14 by 19 m and will be 4.6 m tall. The Project will also include a warehouse that will measure 8 by 25 m and will be 4.6 m tall, and a guardhouse that will measure approximately 3 by 3 m.
- **Access tracks and fencing**: The Project will include tracks throughout the site to permit access for maintenance vehicles and personnel. Vegetation (such as grass) will be permitted to grow throughout the site but will be kept low. A security fence, alarm system, and close circuit television security cameras will surround the site.
- **Balance of system**: The remaining components that will make up the Project, commonly referred to as “balance of plant” components, typically include, but are not limited to, combiner boxes, DC cables, trenches, power conversion stations, AC cables and earthing, and lightning protection.
- **Transmission line**: a 132 kV transmission line will connect the plant switchyard and the Golomoti Substation. The transmission line will be approximately 0.5 km long. The wayleave for the transmission line will be 30 m (15 m on each side of the centreline). The transmission line will follow the path of the existing 33 kV ESCOM distribution lines. ESCOM will relocate the 33 kV distribution lines to allow space for the new Golomoti 132 kV line.
- **Connection to the grid**: The ESCOM Golomoti Substation will require expansion to the north to provide a bay for connection of the plant Transmission Line. The Golomoti Substation provides incoming and out-going 132 kV transmission lines and 33 kV and 66 kV distribution lines to regional communities. The Golomoti Substation includes a control room that is staffed by ESCOM employees.

Key Project components for the Project will be source by the EPC Contractor and will most likely be sourced from China.

2.5 PROJECT ACCESS

The Project will involve the construction of a short Access Road extending from the highway to the northeast (M5). The section of the access road located between the highway and the Project Site is approximately 80 m long. Once inside the Project Site, the access road will follow the eastern and southern borders of the Project Site to the buildings to be located in its southwest corner (Figure 2-2). It will then follow the transmission line way leave to the Golomoti Substation.

2.6 PROJECT PHASES

2.6.1 Project Planning and Design

The Project has been in the planning and design phase since June 2015. During this this phase of the Project, multiple pre-feasibility and feasibility studies have been conducted, as well as engagement with government and community stakeholders. The studies that have been undertaken during this phase include:

- Grid Analysis and Market Review;
- Site Pre-feasibility Study;
- Feasibility Study (in progress); and
- Land Acquisition and Compensation Study.

This ESIA has also been conducted as part of the planning and design phase of the Project.

2.6.2 Site Preparation and Construction Phase

Site preparation will start with the construction of a short (80 m) Access Road extending from the highway to the northeast (M5). Site preparation will proceed with the clearance of vegetation, installation of fencing, and grading of the site.

The construction phase will be initiated following the completion of site preparation activities. The following activities will take place during the construction phase:

- Transportation of equipment and components to the Project Site;
- Establishment of workshops and temporary laydown areas;
- Excavation of cable trenches;
- Ramming or drilling of the mounting structure frames, depending on the geotechnical condition of the ground;
- Installation of the modules onto the frames;
- Installation of measuring equipment;
- Laying of cables between the module rows to the inverter stations;
- Construction of inverter and transformer station foundations and installation of inverter stations;
- Construction of transmission lines, switchyard, and upgrades/expansions at the Golomoti Substation, if required;
- Construction of stores, workshop, and office buildings;
- Testing and commissioning; and
- Removal of equipment and demobilisation of the construction team.

The following facilities will be constructed:

- PV panels (see #1 in Figure 2-2 for location);
- Control building, which will contain the equipment required to monitor and operate the solar power plant (#2 in Figure 2-2);

- Warehouse, which will be utilized to store equipment and supplies (#3 in Figure 2-2);
- Guardhouse, which will provide shelter for security guards (#4 in Figure 2-2);
- Access road, which will be utilized to access and traverse the Project Site (#5 in Figure 2-2); and
- Switchyard, from which the transmission line to the Golomoti Substation will extend (#6 in Figure 2-2).

The primary Project components will be delivered in the following way during construction:

- Inverters – eight truck deliveries;
- Main Transformer – One specialised abnormal load delivery;
- LV/MV Transformers – eight truck deliveries;
- PV modules – 200 truck deliveries;
- Tracker/structures – 300 truck deliveries; and
- Miscellaneous – 200 truck deliveries.

The following construction vehicles/machinery are anticipated to be on site during the construction period:

- Two Dump trucks;
- Three Bobcats;
- One tractor;
- Four water trucks;
- Four tractor-loader-backhoes;
- Ten pick-up trucks; and
- Three excavators.

Waste generated during construction will include general domestic waste, including sanitary and food waste, office waste, and organic material. Petrol and diesel by-products will be generated from the transportation of goods and personnel, generators, and heavy construction equipment. Large quantities of non-hazardous waste will be generated from the solar PV panel packaging material, which typically arrive in wood pallets. The recycling and/or donation of these materials to affected communities will be investigated. Waste will be separated at source and labelled bins will be located within the Project Site for the storage of the various categories. Staff will be trained in proper waste management practices and the importance of implementing them. Cleaning staff will be trained in the safe handling and storage of waste and hazardous materials. They will also be provided with adequate personal protective equipment.

Hazardous waste generated by the Project will comprise of petrol and diesel by-products generated from the transport of goods and personnel, generators, and heavy construction equipment. No chemicals will be utilized apart from those present in construction materials, such as paint and solvents. All hazardous waste generated during construction will be removed by the EPC Contractor and safely disposed of in a licensed facility. JCM will investigate the possibility of recycling non-hazardous waste. Non-recyclable, non-hazardous solid waste will be sent to a licensed waste site.

Wastewater from construction activities will include temporary sanitary facilities, storm water, and drainage over potentially contaminated areas (e.g., concrete batching/mixing areas and equipment storing areas). The EPC Contractor will manage wastewater during construction. Any hazardous wastewater will be stored on site and treated, if required, before disposal.

Electricity during the construction phase will be provided through the use of diesel powered generators. It is estimated that five 24 kW generators running at ¾ capacity for 10 hours a day and 5 days a week for 43 weeks will satisfy the electricity requirements of the office trailers during construction. The estimated consumption of fuel during construction for office trailers is therefore 58,050 L. It is estimated that ten 8 kW generators running at ¾ capacity for 6 hours a day and 5 days a week for 43 weeks will satisfy the electricity requirements of the operation of equipment during construction. The estimated consumption of fuel during construction for equipment use is therefore 21,930 L.

Construction will occur over 10 months. It is anticipated that there will be approximately 200 workers (skilled and unskilled) on the Project Site during the construction phase.

2.6.3 Operational Phase

The solar PV power plant will be operated on a 24 hour, 7 days a week basis, although generation of electricity will only occur during sunlight hours. Operational activities will include:

- Cleaning of the modules by trained personnel using high pressure water hoses or hand washing;
- Vegetation management under and around the modules to allow maintenance and operation at full capacity;
- Maintenance of all components, including modules, mounting structures, trackers, inverters, transformers, switching station plant, and equipment;
- Control room management and maintenance of staff facilities;
- Supervision of electricity production; and
- Site security monitoring.

Minimal waste is expected to be generated during the operations phase. Hazardous materials used on site during operations will include fuels, oils, lubricants, cleaning products, and specialised gases (for use in switchgear). Oil that needs to be replaced will be recycled, if possible, or safely stored and removed from the site and correctly disposed. It is estimated that 50 kg of domestic waste will be produced weekly by the 20 person workforce during operations. Industrial waste production will be occasional (e.g., solar panels, electrical waste) as they will only require disposal if they become damaged.

Wastewater from operations will comprise of onsite sanitary facilities and run off from panel cleaning activities. There will be minimal sewage from sanitary facilities during operations. These facilities will operate on a septic tank system and JCM will arrange for safe disposal of waste from the septic tank. Run-off from panel cleaning and storm water are not expected to be contaminated and adequate drainage of the site will be a design requirement for the Project Site.

During operations, the facility will be supplied with solar-generated electricity and electricity purchased from ESCOM when the plant is not generating electricity.

It is estimated that there will be up to 20 workers on the Project Site and minimal Project related traffic during operations. The breakdown of workers will be eight skilled workers, including technicians, operations, and security, and 12 unskilled workers, including general facility housekeeping (weeding), panel cleaning, and cleaners.

2.6.4 Decommissioning Phase

The proposed Project is expected to operate for at least 20 years. Once the plant reaches the end of its life, the PV modules may be refurbished or replaced to continue operations or the facility may be closed and decommissioned. If decommissioned, all components would be removed and the site rehabilitated. All materials will be recycled if possible. If this is not possible, they will be disposed of in accordance with local regulations and good international industry practise. Approximately 200 workers will be required for decommissioning.

3. PROJECT ALTERNATIVES

3.1 ACTIVITY ALTERNATIVES

JCM was awarded preferred bidder status through ESCOM's competitive tender for the supply of solar PV electricity in 2016/2017. The tender specified solar PV as the activity to generate electricity resulting in no activity alternatives being investigated.

3.2 LOCATION ALTERNATIVES

A site feasibility and alternatives analysis was conducted of the proposed Project Site and surrounding 576 km^2. Site feasibility was evaluated based on a review of landscape characteristics pertaining to three primary aspects: operational, social, and environmental. The purpose of the operational analysis was to determine the engineering feasibility for development on the proposed Project Site compared to alternative locations. The purpose of the environmental and social analyses was to identify general environmental and social preferences and constraints of the proposed Project Site and compare these to those of alternative locations.

3.2.1 Criteria and Preferences

Criteria and preferences for each of the three feasibility analyses are listed below.

3.2.1.1 Operational

- Solar Resources: Good solar resources with minimal topographic or anthropogenic obstructions;
- Topography: Flat land with little to no gradient;
- Substation Access: Within 5 km of a substation;
- Road Access: Good access to existing road network;
- Available Land: Approximately 100-200 hectares of available land; and
- Floodplains/wetlands: No floodplains or wetlands.

3.2.1.2 Social

- Population: Sparsely populated;
- Structures: Few to no structures;
- Forests: No community forest opportunity areas; and
- Points of Interest: No places of worship, schools, or other points of interest.

3.2.1.3 Environmental

- Protected Land: Does not intersect with protected land;
- Floodplains/Wetlands: No floodplains or wetlands; and
- Modified Habitat: Located on land that has already been altered or disturbed by human presence.

3.2.2 Results of the Analyses

The site feasibility and alternatives analyses were conducted using publicly available spatial information along with custom analysis of commercial high-resolution satellite imagery. A summary of the results of the analyses are provided below.

3.2.2.1 Operational

Project placement close to existing roads and an existing substation was considered to be highly preferable, as it would reduce the cost and impact of building access roads and transmission lines necessary to reach the substation. The only substation within the 576 km^2 study area is the Golomoti Substation (Figure 3-1). Potential locations to the west of the substation were considered unfeasible because the slope exceeds operational requirements. Land farther east than the proposed Project Site is flat but there are fewer access roads and they are located farther from the substation. While locations in the eastern part of the study area have a slightly greater PV production value (Figure 3-2), they are less ideal for development purposes due to their more remote location.

The proposed Project Site was found to be feasible and preferred over alternative locations from an operational perspective for the following reasons:

- It has a gradient of 0-2 degrees across the entire site;
- It has relatively good solar irradiance, with only small obstructions from transmission line towers and small hills to the southwest;
- It is located less than 1 km from Golomoti Substation;
- It is located less than 100 m from a paved road;
- It represents over 100 hectares of available land for development; and
- There are no floodplains or wetlands within or directly adjacent to the site.

3.2.2.2 Social

From a social perspective, preferred locations for development are those located outside Golomoti Trading Centre and surrounding villages, where there are relatively few structures and land has been cleared for agriculture and grazing purposes (Figure 3-2). Cleared areas represent the preferred locations for solar development as they have minimal impacts to communities compared to sites that directly affect settlements or culturally important natural landscapes. Areas to the west of Golomoti and Kabulika were considered unfeasible from a social perspective, as development would affect potential community forest opportunity areas.

The proposed Project Site was found to be feasible from a social perspective for the following reasons:

- It is relatively sparsely populated;
- It only intersects with one structure;
- There are no points of interest, places of worship, or schools within 660 m of the site; and
- There are no community forest opportunity areas within 387 m of the site.

While other socially feasible locations were identified, none of them were preferable to the proposed Project Site based on social criteria.

3.2.2.3 Environmental

Forest and vegetated areas in the western part of the study area are considered to be environmentally sensitive and thus unfeasible for development. Areas that have been cleared for agriculture or grazing purposes are prioritized for development purposes. As a result, locations directly north of and proximal to Golomoti are optimal for the development project. Locations to the east of Golomoti are predominantly grassland and could be environmentally important areas.

The proposed Project Site was found to be feasible from an environmental perspective for the following reasons:

- There are no protected areas within 2 km of the site;
- There are no wetlands or floodplains within 1 km of the site; and
- It mostly consists of land utilized for subsistence agriculture and/or grazing.

While other environmentally feasible locations were identified, none of them were preferable to the proposed Project Site based on environmental criteria.

To summarize, the feasibility and alternatives analysis found that from an operational perspective, the proposed Project Site is feasible and preferable to alternative locations. While other socially and environmentally feasible locations were identified, none of them were preferable to the proposed Project Site. When the results of all three analyses are considered together, the proposed Project Site is the preferred location, with no preferred alternatives identified within the 576 km^2 study area.

3.2.3 Land Negotiations

Land negotiations with DLO and traditional leaders were undertaken from November 2015 to March 2016. The proposed Project Site was identified through this process. Following the identification, JCM has undertaken all required steps for the leasing of land according to Malawi regulatory requirements. The record of customary land consultation with Senior Chief Kachindamoto and the Group Village Headman is provided as Appendix K.

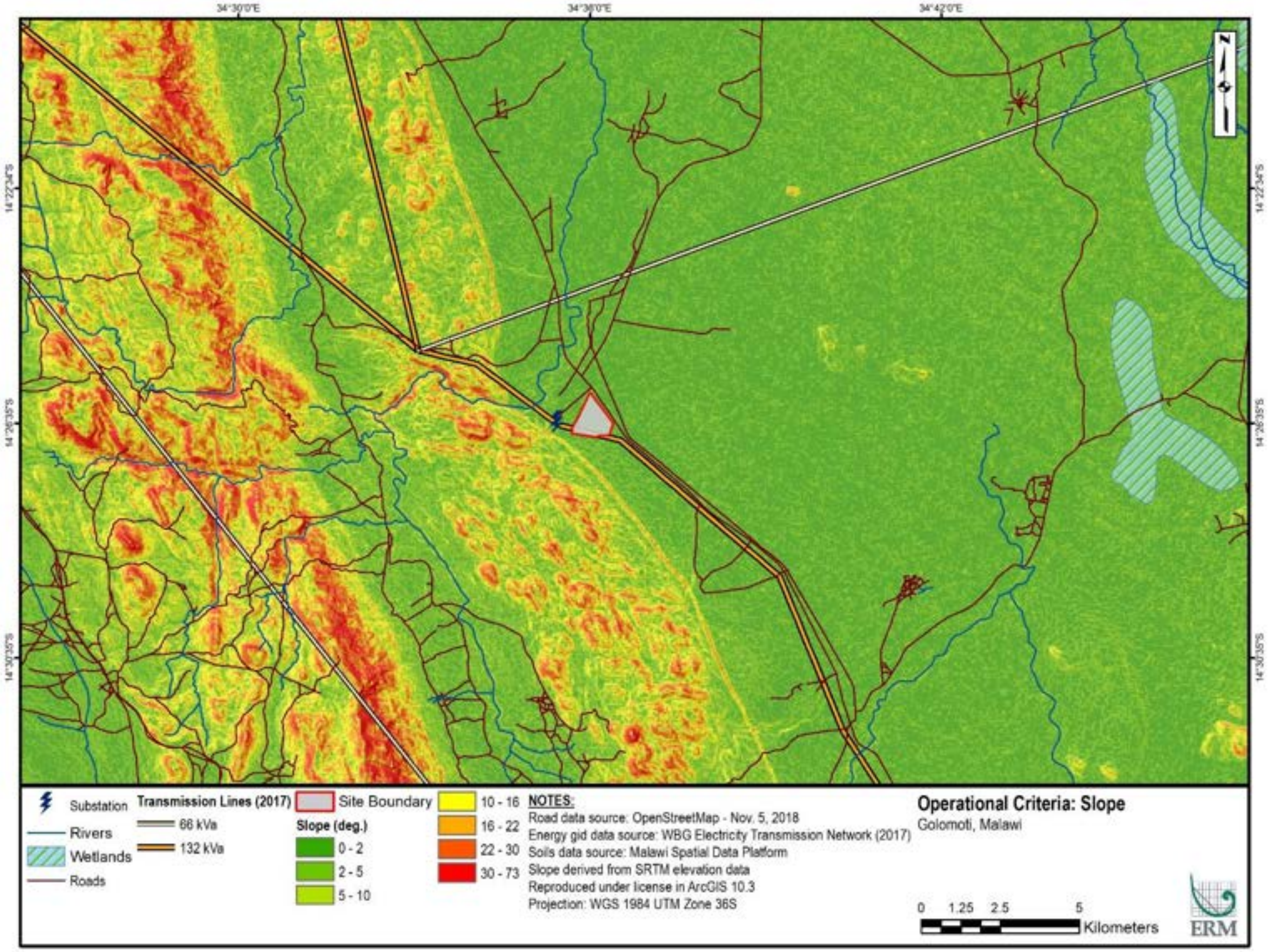
3.3 TECHNOLOGY ALTERNATIVES

Various technology alternatives will be investigated as part of the EPC bidding process for the Project. Each EPC bid will include a variety of technical specifications that will be evaluated by JCM.

3.4 NO ACTION ALTERNATIVE

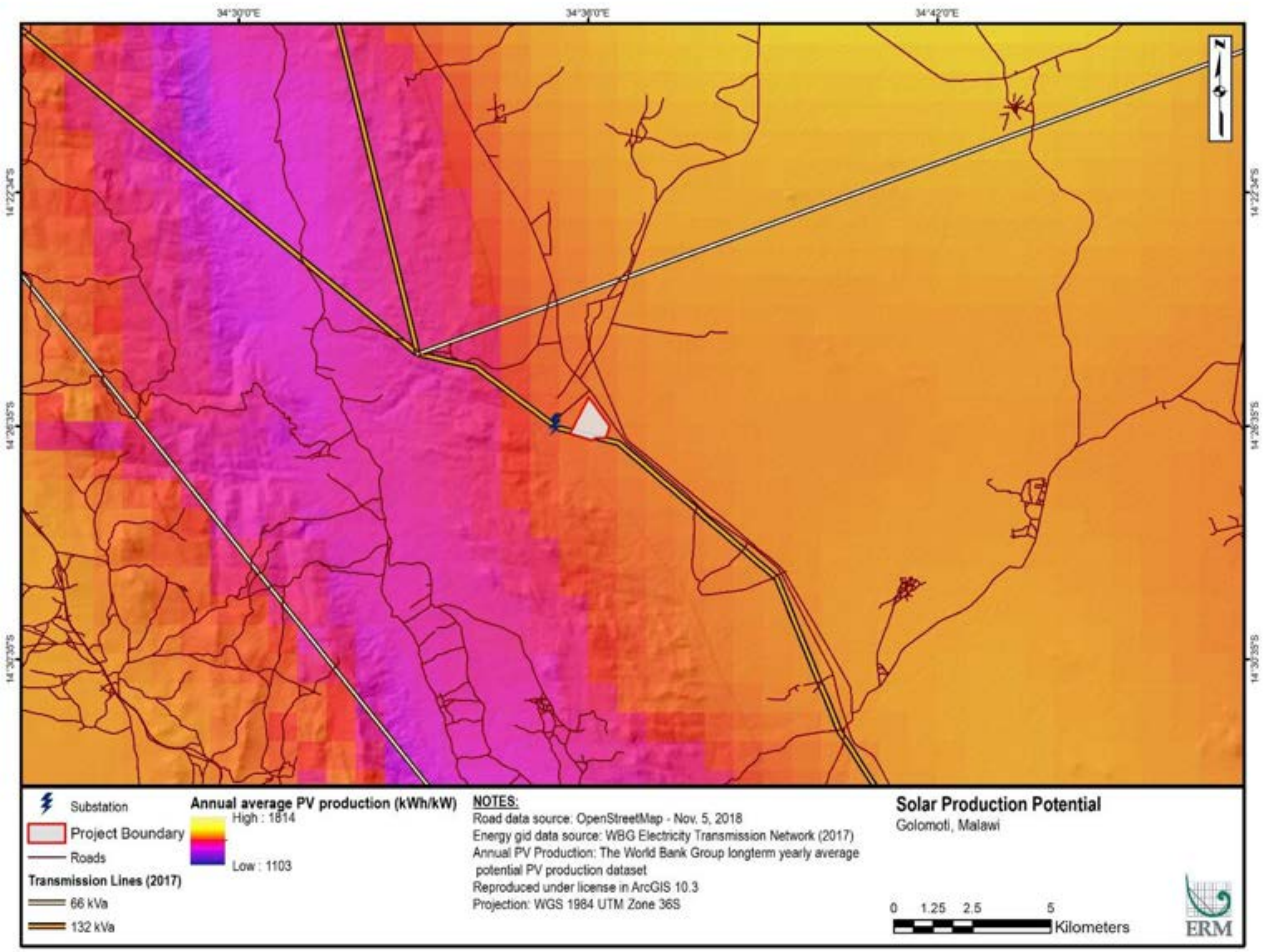
If the Project is not undertaken, then Malawi will not receive the significant increase in electricity generation for the country. In addition, temporary benefits from construction employment and permanent benefits from operational employment will not be realised. CSR programs to benefit local communities will not be undertaken.

Figure 3-1: Operational Criteria for Site Feasibility and Alternatives Analysis.



Source: ERM, 2019.

Figure 3-2: Solar Production Potential.



NOTES:

Road data source: OpenStreetMap - Nov. 5, 2018

Energy gid data source: WBG Electricity Transmission Network (2017)

Annual PV Production: The World Bank Group longterm yearly average potential PV production dataset

Reproduced under license in ArcGIS 10.3

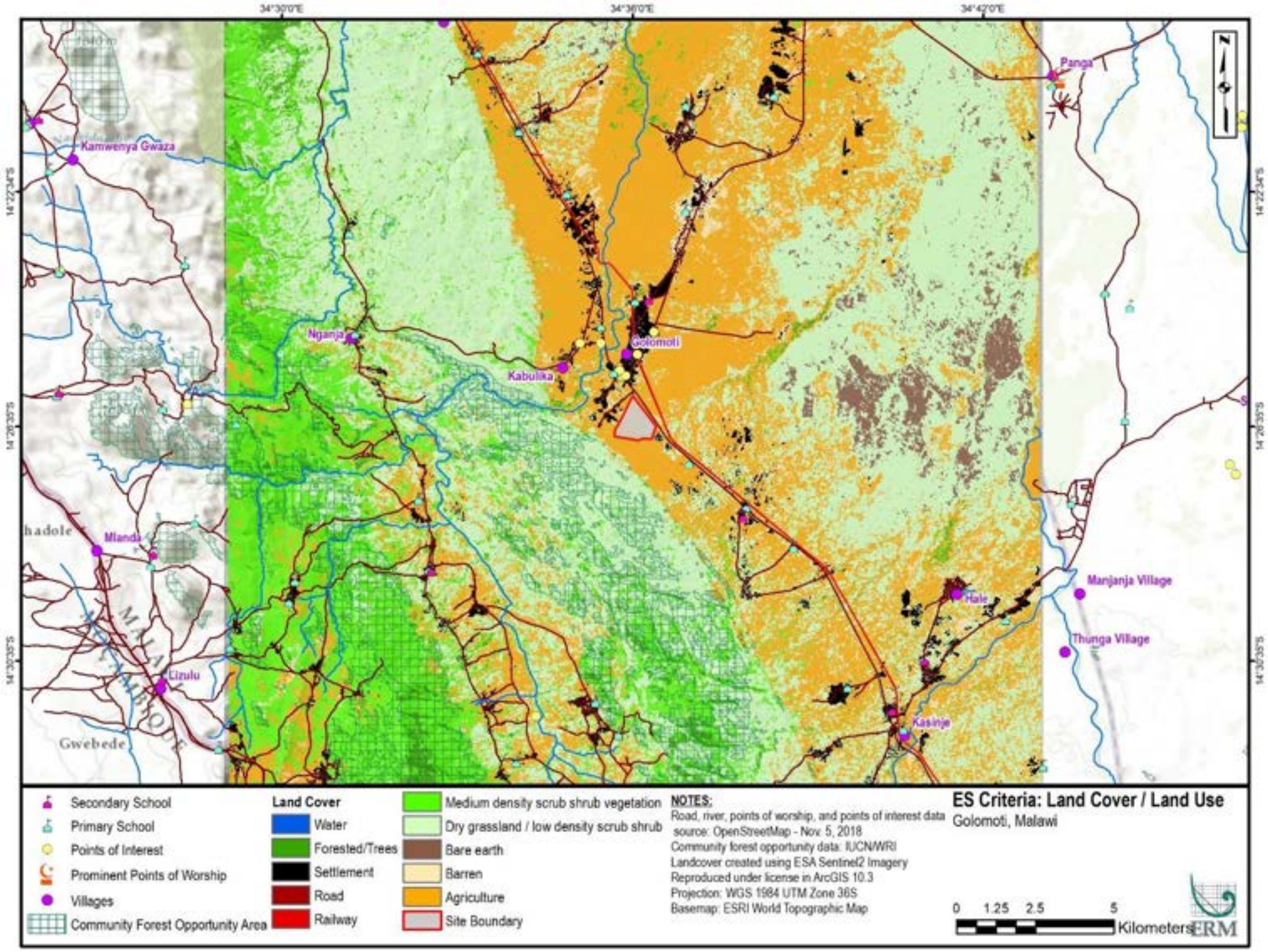
Projection: WGS 1984 UTM Zone 36S

Solar Production Potential

Golomoti, Malawi

Source: ERM, 2019.

Figure 3-3: Social and Environmental Criteria for Site Feasibility and Alternatives Analysis.



NOTES:
Road, river, points of worship, and points of interest data source: OpenStreetMap - Nov. 5, 2018
Community forest opportunity data: IUCN/WRI
Landcover created using ESA Sentinel2 Imagery
Reproduced under license in ArcGIS 10.3
Projection: WGS 1984 UTM Zone 36S
Basemap: ESRI World Topographic Map

ES Criteria: Land Cover / Land Use
Golomoti, Malawi

Source: ERM, 2019.

4. POLICY AND LEGAL FRAMEWORK

This chapter presents an overview of the principal national environmental and social policies, laws, and regulations applicable to the Project,[7] as well as international treaties and conventions to which Malawi is party. It also includes an overview of international lender standards, which define international best practice. In addition, they are likely to be applicable to the Project under lender loan agreements.

4.1 MALAWIAN INSTITUTIONAL FRAMEWORK

4.1.1 Constitution of Malawi

The 1995 Constitution of the Republic of Malawi (Constitution) is the supreme law of the country. The Constitution recognises that responsible environmental management can make an important contribution towards achieving sustainable development, improved standards of living, and conservation of natural resources (SADC, 2012). The Constitution states that the environment of Malawi should be managed in order to:

- Prevent degradation of the environment;
- Provide a healthy living and working environment for the people;
- Accord full recognition of the rights of future generations by means of environmental protection; and
- Conserve and enhance biological diversity.

The Constitution includes a framework for the integration of environmental considerations into development programs. The government, its partners, and the private sector therefore have a responsibility to ensure development programs and projects are undertaken in an environmentally responsible manner.

The Constitution also sets forth the legislative basis for land acquisition in the country. Section 28 (2) of the Constitution states that “No person shall be arbitrarily deprived of property,” and Section 44 (4) states that “Expropriation of property shall be permissible only when done for public utility and only when there has been adequate notification and appropriate compensation, provided that there shall always be a right to appeal to a court of law.”

With regard to women’s rights, Section 24 of the Constitution states that:

> Women have the right to full and equal protection by the law, and have the right not to be discriminated against on the basis of their gender or marital status which includes the right… to be accorded the same rights as men in civil law, including equal capacity… to enter into contracts… [and] to acquire and maintain rights in property, independently or in association with others, regardless of their marital status…

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[7] Walmsley, B and Patel, S, 2011. Handbook on environmental assessment legislation in the SADC region. 3rd edition. Pretoria: Development Bank of Southern Africa in collaboration with the Southern African Institute for Environmental Assessment.

4.2 MALAWIAN NATIONAL POLICIES AND PLANS

4.2.1 National Environmental Action Plan (2004)

The National Environmental Action Plan (NEAP) was developed in 1994 (updated in 2004) in response to Agenda 21 (Rio 1992 Declaration) as an action plan for integrating environmental issues into socio-economic development programs. The objectives of the NEAP are to:

- Document and analyse all major environmental issues and measures;
- Promote sustainable use of natural resources; and
- Develop an environmental protection and management plan.

The NEAP outlines actions that need to be considered to ensure adequate environmental protection. For example, ESIAs are required for any development that may affect fragile ecosystems, and the government is required to ensure that workers are supplied with appropriate protective equipment during construction and operation.

The NEAP is applicable to the Project because it has the potential to negatively impact the surrounding environment and therefore an ESIA is required. In the ESIA, impacts and management measures are detailed and a management plan is included in accordance with the objectives of the NEAP.

4.2.2 National Environmental Policy (2004)

The National Environmental Policy (NEP) aims to create a balance between protection of natural resources and national development. The policy promotes sustainable social and economic development through sound management of the environment and natural resources. The policy seeks, among other things, to:

- Secure an environment suitable for the health and well-being of all citizens of Malawi;
- Promote efficient utilisation and management of the country’s natural resources and encourage self-sufficiency in food, fuel wood, and other energy requirements;
- Facilitate the restoration, maintenance, and enhancement of the ecosystems and ecological processes essential for the functioning of the biosphere and prudent use of renewable resources;
- Integrate sustainable environmental and natural resource management into the decentralised governance systems and ensure that the institutional framework for the management of natural resources supports environmental governance in local government authorities;
- Enhance public education and awareness of various environmental issues and public participation in addressing them; and
- Promote local community, NGO, and private sector participation in environmental and natural resource management.

The NEP includes strategies on environmental planning and environmental impact assessment. The objective of environmental planning is to ensure that national and district development plans integrate environmental concerns in order to improve environmental management and ensure sensitivity to local concerns and needs.

The NEP is applicable to the Project because it requires an ESIA. The objective of the NEP is to regularly review and administer the guidelines for ESIAs, audits, monitoring, and evaluation so that adverse environmental impacts can be eliminated or mitigated and environmental benefits enhanced.

4.2.3 National Land Policy (2002)

The National Land Policy (2002) guides land management and administration issues, provides definitions of land ownership categories, and provides details on compensation payments for land. In terms of land use planning, the policy provides that land allocation should make effective use of land and take into account the environment and the welfare of communities. In terms of environmental management, the policy aims to lend support to the policies and strategies that are already in place. The policy covers issues related to both urban and rural management of solid and liquid waste, protection of sensitive areas, agricultural resource conservation and land use, community forests and woodland management, over-dependence on wood fuel, forest programs, coordination of multiple land uses, water resources and wetlands, lakeshore environmental management, and mining and minerals.

The National Land Policy is applicable to the Project because the Project includes land acquisition.

4.2.4 National Water Policy (2004)

The National Water Policy (2004) requires that:

- Water should be managed and used efficiently and effectively in order to promote its conservation and future availability in sufficient quantity and acceptable quality; and
- All programs related to water should be implemented in a manner that mitigates environmental degradation.

The National Water Policy is applicable to the Project because the Project will draw water from groundwater resources. Permits for water extraction are not part of the ESIA process but require the approved ESIA as part of the application. Once the ESIA has been approved, the Project will apply for the water use license.

4.2.5 National Energy Policy (2018)

The National Energy Policy (2018) describes technical, financial, institutional, and socio-cultural barriers to Renewable Energy Technologies (RETs). Technical barriers include a lack of capacity in manufacturing, distributing, installing, and maintaining RETs. Financial barriers include high initial cost, a large proportion (45%) of which emanates from import duties and surtaxes. Other key financial barriers are a lack of dedicated and affordable financing mechanisms, a lack of financers and suppliers with knowledge about establishing dedicated financing mechanisms and appraising applications for credit, a lack of skills to develop business plans, a lack of knowledge about local, regional, and international financial facilities for RETs, a lack of confidence in RETs, and low returns on investment (for financiers) and the non-availability of loans (for end users). Institutional barriers include a lack of standards and a regulatory framework, limited delivery modes, a small number of RET companies, a latent market and a small number of qualified technicians to undertake installations, a lack of deliberate policies and strategies, and a lack of information about the efficacy of RETs among policy makers, NGOs, and the public. Social-cultural barriers include gender insensitivity in the design and operation of some RETs.

The National Energy Policy is applicable to the Project because it will produce renewable energy.

4.2.6 National HIV/AIDS Policy (2012)

The National HIV/AIDS Policy (2012) provides technical and administrative guidelines for the design, implementation, and management of HIV/AIDS interventions, programs, and activities at all levels of Malawi society. It offers:

- Guidance on critical intervention areas, for example social and economic support for people living with HIV/AIDS;
- Provision of care and support for treatment to achieve a better quality of life for all people living with HIV/AIDS; and
- Protection of the human rights and freedoms of people living with HIV/AIDS.

The goals of the National HIV/AIDS Policy are to:

- Prevent the further spread of HIV infection; and
- Mitigate the impact of HIV/AIDS on the socioeconomic status of individuals, families, communities, and the nation.

The National HIV/AIDS Policy is applicable to the Project because potential HIV/AIDS impacts were investigated in the ESIA and are addressed in this ESIA Report. Measures to mitigate these impacts are in line with the policy.

4.2.7 National Health Policy (2008)

The overall goal of the National Health Policy (2008) is to improve the health status of all people in Malawi by reducing the risk of ill health and the occurrence of premature deaths.[8] The policy acknowledges the inadequate resources available for the health sector and defines the Essential Health Package, which is available to all Malawians free of charge.[9]

The National Health Policy is applicable to the Project because JCM is committed to ensuring that the health of workers and surrounding communities are not negatively impacted by Project activities.

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[8] WHO, Malawi, “Analytical summary - General country health policies,” nd. Accessed on 18-Mar-19 at: http://www.aho.afro.who.int/profiles_information/index.php/Malawi:Analytical_summary_-_General_country_health_policies.

[9] WHO, Malawi, “Analytical summary - General country health policies,” nd. Accessed on 18-Mar-19 at: http://www.aho.afro.who.int/profiles_information/index.php/Malawi:Analytical_summary_-_General_country_health_policies.

4.2.8 Republic of Malawi Gender Policy (2015)

The Republic of Malawi Gender Policy (2015) focuses on building a society where men, women, boys, and girls equally and effectively participate in and benefit from development. A key aspect of this is to increase land ownership for women and promote women's participation in community afforestation, water, and land.

The Republic of Malawi Gender Policy is applicable because JCM will, as practicable, promote gender equality in all aspects of the Project.

4.3 MALAWIAN ENVIRONMENTAL LAWS

4.3.1 Environmental Management Act (1996)

The Environmental Management Act (EMA) was enacted in 1996 to provide the legal framework for addressing environmental problems impacting Malawi, including soil erosion and land degradation, deforestation, water resources degradation and depletion, threats to fish resources, threats to biodiversity, human habitat degradation, and air pollution, including greenhouse gas emissions and climate change. The EMA requires certain development projects to conduct an ESIA to evaluate their potential environmental and social impacts and to develop measures to avoid or mitigate these impacts. The Environmental Affairs Department (EAD) of the Ministry of Natural Resources, Energy, and Mining has developed guidelines for conducting ESIAs and preparing ESIA reports in compliance with the EMA (see Section 4.3.2 of this report).

Part IV of the EMA makes provisions for the control of air and water pollution, and the act prohibits the discharge of pollutants into the environment. The EMA states that it is the duty of every person to prevent the discharge of any pollutant into the environment except in accordance with specifications made by the Minister (of Natural Resources, Energy, and Mining) or Director (of EAD). It states that the Minister is able to direct anyone to prevent and/or minimise any pollutant discharged into the environment. Finally, it requires that any discharge of pollutants be conducted in accordance with the EMA.

Section 24 of the EMA provides information on the need for projects for which an ESIA may be required, as detailed below.

- The Minister may specify the types and sizes of projects that will not be implemented unless an ESIA is undertaken;
- Before implementing a project that requires an ESIA, the project developer must submit the following information to the Director:
    - A description of the project;
    - A description of the activities to be undertaken in the implementation of the project;
    - The likely impact of those activities on the environment;
    - The number of people to be employed by the project (construction and operation);
    - Details of the environment likely to be affected by the project; and

- Any additional information that the Director deems to be relevant to the project.

A Project Brief was submitted to the EAD in November 2018, which outlined the scope of the Project. The EAD responded in a letter dated December 14, 2018 by confirming that an ESIA was required. This ESIA Report satisfies the requirements of the EMA.

4.3.2 Guidelines for Environmental Impact Assessment (1997)

The EAD issued Guidelines for Environmental Impact Assessment shortly after passage of the EMA, in 1997. The guidelines address prerequisites for EIA (Section 1.3), statutory basis for EIA (Section 1.4), integrating EIA into the project cycle (Section 1.5), the EIA process (Section 2.2), EIA roles and responsibilities (Section 2.3), and public consultation and access to information (Section 2.4). Appendix C.3 provides guidelines on the structure of EIA Reports.

The Golomoti ESIA was conducted and this ESIA Report was prepared in accordance with the Guidelines for Environmental Impact Assessment (1997).

4.3.3 Forestry Act (1997)

The Forestry Act (1997) addresses the management of indigenous forests on customary land, private land, forest reserves, protected forest areas, and plantations.[10] The objectives of the Forestry Act include to:

- Protect trees and resources in forest reserves;
- Conserve and enhance biodiversity;
- Protect and facilitate management of trees on customary land; and
- Promote sustainable utilisation of timber and other forest produce and protect fragile areas such as riverbanks and water catchment areas.

The Project Area is largely modified by human activities with most of the area being used for the cultivation of crops. There is no land take required from forest reserves, protected forest areas, or plantations. Any removal of trees, however, will be conducted in line with the Forestry Act.

4.3.4 Electricity Act (2004)

Under the Electricity Act (2004), developers are required to give no less than 30 days' notice before placing, laying down, or carrying any transmission line, distribution line, water pipeline, or other equipment through, over, or under any land without the consent of the owner, lessee, or occupier of the land.[11] Notice must be published in the *Gazette* or in a paper in general circulation. Notices should include the nature of the work and the name and location of the project. Notice must also be provided to affected people. It is the responsibility of the authorities to determine the amount of compensation, either by

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[10] Republic of Malawi, Forestry Act, 1997. Accessed on 19-Mar-19 at http://extwprlegs1.fao.org/docs/pdf/mlw10025.pdf.

[11] Republic of Malawi, Electricity Act, 2004. Accessed on 18-Mar-19 at https://www.meramalawi.mw/index.php/legislation/send/2-legislation/5-the-electricity-act-2004.

payment of a lump sum, annual rental, or both, to the impacted owners, lessees, or occupiers.

The Project is in the process of securing the necessary licenses from ESCOM for the generation of electricity. The notifications required by the Electricity Act will also be made prior to the initiation of construction activities.

4.3.5 Energy Regulation Act (2004)

The Energy Regulation Act (2004) established the Malawi Energy Regulatory Authority (MERA) to regulate the energy sector, defined the functions and powers of MERA, and provided for licensing of energy undertakings.[12] The mandate of MERA is to regulate the energy sector in a fair, transparent, efficient, and cost effective manner for the benefit of consumers and operators. In addition, MERA is mandated to promote renewable energy.

The Project will generate electricity from renewable sources and its operation will be regulated by MERA. The Project will adhere to all licensing and monitoring requirements under the Energy Regulation Act.

4.3.6 Water Resources Act (2013)

The Water Resources Act (2013) provides for the management and conservation of water resources in Malawi.[13] It is the principal legislation dealing with the control, conservation, apportionment, and use of water resources in the country. The act prohibits any person to divert, dam, store, extract, or use public water except in accordance with its provisions. The act defines water pollution as any activity that directly or indirectly alters "the physical, thermal, chemical, biological or radioactive properties of any water so as to render the water less fit for any beneficial purpose for which it is, or may reasonably be, used or to cause a condition which is hazardous or potentially hazardous to public health, safety or welfare, or to animals, birds, fish or aquatic life or other organisms or to plants."

The activities of the proposed Project will require water and have the potential to pollute the water resources surrounding the Project Area. All water extraction and discharges will be conducted in accordance with the Water Resources Act and its implementing regulations.

4.3.7 Land Act (2016)

The Land Act (2016) makes provisions for various matters relating to customary, private, and public land, and enumerates the power of the Minister in respect to such land.[14] The act vests all land in the Republic in perpetuity. The act defines customary land as "all land which is held, occupied or used under customary law, but does not include any public land." It defines public land as "all land which is occupied, used or acquired by the Government and any other land, not being customary land or private land, and includes (a) any land held by the Government consequent upon a reversion thereof to the Government on the termination, surrender or falling-in of any freehold or leasehold estate

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[12] Republic of Malawi, Energy Regulation Act, 2004. Accessed on 19-Mar-19 at http://extwprlegs1.fao.org/docs/pdf/mlw119224.pdf.

[13] Republic of Malawi, Water Resources Act, 2013. Accessed on 19-Mar-19 at http://extwprlegs1.fao.org/docs/pdf/mlw167598.pdf.

[14] Republic of Malawi, Land Act, 2016. Accessed on 19-Mar-19 at http://extwprlegs1.fao.org/docs/pdf/mlw170885.pdf.

therein pursuant to any covenant or by operation of law; and (b) notwithstanding the revocation of the existing Orders, any land which was, immediately before the coming into operation of this Act, public land with the meaning of the existing Orders." Private land is defined as "all land which is owned, held or occupied under a freehold title, or a leasehold title, or a Certificate of Claim or which is registered as private land under the Registered Land Act."[15]

The Project is being developed on customary land utilized by community members in the area. All land related actions will occur in compliance with the Land Act.

4.3.8 Customary Land Act (2016)

The Customary Land Act (2016) provides for the management and administration of customary land and for associated matters.[16] Customary land is the land occupied and used by members of a community who live under customary law. Customary land, however, is not communal land. Most customary land is divided into parcels allocated for the use of individuals and their families. Rights to this land are usually well defined, often for exclusive use and transmissible.

The Project is being developed on customary land utilized by community members in the area. All land related actions will occur in compliance with the Customary Land Act.

4.3.9 Land Acquisition (Amendment) Act (2016)

The Lands Acquisition (Amendment) Act (2016) empowers the Minister to acquire land in the interest of the public.

The Project is being developed on customary land utilized by community members in the area. All land acquisition will occur in compliance with the Land Acquisition (Amendment) Act.

4.3.10 Employment Act (2000)

The Employment Act (2000)[17] prohibits forced labour and discrimination based on race, colour, sex, language, religion, political or other opinion, nationality, ethnic or social origin, disability, property, birth, marital or other status or family responsibilities. It requires equal pay and establishes remedies for infringement of fundamental rights. It also sets limits on child labour and regulates contracts, working hours, weekly rest and leave, wages, and discipline and dismissal.

All Project employment will be in compliance with the Employment Act.

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[15] Republic of Malawi, Land Act, 2016. Accessed on 18-Mar-19 at http://extwprlegs1.fao.org/docs/pdf/mlw41845.pdf.

[16] Republic of Malawi, Customary Land Act, 2016. Accessed on 18-Mar-19 at http://extwprlegs1.fao.org/docs/pdf/mlw170882.pdf.

[17] Republic of Malawi, Employment Act, 2000. Accessed on 19-Mar-19 at https://www.ilo.org/wcmsp5/groups/public/---ed_protect/---protrav/---ilo_aids/documents/legaldocument/wcms_125534.pdf.

4.3.11 Labour Relations Act (1996)

The Labour Relations Act (1996)[18] promotes sound labour relations through the protection and promotion of freedom of association, collective bargaining and organizational rights, and dispute resolution. It also covers trade unions and employer organizations, the Tripartite Labour Advisory Council, and the Industrial Relations Court.

All Project employment will be in compliance with the Labour Relations Act.

4.3.12 Malawi Bureau of Standards

The Malawi Bureau of Standards (MBS) is charged with the preparation and promulgation of national standards.[19] Standards are formulated through Technical Committees whose membership covers a variety of sectors. Current Technical Committees include one for environmental protection and one for pollution control. Malawi is also developing its own emissions standards. The standards developed by MBS to date that are most relevant to the Project are:

- 13.020.10 – Environmental Management (adoption of the ISO14000 series on environmental management);
- MS 173:2005 – Acoustics noise pollution (tolerance limits);
- MS 214:2013 – Drinking water (specification); and
- MS 691:2005 – Tolerance limits for domestic sewage effluents discharged into in land surface waters (specification).

All Project-related activities will be conducted in compliance with the above standards.

4.3.13 Occupational Safety, Health and Welfare Act (1997)

The principal legislation that regulates occupational health and safety in Malawi is the Occupational Safety, Health and Welfare Act (1997).[20] The act regulates conditions of employment in workplaces with regard to safety and the health and welfare of employees. The act imposes duties on employers, the self-employed, and other persons in control of premises, manufacturers, and suppliers (Wage Indicator, 2017).

The Project will comply with the Occupational Safety, Health and Welfare Act and all occupational health and safety regulations in Malawi. Working conditions on site will be monitored to ensure compliance.

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[18] Republic of Malawi, Labour Relations Act, 1996. Accessed on 19-Mar-19 at http://www.ilo.org/dyn/natlex/docs/ELECTRONIC/44859/104140/F547679546/MWI44859.pdf.

[19] Malawi Bureau of Standards, Catalogue of Malawi Standards, 2015. Accessed on 19-Mar-19 at http://www.malawitradeportal.gov.mw/kcfinder/upload/files/2015%20%20Malawi%20Standards%20Catalogue_1.pdf.

[20] Republic of Malawi, Occupational Safety, Health and Welfare Act, 1997. Accessed on 19-Mar-19 at https://www.ilo.org/wcmsp5/groups/public/---ed_protect/---protrav/---ilo_aids/documents/legaldocument/wcms_125535.pdf.

4.3.14 Public Health Act (1948)

The Public Health Act (1948) is the principal law addressing public health in Malawi.[21] The act is currently under revision.

All Project activities will be conducted in compliance with the Public Health Act.

4.3.15 Gender Equality Act (2013)

The Gender Equality Act (2013) was enacted to: promote gender equality, equal integration, influence, empowerment, dignity, and opportunities for men and women in all functions of society; prohibit and provide redress for sex discrimination, harmful practices, and sexual harassment; and provide for public awareness on promotion of gender equality.[22]

The Project will, as practicable, promote gender equality in its activities, particularly through employment and community investment initiatives.

4.3.16 Marriage, Divorce and Family Relations Act (2015)

The Marriage, Divorce and Family Relations Act (2015) consolidates various laws related to marriage, including a key provision to recognise the validity of four “same legal status” forms of marriage. These are civil marriage, customary marriage, religious marriage, and marriage by reputation or permanent cohabitation. The act also sets the minimum age for marriage at 18.[23]

The Project will, as practicable, implement measures to ensure community dynamics are not impacted and that issues regarding gender-based violence are not exacerbated as a result of Project activities.

4.4 REQUIRED PERMITS

The principal agreements, licenses, and permits that JCM understands it will need to construct and operate the Project, along with their statuses, are listed in Table 4-1.

Table 4-1: Status of Principal Agreements, Licenses, and Permits.

Agreement / License / Permit	Agency	Status
Certificate of Incorporation	Registrar of Companies	Obtained

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[21] Republic of Malawi, Public Health Act, 1948. Accessed on 19-Mar-19 at https://www.ilo.org/dyn/natlex/docs/ELECTRONIC/86506/97716/F553398709/MWI86506.pdf.

[22] Republic of Malawi, Gender Equality Act, 2013. Accessed on 19-Mar-19 at https://womenlawyersmalawi.files.wordpress.com/2017/06/gender-equality-act.pdf.

[23] United Nations Global Database on Violence against Women. Accessed on 19-Mar-19 at http://evaw-global-database.unwomen.org/en/countries/africa/malawi/2015/the-marriage-divorce-and-family-relations-bill.

Agreement / License / Permit	Agency	Status
Tax Payer Identification Number	Malawi Revenue Authority	Obtained
Business License	Ministry of Trade, Industry, and Tourism	Obtained
Exchange Control Approval for Non-Resident Shareholders	Reserve Bank of Malawi, through an authorized dealer bank	Obtained
Implementation Agreement	Government of the Republic of Malawi, as represented by the Minister of Finance, Economic Planning, and Development and the Minister of Natural Resources, Energy, and Mining	Signed on August 23, 2018.
Power Purchase Agreement	Electricity Supply Corporation of Malawi Limited	Signed on September 13, 2018.
Connection Agreement	Electricity Supply Corporation of Malawi Limited	Pending, to be signed upon completion of feasibility studies and ESCOM's internal connection impact assessment.
Electricity Generation License	Electricity Supply Corporation of Malawi Limited	Pending.
Generation License	Malawi Energy Regulatory Authority	Pending, contingent upon ESIA approval certificate and acquisition of land according to national procedures.
Approval of Power Purchase Agreement	Malawi Energy Regulatory Authority	Pending
Approval of Tariffs	Malawi Energy Regulatory Authority	Pending

Agreement / License / Permit	Agency	Status
Permit for Diesel Tank/Storage	Malawi Energy Regulatory Authority	Pending
Environmental Impact Assessment License	Environmental Affairs Department	Pending, contingent upon ESIA approval certificate.
Disposal of Waste	Environmental Affairs Department	Pending
Construction License	National Construction Industry Council	Pending
Water License	National Water Resources Council	Pending
Planning Permit	Ministry of Lands, Physical Planning Department	Pending
Land Lease	Minister responsible for land matters	Pending
Registration of Pension Fund	Reserve Bank of Malawi, Registrar of Financial Institutions	Pending
Registration for Occupational Health and Safety	Ministry of Labour	Pending
Temporary Employment Permits (for expatriate employees)	Minister of Home Affairs, Immigration Department	Pending
Renewable Energy Certificate	Energy Regulatory Authority	Pending

4.5 INTERNATIONAL CONVENTIONS

Malawi has concluded or ratified a number of international conventions and agreements relating to industry, development, and environmental management. In certain cases, conventions and agreements have influenced policy, guidelines, and regulations, and therefore are relevant to the planning, construction, and operation of the Project.

Table 4-2 lists the relevant international conventions and protocols to which Malawi has either concluded or ratified that are relevant to the Project. Many of these are incorporated into the various World Bank Operational Procedures and the IFC Performance Standards.

By conforming to these two sets of standards, the Project will comply with the requirements of the relevant international conventions.

Table 4-2: International Convention and Agreements Concluded or Ratified by Malawi.

Year	Name of the Convention / Agreement
2003	The Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (Basel Convention)
2001	The International Labour Organisation (ILO) Fundamental Convention related to forced labour, freedom of association, discrimination and child labour
2000	International Covenant on Economic, Social and Cultural Rights
2000	International Covenant on Civil and Political Rights
1992	United Nations Framework Convention on Climate Change
1992	Convention on Biological Diversity
1989	African Charter on Human and People’s Rights
1989	Montreal Protocol on Substances that deplete the Ozone Layer
1985	Vienna Convention for the Protection of the Ozone Layer
1975	Convention Concerning the Protection of the World Cultural and Natural Heritage (World Heritage Convention), Paris
1971	Ramsar Convention on Wetlands of International Importance, especially Waterfowl Habitats (Ramsar, Iran)
1968	African Convention on Conservation of Nature and Natural Resources

4.6 INTERNATIONAL LENDER STANDARDS

In addition to national legislation, the Project is being developed in line with the standards and guidelines of international financial institutions. These standards and guidelines are intended to complement and reinforce national legislation and ensure the Project is conducted in accordance with international industry good practice and in a way that minimises risks and impacts.

The Project is currently seeking financing from Equator Principle Financial Institutions. As a result, the Equator Principles (2013) will likely be applicable to the Project. Principle 3 (Applicable Environmental and Social Standards) of the Equator Principles states that: “For Projects located in Non-Designated Countries, the Assessment process evaluates compliance with the then applicable IFC Performance Standards on Environmental and Social Sustainability (Performance Standards) and the World Bank Group Environmental, Health, and Safety Guidelines (EHS Guidelines).” Malawi is a Non-Designated Country under the Equator Principles. As a result, the International Finance Corporation (IFC) Performance Standards on Environmental and Social Sustainability (2012) and relevant World Bank EHS Guidelines will also likely be applicable to the Project.

4.6.1 Equator Principles

The Equator Principles (2013) is a risk management framework adopted by financial institutions for determining, assessing, and managing environmental and social risk in project finance. It is primarily intended to provide a minimum standard for due diligence to support responsible risk decision making. As of March 2019, 94 financial institutions in 37 countries have officially adopted the Equator Principles, covering the majority of international project finance debt in emerging and developing markets.

A summary of each principle in the Equator Principles is provided in Table 4-3.

Table 4-3: Summary of the Equator Principles.

No.	Principle	Summary of Applicable Requirements
1	Review and Categorisation	Requires projects to be categorized based on the magnitude of potential environmental and social risks and impacts.
2	Environmental and Social Assessment	Requires all Category A and B projects to conduct an assessment process to address the relevant environmental and social risks and impacts of the proposed project. For Category A and, as appropriate, Category B projects, the assessment documentation should include an Environmental and Social Impact Assessment (ESIA). Requires all projects to conduct, when combined Scope 1 and 2 emissions are expected to be more than 100,000 tonnes of CO_2 equivalent annually, an alternatives analysis to evaluate less greenhouse gas (GHG) intensive alternatives.
3	Applicable Environmental and Social Standards	Requires projects located in Non-Designated Countries, including Malawi, to align with the IFC Performance Standards.
4	Environmental and Social Management System and EP Action Plan	Requires all Category A and B projects to develop or maintain an Environmental and Social Management System, and prepare an Environmental and Social Management Plan (ESMP).
5	Stakeholder Engagement	Requires all Category A and B projects to demonstrate effective stakeholder engagement as an ongoing process in a structured and culturally appropriate manner with affected communities. Commensurate to the project’s risks and impacts, appropriate documentation should be readily available to the affected communities. The results of the stakeholder engagement process should also be documented.
6	Grievance Mechanism	Requires all Category A and, as appropriate, Category B projects to establish a grievance mechanism to receive and facilitate resolution of concerns and grievances about the project’s environmental and social performance.
7	Independent Review	Requires all Category A and, as appropriate, Category B projects to appoint an Independent Environmental and Social Consultant (IESC) to perform and independent review and propose an Equator Principles Action Plan.
8	Covenants	Requires the development of suitable covenants in the financing documentation to ensure host country law compliance, implementation of the Equator Principles Action Plan, and, as needed, periodic monitoring.
9	Independent Monitoring and Reporting	Requires appointment of an IESC to assess project conformance with the Equator Principles and ensure ongoing monitoring and reporting after financial close and over the life of the loan.
10	Reporting and Transparency	Requires the project proponent to ensure that, at a minimum, a summary of the key environmental and social information (and ideally the ESIA) is accessible and available online. In addition, requires the project proponent to publicly report

No.	Principle	Summary of Applicable Requirements
		GHG emission levels (combined Scope 1 and 2 emissions) during the operational phase if the project emits over 100,000 tonnes of CO_2 equivalent annually. Requires the lenders to report publicly, at least annually, on transactions that have reached financial close.

4.6.2 IFC Performance Standards

The IFC's Sustainability Framework articulates the IFC's strategic commitment to sustainable development, and is an integral part of their approach to risk management. The IFC Performance Standards on Environmental and Social Sustainability (2012) are a key part of the Sustainability Framework. The IFC Performance Standards are "directed towards clients, providing guidance on how to identify risks and impacts, and are designed to help avoid, mitigate, and manage risks and impacts as a way of doing business in a sustainable way, 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 its clients to apply the Performance Standards to manage environmental and social risks and impacts so that development opportunities are enhanced."[24]

A summary of each Performance Standard (PS) and an indication of where they are addressed in this ESIA Report are provided in Table 4-4.

Table 4-4: Summary of the IFC Performance Standards and Where They Are Addressed in this ESIA Report.

PS	Title	Scope	Section in ESIA Report
1	Assessment and Management of Environmental and Social Risks and Impacts	Defines requirements for ensuring appropriate E&S management, policy implementation and accountability through an ESIA and associated ESMP for which the PS 1 defines requirements.	All
2	Labour and Working Conditions	Defines requirements for ensuring that workers are treated fairly and are provided with safe and healthy working conditions and international labour standards are followed.	Sections 6.3.2 and 6.3.14
3	Resource Efficiency and Pollution Prevention	Defines requirements for ensuring an appropriate level of pollution prevention and abatement.	Section 5.1 and Sections 6.4.1 through 6.4.4
4	Community Health, Safety, and Security	Defines requirements for ensuring that adverse impacts from the project on the receiving community are managed and controlled including project-related security management.	Section 5.3 and Sections 6.4.11 through 6.4.13
5	Land Acquisition and Involuntary Resettlement	Defines requirements to minimise adverse social and economic impacts from involuntary resettlement, land acquisition, or restrictions on land use.	Sections 5.3 and 6.4.9
6	Biodiversity Conservation and Sustainable	Defines requirements for ensuring that the project's impacts on nature, ecosystems, habitats, and	Section 5.2 and Sections 6.4.5 through 6.4.7

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[24] International Finance Corporation, Performance Standards on Environmental and Social Sustainability, 2012. Accessed on 19-Mar-19 at https://www.ifc.org/wps/wcm/connect/115482804a0255db96fbffd1a5d13d27/PS_English_2012_Full-Document.pdf?MOD=AJPERES.

PS	Title	Scope	Section in ESIA Report
	Management of Living Natural Resources	biodiversity are appropriately minimised and managed.	
7	Indigenous Peoples	Defines requirements for the protection of Indigenous Peoples.	Not applicable to the Project as there are no Indigenous people as defined by PS 7 in the Project Area.
8	Cultural Heritage	Defines requirements to protect cultural heritage from the adverse impacts of project activities, to support its preservation, and to promote the equitable sharing of benefits from the use of cultural heritage.	Sections 5.4 and 6.4.15

4.6.3 World Bank Group EHS Guidelines

The World Bank Group Environmental, Health, and Safety (EHS) Guidelines are technical reference documents with general and industry-specific examples of Good International Industry Practice and are referred to in the World Bank's Environmental and Social Framework and the IFC Performance Standards. The EHS Guidelines contain the performance levels and measures that are normally acceptable to the World Bank Group and that are generally considered to be achievable in new facilities at reasonable cost by existing technology.[25] The EHS Guidelines generally provide additional details for projects to align with PS 3 (Resource Efficiency and Pollution Prevention) and, to a lesser extent, PS 2 (Labour and Working Conditions).

The following World Bank Group EHS Guidelines are applicable to the Project:

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

Please note that there are currently no EHS guidelines specific to solar projects.

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[25] International Finance Corporation, Environmental, Health, and Safety Guidelines. Accessed on 19-Mar-19 at https://www.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/sustainability-at-ifc/policies-standards/ehs-guidelines.

5. ENVIRONMENTAL AND SOCIAL SETTING

The objective of the environmental and social baseline is to establish the existing biophysical conditions in the Project direct and indirect AoI, as defined in Section 6.2.1. This chapter presents the baseline conditions in the Project Area and serves as the reference point against which changes can be predicted and ultimately monitored.

5.1 PHYSICAL BASELINE

This section describes the physical environment of the Project Area. The information in this section is based on a desktop review of publicly available information and specialist on-site studies.

5.1.1 Climate and Meteorology

The Project Site's climate is classified as Aw (Savannah). Golomoti has an average minimum temperature between 18 and 20 degrees Celsius and average maximum temperature between 28 and 30 degrees Celsius. Golomoti has an annual average rainfall of between 1001 and 1200 mm.

5.1.2 Air Quality

There are no notable point source air emissions in the Project Area, and there are no major urban or industrial activities near the Project Site.

5.1.3 Noise

There are no notable point source noise emissions in the Project Area. The Project Site is surrounded by agricultural land, and there are no major industrial or urban areas located nearby.

5.1.4 Geology

The Project Site is underlain by a charnockitic suite, which has been subjected to gneissic foliation. It consists of banded pyroxene-granulites, gneisses, and hypersthene granite. In addition, the area has been affected by orogenic episodes (ubendian, Irumide, and the Mozambican cycles). Plastic deformation is a common characteristic of the Project Site, which has resulted in large areas of biotite and hornblende gneisses, charnockitic granulites, and gneisses. The provincial area around the site is classified as quaternary alluvium and lacustrine sediments.

The major geological hazard of concern in the Dedza District is seismic activity. According to the Global Facility for Disaster Reduction and Recovery's ThinkHazard project tool, the Dedza District's earthquake hazard is classified as medium. Medium-risk areas indicate that there is a 10% chance of a potentially damaging earthquake occurring within the Project Area within the next 50 years. Based on this information, the impacts of seismic activity should be considered in all phases of the Project, in particular during the design and construction phases. Project planning decisions, Project design, and construction methods should take into account the level of earthquake hazard.[26] The largest interior tremor, of magnitude 6.1, killed 8 people and damaged a few buildings in Golomoti in 1989.[27]

5.1.5 Topography

The Project Site is located in the Rift Valley Plains. The Rift Valley Plains are largely formed by the deposition of sediments eroded from the Rift Valley Escarpment. The plains extend along parts of Lake Malawi's shore and the Upper Shire Valley, and are characterized by gentle slopes and subdued relief. Average elevations throughout the plain are less than 600 metres above sea level (masl) and decline to below 100 masl in the Lower Shire Valley.[28]

The Project Site has an average elevation of 555 masl. Golomoti Trading Centre, which is located less than 1 km from the Project Site, has an elevation of 547 masl. The Project Site is located northeast of the Bangwe Forest Reserve, which encompasses an area of approximately 14 km^2.[29] The Bangwe Forest Reserve is located within the Rift Valley Escarpment, and has an average elevation of 907 m. The Rift Valley Escarpment is where the East Africa Rift descends from the Plateau in a series of stepped faults. "This zone of often precipitous slopes is, in general, highly dissected and commonly characterised by bare recent erosion surfaces."[30] The two highest points in the Bangwe Forest Reserve are Mbisa Hill, which has an elevation of 983 masl, and Bangwe Hill, which has an elevation of 890 masl. Both are located almost due south from the Project Site. The northeast boundary of the Bangwe Forest Reserve, which is where the escarpment ends and the plains begin, is located approximately 400 m southwest of the Project Site.

The closest major water body to the Project Site is the Livulezi River, the nearest point of which is approximately 1.2 km to the northwest. The Livulezi River flows into Lake Malawi, which is located approximately 18.5 km to the northeast of the Project Site.

5.1.6 Soils

The Project Site appears to contain mixed soil content, including phaeozems, luvisols, fluvisols, and vertisols. Phaeozems are humus-rich and highly arable soils that are commonly used for agricultural purposes, pasture for cattle, and wood/fuel production. Luvisols contain mixed mineralogy, high nutrient content, and generally have good drainage. Luvisols are also used for various agricultural purposes. Fluvisols are common along rivers and in level topography. They can be cultivated for dryland crops and are commonly used for grazing in the dry season. Vertisols are dark-coloured soils,

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[26] Global Facility for Disaster Reduction and Recovery, Earthquake Hazards in Dedza Malawi (2009). Accessed at: http://thinkhazard.org/en/report/19307-malawi-central-region-dedza/EQ

[27] B. Halle and J. Burgess, "Country Environmental Profile for Malawi," Draft Report, Commission of the European Communities, August 2006, page 22.

[28] B. Halle and J. Burgess, "Country Environmental Profile for Malawi," Draft Report, Commission of the European Communities, August 2006, page 16.

[29] Protected Planet, 2014. Accessed at: https://www.protectedplanet.net/bangwe-forest-reserve

[30] B. Halle and J. Burgess, "Country Environmental Profile for Malawi," Draft Report, Commission of the European Communities, August 2006, page 16.

composed of ≥ 30% clay, and are typically found in climatic zones that have distinct wet and dry seasons. Due to their clay content, vertisols are generally not well suited for cultivation without significant management and labour.[31]

5.1.7 Land Use

Agricultural land covers the majority of Dedza District, followed by tree coverage, herbaceous coverage, and urban areas. Table 5-1 identifies the specific land coverage type totals and percentages.

Table 5-1: Land Coverage in Dedza District.

Land Coverage Type	Total Hectares (ha)	Percentage of Total
Flood and Rain-fed Herbaceous Crops with Small Sized Fields	223,075.0	57.5%
Open Woodland with Herbaceous Layer	92,497.80	23.8%
Rain-fed Herbaceous Crop(s) and Sparse Trees	27,264.70	7.0%
Savannah, Trees, and Shrubs	11,259.20	2.9%
Dambo, Temporarily Flooded Land	9,550.10	2.5%
Thicket	7,266.30	1.9%
Deciduous Trees	5,248.50	1.4%
Urban Areas	4,719.80	1.2%
Other Areas	7,385.40	1.8%
Total	**388,266.80**	**100%**

Source: Food and Agriculture Organization of the United Nations, "Atlas of Malawi Land Cover and Land Cover Change 1990-2010," published October 10, 2013. Accessed at: http://www.fao.org/3/a-be893e.pdf.

The Project Site is generally flat land and is predominantly used for agricultural purposes. Local residents report that crops cultivated on the Project Site include maize, cotton, soy, cowpeas, and sweet potatoes. Trees on the Project Site include native and planted trees, including mango, acacia, and baobab trees. Local residents report that medicinal plants are collected from the Project Site, although these plants can be collected elsewhere. There are also several footpaths that traverse the Project Site.

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[31] Food and Agriculture Organization of the United Nations, Key to the FAO Soil Units, 1974. Accessed at: http://www.fao.org/soils-portal/soil-survey/soil-classification/fao-legend/key-to-the-fao-soil-units/en/

5.1.8 Surface Water

Dedza District has an abundance of surface water features, including rivers, streams, and Lake Malawi in Dedza East. The district's major rivers are the Linthipe, Bimbili, Mwachikula, Nadzipulu, Livulezi, and Lifidzi. The closest river to the Project Site is the Livulezi River. Its nearest point to the Project Site is approximately 1.2 km to the northwest. The Livulezi River flows into Lake Malawi, which is located approximately 18.5 km northeast of the Project Site.

There are no permanent surface water bodies on or near to the Project Site, although there are small, temporary ponds that form during the wet season (see Appendix B).

5.1.9 Drainage

A local consultant, Geoconsult, was retained to conduct a "Hydrology and Flood Risk Assessment" of the Project Site (Appendix B). Geoconsult calculated the size of the catchment area for the Project Site based on two different topographic software models. The two models were needed to achieve a greater understanding of the ground elevation and slope on the flat flood plains. The catchment area has been reduced in size from its natural area and is now bound by the M5 highway to the northeast and the Golomoti Substation access road to the northwest (Figure 5-1). The size of the current catchment area is approximately 3.5 km^2.

The catchment area starts in the Bangwe Forest Reserve to the southwest and terminates on the Golomoti Plain. Due to the topography of the mountain range, the majority of water flowing down the escarpment is diverted north of the Project Site into the Livulezi River. Any excess water build up is channelled through two culverts located along the M5 highway, which discharge into a stream further downhill (Appendix B, Figure 17).

Figure 5-1: Catchment Area of the Project Site

Source: Hydrology and Flood Risk Assessment (Geoconsult 2019a): Figure 3

5.1.10 Groundwater

The Hydrology and Flood Risk Assessment identified three installed water boreholes near the Project Site. WBH1 is a community-installed well and services a few adjacent residences. WBH2 is located approximately 500 m northwest of WBH1. It is a government-installed borehole that services a larger group of over 40 households. WBH3 is the only borehole with an electric pump within the Project Area. It supplies a 12,000 litre tank as well as community taps. The borehole is primarily run by and utilized for the Golomoti Substation, the ESCOM staff who live nearby, and residents immediately surrounding the substation. According to reports, the boreholes were drilled a depth of 50 m and have never run dry. Information regarding flow and yield could not be obtained from the government.

The provincial area around the Project Area is classified as alluvium/weathered aquifer (Appendix B, Figure 20). A more localised map classifies the area as a weathered aquifer with a potential yield of 0.25 to 1 litre per second (l/s) (Figure 5-2). The chemical composition for weathered aquifers across the provincial area is presented in Figure 5-3. Regional water quality maps indicate low levels of sulphates, nitrates, chlorides, fluoride, calcium, magnesium, sodium, and iron, and medium levels of acidity (Appendix B, Figures 21-29).

A more detailed chemical study of the Bua catchment area was conducted by the British Geological Survey.[32] The report states that there are generally low salinity values for groundwater from weathered basement in the Bua catchment of western Malawi. Total dissolved solids were found to be in the range of 200 to 740 milligrams per litre (mg/l). Low conductivity groundwater in basement aquifers from the Livulezi (central) and Dowa West (south-central) areas with electrical conductance were usually less than 750 micro Siemens per centimetre (µS/cm), but extremes of up to 4000 µS/cm were recorded.

Figure 5-2 indicates that the flow rates in the vicinity are between 0.25 and 1 l/s. The pump installed at WBH3 was a 0.75 horsepower Franklin Electric water pump. Based on the control box, it is likely a 4-inch 3200 Series pump is installed in the borehole. The performance chart for this pump indicates that it has an average yield of 9 m^3 per hour, or 2.5 l/s (Appendix B, Figure 15).

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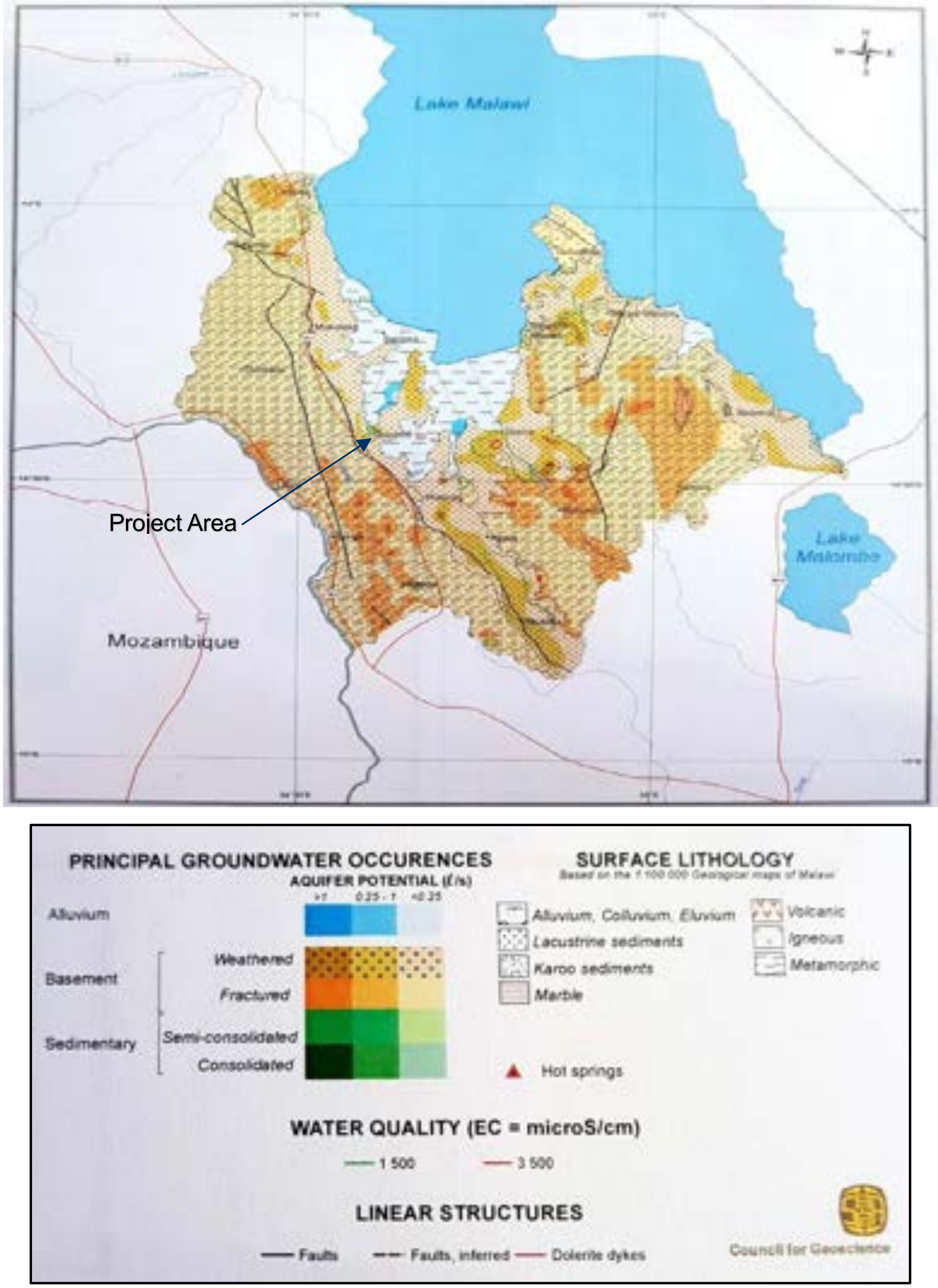
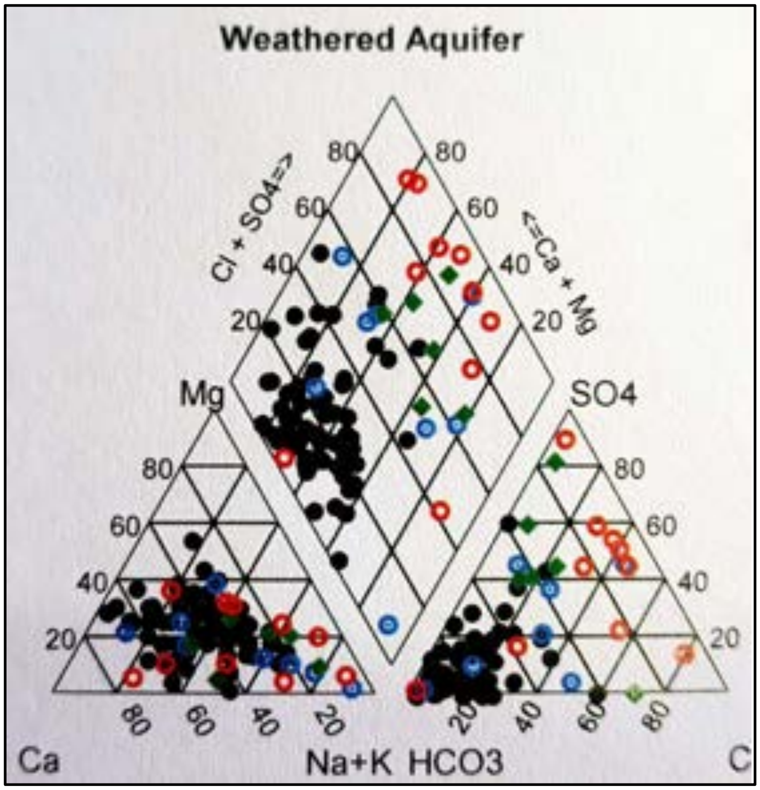
[32] “Groundwater Quality: Malawi.” British Geological Survey, 2004.

Figure 5-2: Aquifer Classification in the Project Vicinity.



Source: Hydrology and Flood Risk Assessment (Geoconsult 2019a): Figure 13.

Figure 5-3: Chemical Composition of Weathered Aquifers.



Source: Hydrology and Flood Risk Assessment (Geoconsult 2019a): Figure 14.

5.2 BIOLOGICAL BASELINE

5.2.1 Terrestrial Ecoregions

Biological baseline studies conducted in support of this ESIA had the following objectives:

- Describe and assess the habitat types on the Project Site and in the immediately surrounding areas in the context of IFC Performance Standard (PS) 6;
- Identify flora, mammal, bird, reptile, and amphibian species observed on the site and their Malawian and International Union for Conservation of Nature (IUCN) status; and
- Assess and describe any priority ecosystem services in the Project Site.

The methodology included preliminary desktop studies followed by field survey, as described in the subsections below.

5.2.1.1 Desktop Studies

Prior to initiating field surveys, the sources listed below were consulted to develop an initial characterization of the Project Site and to understand the habitats and species likely to be present.

- National Guidelines for Environmental Impact Assessment (EIA) (Government of Malawi, 1997);

- Desktop Environmental Scoping Report for Golomoti JCM Solar Power Plant Project (ERM, 2019);
- Socio-economic Profile for Dedza District (2013-2018);
- Satellite image taken in February 2018;
- Identification guides, including for:
    - Terrestrial Vegetation (Baunman 2005; Msekandian & Mlangeni 2002);
    - Birds (Dowsett-Lemaire and Dowsett 2006; Watson 2003; Stevenson & Fanshawe 2003);
    - Mammals (Monadjen 2010); and
    - Reptiles and Amphibians (Channing 2010; Frost 2010; Spawls et al. 2004).
- Various databases and websites, including:
    - Flora Zambesiaca (http://apps.kew.org/efloras/search.do);
    - IUCN Red List of Threatened species (http://www.iucnredlist.org);
    - Reptiles (http://tigr.org/reptiles);
    - Amphibians (http://amphibianweb.org);
    - Global Biodiversity Information Facility database (http://data.gbif.org);
    - Avibase (http://www.africanbirdclub.org/countries/checklists/download); and
    - IFC PS 6 (https://www.ifc.org/wps/wcm/connect/bff0a28049a790d6b835faa8c6a8312a/PS6_English_2012.pdf?MOD=AJPERES).

5.2.1.2 Field Survey

This field survey was aimed at collecting biodiversity baseline data; assessing the ecological state of the habitat of the proposed project site; assessing sensitive habitats and species of conservation concern, if any; and identifying priority ecosystem services supported by the site, if any. The field surveys were carried out in the late wet season, from March 29 to 31, 2019.

Given the heavily modified nature of the site (92.7% crop land), a single wet season survey was considered sufficient to capture the biological baseline. In the tropics, based on ERM experience, wet season surveys typically capture more of the species utilizing a site than dry season surveys.

Vegetation and Habitats

The assessment of vegetation and habitats was carried out via walking a series of transects crossing the site. Flora species encountered were identified and recorded. Plants that could not be identified on site were photographed or their specimens were collected for later identification using the Flora Zambesiaca volumes and various field guides. Particular attention was paid to species of conservation concern (i.e., endemic, protected, and endangered species). On the basis of the vegetation surveys, three distinct habitats were identified.

Birds

The standardized search method of Watson (2003) was used to survey birds by walking slowly through various vegetation communities, preferably along paths or tracks, and recording the species seen or heard within 20-minute segments in each vegetation community. Six transects spaced approximately 200 m apart were established on the proposed Project Site. Transects were walked twice in the morning, twice around midday, and twice in the evening in order to improve the chances of recording species that reveal themselves at different times of the day. Playback calls were used to encourage cryptic species to reveal themselves to supplement visual observation.

Mammals

Mammal species were recorded incidentally while surveying birds. Indirect evidence such as spoor or dung was used to confirm presence of mammal species in the Project Site, in conjunction with limited visual or audio confirmation. Mammal species were surveyed twice in the morning, twice around midday, and twice in the evening via the six transects.

Reptiles and Amphibians

Reptiles and amphibians were surveyed during the day by visual scanning of likely habitat, investigating potential refuges such as under logs, between rocks, beneath the old bark of dead trees, and in leaf litter.

5.2.2 Vegetation and Habitats

As noted above, the Project Site is Modified Habitat dominated by grazing and crop cultivation with few trees. The 92 ha Solar Plant Site is generally flat land used for subsistence agriculture. Crops cultivated on the Project Site and in surrounding areas include maize (*Zea mays*), groundnut (*Arachis hypogaea*), cotton (*Gossypium herbaceum*), sorghum (*Sorghum bicolour*), finger millet (*Eleusine coracana*), pumpkin (*Cucubirta maxima*), cowpea (*Vigna unguiculata*), Pigeon pea (*Cajanus cajana*), and okra (*Hibiscus cannabinus*). Trees on the site include natural and planted trees such as mangoes. Within the Project Site, residents also graze livestock including cattle, goats, and sheep. A seasonal wetland in the southern portion of the site, dominated by white buffalo grass (*Urochloa mossambicensis*), is used for livestock grazing. Baobab trees (*Adansonia digitata*) occur on the site, likely preserved for shade and cultural reasons, or possibly because they are protected by the Forestry Laws and Regulations due to over-exploitation.

The field surveys identified three vegetation types in the proposed Project Site:

- Cultivated mosaic woodland (85.3 ha/92.71% of Project Site);
- Secondary mixed deciduous woodland (2.9 ha/3.15% of Project Site); and
- Seasonal wetland (3.8 ha/4.14% of Project Site).[33]

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[33] The three habitat types were described and named by WWEC, ERM's Malawian environmental and social contractor.

These habitat types are mapped in Appendix E, Figure 3 and described in more detail below.

5.2.2.1 Cultivated Mozaic Woodland

Cultivated Mozaic Woodland (Figure 5-4) was the dominant habitat type, comprising 92% of the Project Site. It has been cultivated with the typical, dryland subsistence crops noted above (maize, *s*orghum, groundnuts, cotton, maroon cucumber, watermelon, mango, sweet potato, cucumber, cowpea, pigeon peas and common pumpkin). This habitat type also supports some scattered indigenous trees, shrubs, and weeds common to disturbed former woodland converted to cropland in the region. Species present include baobab (*Adansonia digitata*), marula tree (*Sclerocarya birrea*), basil (*Ocimum americanum*), white acacia (*Faidherbia albida*), monkey bread tree (*Piliostigma thonningii*), Large fruited bushwillow (*Combretum zeyheri*), African star-chestnut tree (*Sterculia africana*), velvet wild medlar tree (*Vangueria infausta*), sourplum tree (*Ximenia caffra*), Yellow plum (*Ximenia americana*), Chinese banyan (*Ficus thonningii*), Kalahari white bauhinia (*Bauhinia petersiana*), mango (*Mangifera indica*), tropical spiderwort (*Commelina benghalensis*), billygoat weed (*Ageratum conyzoides*), Duncan grass (*Pennisetum unisetum*), okra (*Hibiscus cannabinus*), cattle bush (*Trichodesma zeylanicum*), and vetivar grass (*Chrysopogon zizanioides*).

Figure 5-4: Cultivated Mozaic Woodland.

Source: ERM, 2019.

The high representation of cultivated crops and weeds such as American basil, mango, billygoat weed, tropical spiderwort, and okra suggests that the area has been totally transformed from its natural state, with the remaining trees being retained because they provide benefits to the communities that utilize the area. Tree density was estimated to be 13 trees per ha, a very low density indicative of the conversion of the area to cropland.

The 59 plant species recorded in the Cultivated Mozaic Woodland portion of the site are listed in Table 5-2. None of the species recorded are threatened or endemic, although the baobab tree (*Adansonia digitata*) has been protected under the Forestry Act since 2012 (see Section 5.2.2.4).

Table 5-2: Cultivated Mozaic Woodland Plant Species.

Species Name	Local Name	Comment
Faidherbia albida	(Msangu) or Ana tree	Common tree typical of riparian habitat. Seed pods are eaten by livestock and the trees fix nitrogen in the soil.
Adansonia digitata	Baobab tree	Tree, typical of dry woodland
Zea mays	Maize	Cultivated annual grass used for food
Citrullus lanatus	Water melon	Cultivated annual climber used for food
Gossypium arborea	Cotton	Introduced annual herb, cultivated on farmland
Cucumis anguiria	Maroon cucumber	Cultivated annual climber used for food
Cucumis melo	Cucumber	Cultivated annual climber used for food
Vigna unguiculata	Cowpea	Annual herb, cultivated for food
Cajanus cajana	Pigeon pea	Perennial shrub, cultivated for food
Cucumis maximum	Pumpkin	Annual climber, cultivated for food
Pennisetum unisetum	Udzu or Mission grass	Common grass, typically occurring in disturbed land and invasive in some situations
Commelina baanghelensis	Tropical spiderwort	Common weed, typically occurring in disturbed land and often invasive
Acacia tortilis	Umbrella thorn acacia	Common tree of dryland. Plant is used as feed for livestock
Senna obstusifolia	Sickle Senna	Alien tree, typically introduced by communities on farmlands.
Vernonia glabra	Cornflower	An annual herb, typical of secondary woodland
Trichodesma zeylanicum	Camel bush	Annual herb, typical of secondary woodland
Sclerocarya birrea	Marula tree	Common tree, typical of dry savanna woodland
Melinis repens	Natal grass	Perennial grass, typical of dry land and used for thatching houses
Vernonia poskeana	Sandveld vernonia	Perennial herb, typical of secondary woodland

Species Name	Local Name	Comment
Vernonia glabra	Cornflower	Perennial herb, typical of secondary woodland
Stereospermum kunthianum	Zana	Small tree occurring in open woodland
Ocimum americana	American basil	Small annual herb, typical of open cultivated land.
Corchorus olitorius	Bush Okra	Small annual herb, typical of open cultivated land.
Ceratotheca sesamoides	Sesame	Wild weed and locally grows in cultivated land
Merremia pinnata	Kosrae	Common annual climber
Siphonochilus aethiopicus	Wild ginger	Annual herb, typical of cultivated land
Combretum zeyheri	Large-fruited bushwillow	Tree, typical of open dry woodland
Leucas amartinicensis	Whitewort	Annual herb, typical of cultivated land
Pannicum maximum	Guinea grass	Grass, typical of cultivated and open woodland
Cucumis sativus	Cucumber	Cultivated vegetable
Hibiscus subdariffa	Roselle	Annual woody-based Okra, used for making tonic drink
Vangueria infausta	African medlar	Tree, typical of open secondary or primary forest
Strychnos innocua	Monkey orange	Shrub, typical of cultivated land and natural secondary forest
Ximenia americana	Yellow plum	Tree, typical of cultivated land or natural secondary forest
Sorghum bicolour	Sorghum	Perennial grass usually cultivated
Eleusine coracana	Finger millet	Annual grass usually cultivated for food.
Codyla africana	Wild mango	Tree, typical of primary or secondary woodland
Andropogon shirensis	Beard Grass	Annual grass , typical of cultivated land
Senna spectabilis	Whitebark senna	Tree, introduced in cultivated land
Hyparrhenia filipendula	Fine-hood Grass	Grass, typical of disturbed land and used for thatching.
Digitaria milanjiana	Crabgrass	Grass, typical of disturbed land.
Bidens steppia	Beggarticks	Annual herb, typical of open cultivated land
Heteropogon contortus	Black spear grass	Perennial grass, typical of disturbed land.
Markhamia obtusifolia	Golden bell-bean	Tree, typical of closed and secondary woodland.

Species Name	Local Name	Comment
Biophytum kassneri	Reinwardit	Annual herb, typical of open cultivated land
Vitex mombasae	Chaste tree	Small tree, typical of open woodland and its fruits are edible
Hibiscus esculentus	Lady's fingers okra	Annual herb, cultivated plant and is edible as relish
Bidens pilosa	Black jack	Introduced weed annual herb, present as a result of soil disturbances
Impatiens gomphophylla	Balfour	Annual herb, typical of moist condition and cultivated land.
Bauhinia thonningii	Camelfoot tree	Common tree, typical of dry conditions.
Sterculia quinqueloba	Large-leaved star chestnut	Tree, typical of open woodland.
Sida acuta	Wireween	Weed annual plant, present as a result of soil disturbances.
Cissus buchannii	Mwanmphepo	Annual herb, typical of dry conditions.
Tridax procumbens	Tridax daisy	Annual weed, present due to soil disturbances.
Crinum macowanii	Spider lily	Annual herb, typical of moist conditions.
Chrysopogon zizanioides	Vetivar grass	Introduced grass, typical of moist conditions.
Ficus thonningii	Common wild fig	Tree, typical of open dry woodland
Lagenaria sicenaria	Long melon	Cultivated climber used for food
Chloris vigata	Rhodes grass	Annual grass, typical of open and disturbed habitats
Abelmoschus esculentus	Okra	Annual herb, typical of disturbed land

Source: Biodiversity Baseline Report (WWEC 2019b: Table 1-3).

5.2.2.2 Secondary Mixed Deciduous Woodland

Secondary Mixed Deciduous Woodland (Figure 5-5) was identified in two, small isolated patches totalling 2.9 ha or 3.15% of the Project Site. It was distinguished from the prior habitat type in that it was not actively cultivated and supported more trees. Tree density was estimated at 35 trees per ha.

Figure 5-5: Secondary Mixed Deciduous Woodland.

Source: Biodiversity Baseline Report (WWEC 2019b: Figure 5).

This type of habitat was considered moderately modified as species composition had been transformed due to felling of trees for fuelwood, and these patches were small islands of habitat in the larger cultivated mosaic described above, reducing the potential to function as habitat for native species of fauna. Thirty nine species were recorded and no endangered or endemic species were present. The recorded species are presented in Table 5-3.

Table 5-3: Secondary Mixed Deciduous Woodland Plant Species.

Species Name	Local Name	Comment
Pterocarpus rotundifolius	Round-leaved bloodwood	Common tree typical of dry habitat
Dalbergia nitidula	Purple wood tree	Common tree typical of dry habitat
Markhamia obtusifolia	Golden bell-bean	Tree, typical of closed and secondary woodland.
Combretum zeyheri	Large-fruited bushwillow	Tree, typical of open dry woodland

Species Name	Local Name	Comment
Sterculia quinqueloba	Large-leaved star chestnut	Tree, typical of open woodland
Sclerocarya birrea	Marula tree	Tree, typical of open dry woodland
Brachystegia spiciformis	Brachstegia	Tree, typical of closed canopy and open natural woodland
Acacia polyacantha	White thorn	Tree, typical of open dry woodland
Vitex payos	Chinese chaste tree	Tree, typical of open woodland
Pennisetum unisetum	Udzu or Mission grass	Common grass, typically occurring in disturbed land and invasive in some cases.
Solanum panduriforme	Bitter apple	Perennial herb, typical of open dry woodland and disturbed areas
Acacia tortilis	Umbrella thorn Acacia	Common tree of dryland. Plant is used as feed for livestock
Azanza garckeana	Slime apple	Tree, typical of open dry and secondary woodland
Vernonia glabra	Cornflower	An annual herb, typical of secondary woodland
Combretum adenogonium	Four-leaved bushwillow	Tree, typical of open dry and secondary woodland
Faihderbia albida	(Msangu) or Ana tree	Common tree typical of riparian habitat. Seed pods are eaten by livestock and the tree fix nitrogen in the soil.
Melinis repens	Natal grass	Perennial grass, typical of dry woodland and used for thatching houses
Piliostigma thonningii	Monkey bread tree	Tree, typical of dry woodland
Vernonia glabra	Conflower	Perennial herb, typical of secondary woodland
Adansonia digitata	Baobab tree	Tree, typical of dry woodland
Sterculia quinqueloba	Large-leaved star-chestnut	Tree, typical of dry woodland
Eucalyptus camaldulensis	Bluegum	Introduced tree, typical of disturbed natural woodland
Annona senegalensis	African custard-apple	Shrub, typical of open dry woodland
Bauhinia petersiana	Kalahari white bauhinia	Tree, typical of open dry woodland
Hyparrhenia rufa	Giant thatching grass	Annual grass, typical of open woodland
Markhamia obtusifolia	Golden bean tree	Tree, typical of open dry woodland

Species Name	Local Name	Comment
Senna siamea	Siamese cassia	Introduced tree
Pannicum maximum	Guinea grass	Grass, typical of cultivated and open woodland
Steganotaenia araliacea	Carrot tree	Shrub, typical of open woodland
Strychnos innocua	Monkey orange	Shrub, typical of dry open woodland
Vangueria infausta	African medlar	Tree, typical of open secondary or primary forest
Strychnos innocua	Monkey orange	Shrub, typical of cultivated land and natural secondary forest
Ximenia americana	Yellow plum	Tree, typical of cultivated land or natural secondary forest
Commiphora sansibarica	Corkwood tree	Tree, typical of dry open woodland
Trichodesma zeylanicum	Cattle bush	Annual herb, typical of open woodland
Crinum macuanum	Amaryllis	Perennial herb, typical of open and closed woodland
Lonchocarpus bussei	Small apple-leaf tree	Tree, typical of open dry woodland
Lonchocarpus violacea	Apple-leaf	Tree, typical of open dry woodland
Dichrostachys cinerea	Kalahari Christmas tree	Tree, typical of open dry mixed woodland

Source: Biodiversity Baseline Report (WWEC 2019b: Table 1-4).

5.2.2.3 Seasonal Wetland

A seasonal wetland habitat (Figure 5-6) comprising 3.8 ha or 4.14% of the Project Site was identified in its south-eastern portion. This area was dominated by herbaceous species with some woody shrubs. It is used for livestock grazing and is also considered Modified Habitat. Tree/shrub density was estimated at 17 trees per ha. No species recorded were endangered or endemic. The species recorded are listed in Table 5-4.

Figure 5-6: Seasonal Wetland

Source: Biodiversity Baseline Report (WWEC 2019b: Figure 6).

Table 5-4: Seasonal Wetland Plant Species.

Species Name	Local Name	Comment
Urochloa mosambicensis	White buffalo grass	Grass, typical of dry seasonal wetland
Acacia polyacantha	White thorn	Tree, typical of open dry woodland
Pennisetum unisetum	Udzu or Mission grass	Common grass, typically occurring in disturbed land and invasive in some situations.
Clematis simensis	Clematis	Annual herb, typical of moist conditions
Scleria bulbifera	Nutrushes	Sedge, typical of seasonal wetland
Vernonia glabra	Cornflower	An perennial herb, typical of secondary open woodland
Combretum adenogonium	Four-leaved bushwillow	Tree, typical of open dry and secondary woodland
Scleria racemosa	Sword grass	Sedge, typical of seasonal wetland

Species Name	Local Name	Comment
Melinis repens	Natal grass	Perennial grass, typical of dry woodland and used for thatching houses
Hyparrhenia rufa	Giant thatching grass	Annual grass, typical of open moist woodland
Markhamia obtusifolia	Golden bean tree	Tree, typical of open dry moist woodland
Senna siamea	Siamese cassia	Introduced tree
Pannicum maximum	Guinea grass	Grass, typical of cultivated and open woodland
Cynodon dactylon	Dog’s tooth grass	Grass, typical of moist conditions
Chloris gayana	Rhodes grass	Grass, typical of moist conditions
Cissus grisea	Wild grape	Climber, typical of open woodland
Cissus rubiginosa	Adamant creeper	Climber, typical of moist open woodland
Embelia schimperi	Amargna	Climber, typical of moist open woodland
Grewia asiatica	Phalsa	Shrub, typical of open woodland
Grewia villosa	Mallow raisin	Shrub, typical of open woodland
Grewia retusifolia	Emu-berry	Shrub, typical of open woodland

Source: Biodiversity Baseline Report (WWEC 2019b: Table 1-5).

5.2.2.4 Ministry of Lands Survey

On July 18, 2019, the Ministry of Lands conducted a detailed land and asset survey of the Project Site. The survey identified five species listed as protected under the Forestry (Amendment) Rules, 2012, as gazetted in Government Notice No. 23 (December 31, 2012). Details on these tree species and the number of specimens identified for each are provided in Table 5-5.

Table 5-5: Protected Trees at the Project Site.

Scientific Name	Common Name	Vernacular Name	Tree Use	Number of Specimens Identified
Sterculia sp.	Ghost Tree	Mgoza	Bark used to make ropes	3
Trichilia emetic	Natal Mahogany	Msikidzi	Firewood, timber	3
Albizia gummifera	Peacock flower	Mtangatanga	Firewood, timber	66

Kigellia Africana	African sausage	Mvunguti	Medicinal use	7
Adansonia digitata	Baobab	Malambe		2

Source: Ministry of Lands, 2019.

5.2.3 Fauna

5.2.3.1 Avifauna

Malawi has approximately 650 species of birds. Of these, more than 450 species breed in Malawi and 107 are non-breeding migrants or vagrants. In terms of IUCN Red List status avifauna for Malawi, there are 3 Critically Endangered species, 7 Endangered species, 9 Vulnerable species, and 18 Near Threatened species (BirdLife International, 2019). There are 4 endemic subspecies that have been recorded in country (Kaliba, 2005). Given the largely agricultural character of the Project Site, only thirteen species were observed at the Project Site during the March 2019 wet season field survey (Table 5-6). None of the observed species are of conservation concern or endemic.

Table 5-6: Bird Species Identified on the Project Site.

Scientific Name	Relative Abundance Locally	IUCN Status
Phyllastrephus flavostriatus (Yellow-streaked Bulbul)	Common	Least Concern
Phyllastrephus placidus (Placid Bulbul)	Common	Not Listed
Cyanomitra olivacea (Olive Sunbird)	Very Common	Least Concern
Cynniris talatala (White-bellied Sunbird)	Very Common	Least Concern
Uraeginthus angolensis (Blue Waxbill)	Common	Least Concern
Serinus gularis (Streaky-headed Canary)	Very Common	Not Listed
Hedydipna collaris (Collared Sunbird)	Common	Least Concern
Streptopelia capicola (Cape Turtle Dove)	Common	Least Concern
Threskiornis aethiepicus (Scared Ibis)	Uncommon	Least Concern
Numida meleagris (Helmeted Guinea fowl)	Uncommon	Least Concern
Quelea quelea (Red headed Quelea)	Very Common	Least Concern
Pternistis afer (Red-Necked Francolin)	Uncommon	Least Concern
Bubo lacteus (Verreaux's Eagle-owl)	Common	Least Concern

Sources: Biodiversity Baseline Report (WWEC 2019b: Table 1-5) and ERM, 2019.

5.2.3.2 Mammals

No mammal species were observed on the Project Site during the field surveys. No large mammal species were expected given the habitat and land use. Communities reported that the Project Site does harbour some species of small mammals, however, as presented in Table 5-7. None of these are of conservation concern.

Table 5-7: Small Mammal Species Reported to Occur at the Project Site.

Scientific Name	Relative Abundance Locally	IUCN Status
Acomys spinosissimus (Spiny mouse)	Very Common	Least Concern
Lophuromys flavopunctatus (Yellow-spotted Brush-furred rat)	Very Common	Least Concern
Mus triton (Mouse)	Very Common	Least Concern
Mus musculus (House Mouse)	Common	Least Concern
Crocuta crocuta (Spotted Hyena)	Common	Least Concern
Lepus saxatilis (Cape Scrub Hare)	Common	Least Concern
Hystrix africaeaustralis (Cape porcupine)	Common	Least Concern

Sylvicapra grimmia (Common duiker)	Uncommon	Least Concern

Sources: Biodiversity Baseline Report (WWEC 2019b: Table 1-6) and ERM, 2019.

5.2.3.3 Reptiles

No species of reptiles were recorded during the field survey. Local residents reported five species of reptiles, however, that occur on the proposed Project Site and in the surrounding area (Table 5-8). None of these species are endemic or of conservation concern.

Table 5-8: Reptile Species Reported to Occur at the Project Site.

Scientific Name	Relative Abundance Locally	IUCN Status
Python natalensis (Lesser African Python)	Rare	Not Listed
Dendroaspins polylepis (Black mamba)	Rare	Not Listed
Ophiophagus hannah (King cobra)	Rare	Vulnerable
Bitis arietans (Puff Adder)	Rare	Not Listed
Ahaetulla nasuta (Vine snake)	Common	Not Listed
Chamaeleo chamaeleon (Common chameleon)	Common	Least Concern

Sources: Biodiversity Baseline Report (WWEC 2019b: Table 1-8) and ERM, 2019.

5.2.3.4 Amphibians

Ninety one species of amphibians have been recorded in Malawi, several of which are threatened and several of which are endemic.[34] A total of 4 species of amphibians was recorded on the Project Site during the survey. These species are shown Table 5-9. None of the species are endemic or of conservation concern.

Table 5-9: Amphibian Species Reported to Occur at the Project Site.

Scientific Name	Relative Abundance Locally	IUCN Status
Hyperolius pictus (Reiche's Squeaker)	Uncommon	Least Concern
Sclerophrys garmani (Garman's toad)	Uncommon	Least Concern
Sclerophyrs gutturalis (Guttural toad)	Uncommon	Least Concern
Afrixalus delicates (Delicate Spiny Reed Frog)	Uncommon	Least Concern

Sources: Biodiversity Baseline Report (WWEC 2019b: Table 1-9) and ERM, 2019.

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[34] https://www.inaturalist.org/check_lists/7454-Malawi-Check-List

5.2.3.5 Habitat Sensitivity

The continuous cultivation, grazing, wood gathering, and bush meat hunting observed and reported by the local people interviewed has converted the regional landscape, including the proposed Project Site, into Modified Habitat with very reduced habitat value. This was evidenced by the paucity of avifauna, mammal, reptile, and amphibian species recorded during the field surveys or reported by the local people. While some native species are present, the dominant land cover on over 90% of the site is annual agricultural crops such as maize.

5.2.4 Ecosystem Services

This analysis assesses ecosystem services in accordance with the approach adopted by the World Research Institute (WRI), which complies with requirements of IFC Performance Standard (PS) 6. The WRI approach provides a breakdown of ecosystem services that are classified into Provisioning, Regulating, Supporting, and Cultural Services.[35] This list has been adjusted to match the suite of services that are relevant to the areas associated with the Project Site. The WRI approach provides a simple and logical process to identify priority ecosystem services (Figure 5-7). PS 6 requires that disruptions to priority ecosystem services are assessed as part of an impact assessment, with mitigation measures developed to address the impacts.

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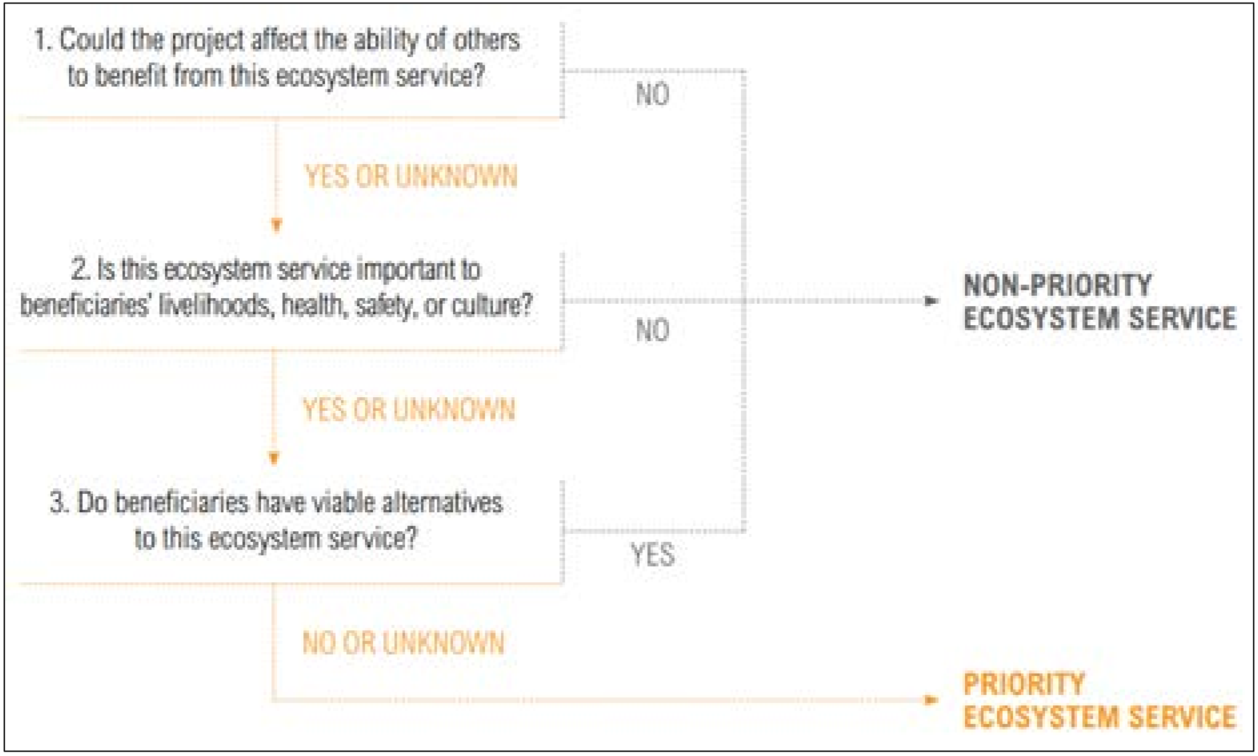
[35] World Research Institute (WRI) approach to assessing Ecosystem Services is available at: https://www.wri.org/publication/weaving-ecosystem-services-into-impact-assessment

Figure 5-7: Logical Approach for Prioritization of Ecosystem Services.



Source: WRI.

During the baseline studies, various ecosystem services were reported by communities and/or observed by the team. The use of ecosystem services, dependence of local beneficiaries, and an assessment of replaceability have been investigated through processes of consultation and incorporating expert opinion.

An overview and description of ecosystem services relevant to the Project Site is provided in Table 5-10, together with a high-level assessment of the potential impact, dependence of beneficiaries, and replaceability of services. These assessments are used to identify priority services based on the logical framework illustrated in Figure 5-7.

Table 5-10: Description and Assessment of Ecosystem Services at the Project Site.

Ecosystem Service	Description of the Service	Location Relevance	Likely Impact	Importance to Beneficiaries	Replaceability	Prioritisation Result
PROVISIONING ECOSYSTEM SERVICES						
Crops cultivated at the Project Site are sources of food and income	There are a number of cultivated food crops such as maize, groundnuts, cucumber, watermelon, sorghum, cassava and cow peas that are grown on the Project Site between December and May each year. These food crops are harvested by subsistence farmers for consumption and income	The 92 ha Project Site, of which 90% (approx. 82 ha) is cultivated land	**Yes** The Project will displace cultivated land and related livelihoods and food source	The crops cultivated are sources of food and income	Replaceable if other lands can be found for the PAPs. There is a high demand for land, which is leading to a decline in the fallow period, and hence replacement land is not readily available. This assessment is unable to confirm the replaceability of arable land as it is the Chief's responsibility to allocate land for cultivation	Priority ES
Livestock grazing land	A small portion of the Project Site is used for	The seasonal	**Yes**	Livestock are an important	Replaceable if other lands can	Non Priority ES

Ecosystem Service	Description of the Service	Location Relevance	Likely Impact	Importance to Beneficiaries	Replaceability	Prioritisation Result
	livestock grazing (cattle, goats)	wetland and other fringe areas not cultivated	The Project will displace grazing land and related livelihoods and protein sources	source of protein and revenue for communities	be found for the PAPs	
Bush meat	The site is also reportedly used for bush meat hunting though no quantification was available	The entire site though wildlife were sparse during the field survey	**Yes** The Project will eliminate people's access to and convert small hunting areas leading to a decline in bushmeat production	Only small animals are hunted and are not a staple protein source for communities	The small animals collected at the Project Site are also found in other areas nearby	Non Priority ES
Wild and introduced plant fruits	The Project Site supports native and introduced fruit bearing plants that are harvested	Across the site outside of the cultivated areas	**Yes** The Project will eliminate people's access to and convert the site to industrial areas	Source of food and income generation	The fruit bearing plants can be planted elsewhere and are also commonly found in other agricultural and bush areas	Non Priority ES
Fuelwood	Fuelwood is the main source of energy for cooking in rural areas,	Limited to 3 to 4 hectares	**No** The project will not significantly	Fuelwood is important, especially to	There are other woodland areas nearby including	Non Priority ES

Ecosystem Service	Description of the Service	Location Relevance	Likely Impact	Importance to Beneficiaries	Replaceability	Prioritisation Result
	though collection of fuelwood is a national problem leading to deforestation, erosion, and soil loss	where trees and other woody species are present	contribute to the impact on scarcity of fuelwood in the area	older women and young girls from surrounding villages	the Forest Reserve. Harvesting fuelwood in the Forest Reserve is illegal but continues. Alternatively fuel wood plots can be planted near communities and managed for continuous yield	
Thatch grass	Thatch is used for roofing structures and is also a source of income	Seasonal wetland	**Yes** Loss of access to the source	Personal use and income source	There are many other sources in the surrounding customary lands	Non Priority ES
Herbal medicines	Certain species of plants found on the Project Site and along the transmission line route are collected by communities to be used in traditional medicine which treat various illnesses	Seasonal wetland and Mixed deciduous Woodland	**Yes** The project will have impact on people due to loss of some medicinal plants	Personal use and income source	There are many other sources in the surrounding customary lands	Non Priority ES
REGULATING ECOSYSTEM SERVICES						

Ecosystem Service	Description of the Service	Location Relevance	Likely Impact	Importance to Beneficiaries	Replaceability	Prioritisation Result
Regulation of soil fertility	Clearing of vegetation and any necessary grading of the site will likely alter soil fertility though erosion and sediment control should minimize impacts	Project Site	**Yes** Clearing plants and any necessary grading will have impact on the fertility of soil	Communities depend on soil fertility for crop production	At the end of Project life, the soils can be restored to fertility	Non-priority ES
Pollination of crops	The Project Site supports a diversity of insects such as butterflies, which pollinate agricultural crops on the Project Site	Seasonal wetland and Mixed deciduous Woodland	**Yes** Clearing of the Project Site will have impact on pollinating insects such as butterflies, bees, but the significance is very low	Pollinating insects are important for production and productivity of crops	It is possible to replace plants which are homes to insects to be lost during the construction by planting around the open areas of the Project Site	Non-priority ES
Regulation of water flows	The seasonal wetland area may provide retention of runoff during the rainy season	Seasonal wetland	**Yes** The project may have a minor effect on this service given that the seasonal wetland area is relatively small	The seasonal wetland likely regulates flow to a limited extent	It is not possible to replace it	Non-priority ES

Ecosystem Service	Description of the Service	Location Relevance	Likely Impact	Importance to Beneficiaries	Replaceability	Prioritisation Result
Soil erosion control	The vegetated areas, comprising only 8% of the site, provide some erosion control function during the rainy season	Seasonal wetland and Mixed deciduous Woodland	**Yes** Clearing of vegetation on the Project Site will have some impact on soil erosion, but proper erosion control measures will minimize	Limited	Existing erosion control functions can be replaced and likely improved with good management practices	Non-priority ES
CULTURAL ECOSYSTEM SERVICES						
Cultural values	The Project Site supports a number of baobab trees which have cultural significance in Malawi and are protected under national law	Project Site	**Yes** Clearance of two baobab trees will have some cultural impact	Clearing of baobabs and other trees that farmers protect because of their social value will have impact on cultural values of the people	Given their slow growth and age of the trees, it will take many generations to fully replace the loss of these trees	Non-priority ES
SUPPORTING ECOSYSTEM SERVICES						
Biodiversity maintenance	The Project Site is entirely Modified Habitat, but still supports biodiversity such as trees, insects and birds	Seasonal wetland and Mixed deciduous Woodland	**Yes** The Project Site supports some modified habitat which will be impacted	Biodiversity underpins a host of ecosystem services, many of which are	The biodiversity values cannot be entirely replaced, but creation of native plant	Non-priority ES

Ecosystem Service	Description of the Service	Location Relevance	Likely Impact	Importance to Beneficiaries	Replaceability	Prioritisation Result
			through vegetation clearing and solar plant installation	discussed above	communities in open areas of the site can mitigate the impacts	

5.2.4.1 Outcome of the Assessment

Table 5-10 indicates that there is a wide diversity of ecosystem services present at the Project Site, many of which are underpinned by biodiversity and all of which are important to community well-being in the area.

5.2.4.2 Overall Sensitivity Assessment

Habitats in the vicinity of the Project Site (i.e., in the Project Area) show considerable evidence of transformation, with the overall floral and faunal species composition showing a divergent change from the natural state. The vegetation is dominated by plant species that provide benefits to local communities, with many non-beneficial species having been eliminated through settlement and cultivation practices. As a result, there are many species of non-native origin present. Human activity has substantially modified the area’s primary ecological functions and species composition, and the habitats there conform to Modified Habitats as described in PS 6 (Paragraph 11).

The Project is not located within the vicinity of protected areas, no highly threatened or range restricted floral or faunal species are considered likely to be present (with the exception of baobab trees, which are now protected under the Forestry Act[36]), and no large congregations of species are expected to occur. What remains of the habitats are representative of a widespread vegetation formation, and are therefore not unique. Based on these observations, no Critical Habitats are expected to occur, and a Critical Habitat Assessment following PS 6 is therefore not necessary.

5.3 SOCIO-ECONOMIC BASELINE

This section describes the current socio-economic context of the Project Area, along with national and district-level information where available and relevant. The information presented in this section is based on a desktop review of publicly available information (e.g., census data, government and international institution reports, and other online sources) and specialist, on-site information gathering.

5.3.1 Primary Data Collection Activities

To ensure a sufficiently robust set of socioeconomic data for the ESIA, the primary data gathering activities listed below were carried out.

- **Household surveys:** Household surveys were undertaken in the Project Area over the course of five days from March 28 to April 1, 2019. The surveys consisted of interviews of 181 households, including Project-affected people (PAPs) that will be impacted by the upcoming land acquisition and non-PAPs whose lands would not be affected by the Project.
- **Focus group discussions (FGDs)**: FGDs were undertaken with women, men, and youth to gather differentiated information including Project perceptions, gender roles, quality of life, access to public services, health issues, and livelihoods, as well as issues that affect youth (e.g., education and employment). PAPs and non-PAPs were invited to participate to ensure diverse perspectives on the Project. It should be noted that participatory rural appraisal tools were also

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[36] Malawi Gazette Supplement, dated December 3, 2012.

utilized, such as gender matrices and access and control frameworks, to gather more focused information on gender roles, equality, and possible issues of discrimination.

- **Key informant interviews (KII)**: KIIs were held with professionals and local organizations with knowledge of specific topic areas and Project perceptions, including health workers, Non-Government Organisations (NGOs), credit and savings structures, and Dedza District sectoral offices.
- **Village profiles**: Village profiles were undertaken in six of the villages near the Project Site to gather sample village-level data including demographics, public infrastructure, and livelihoods.

A full list of meetings is provided in Appendix G.

5.3.2 Geography and Administrative Structure

Malawi is a landlocked country situated in the southeast of the African continent, bordered by Tanzania to the north, Mozambique to the east, Zimbabwe to the south, and Zambia to the west. Malawi has three regions; northern, central, and southern. It is divided into 28 districts, which are further divided into constituencies that are represented by Members of Parliament, as well as wards represented by local councillors.[37] The country is also divided into Traditional Authorities (TA), which are sub-divided into Group Villages, each with its own leader known as a Group Village Headman (GVH).

The Project Site is located in the Central Region of Malawi, approximately 47 km from the Dedza District Centre and within Kachindamoto TA and the Pitala Group Village. There are six villages under GVH Pitala that are expected to be directly affected by the Project, as the Project with be located on customary land belonging to members of these villages. Those six villages are Ching’anipa, Kalumo, Nsamala, Kapesi, Chisaka and Chitseko. Another village on the eastern side of the Project Site, Thondoya, is part of the Nitcheu District but is also expected to be directly affected, though not by land acquisition.

Figure 5-8 is a map of the Project Area marking the villages listed above. As part of the stakeholder engagement/social baseline activities carried out by ERM, approximate village boundaries for the land-affected villages were marked during a walk with each village chief (or his designee). As can be observed in the map, village boundaries are loosely defined with significant overlap, a characteristic that in part demonstrates the close ties/lack of hard divisions between the villages.

The District Commissioner (DC) is the head of the District Government and has overall authority regarding land, development, and infrastructure. The DC is the first point of contact for all project developers requiring land, and to date has been instrumental in the land acquisition and compensation process undertaken for the Project.

The TA/Senior Chief is custodian of the land in the TA and is responsible for overseeing the Group Villages. Each GVH is responsible for representing the

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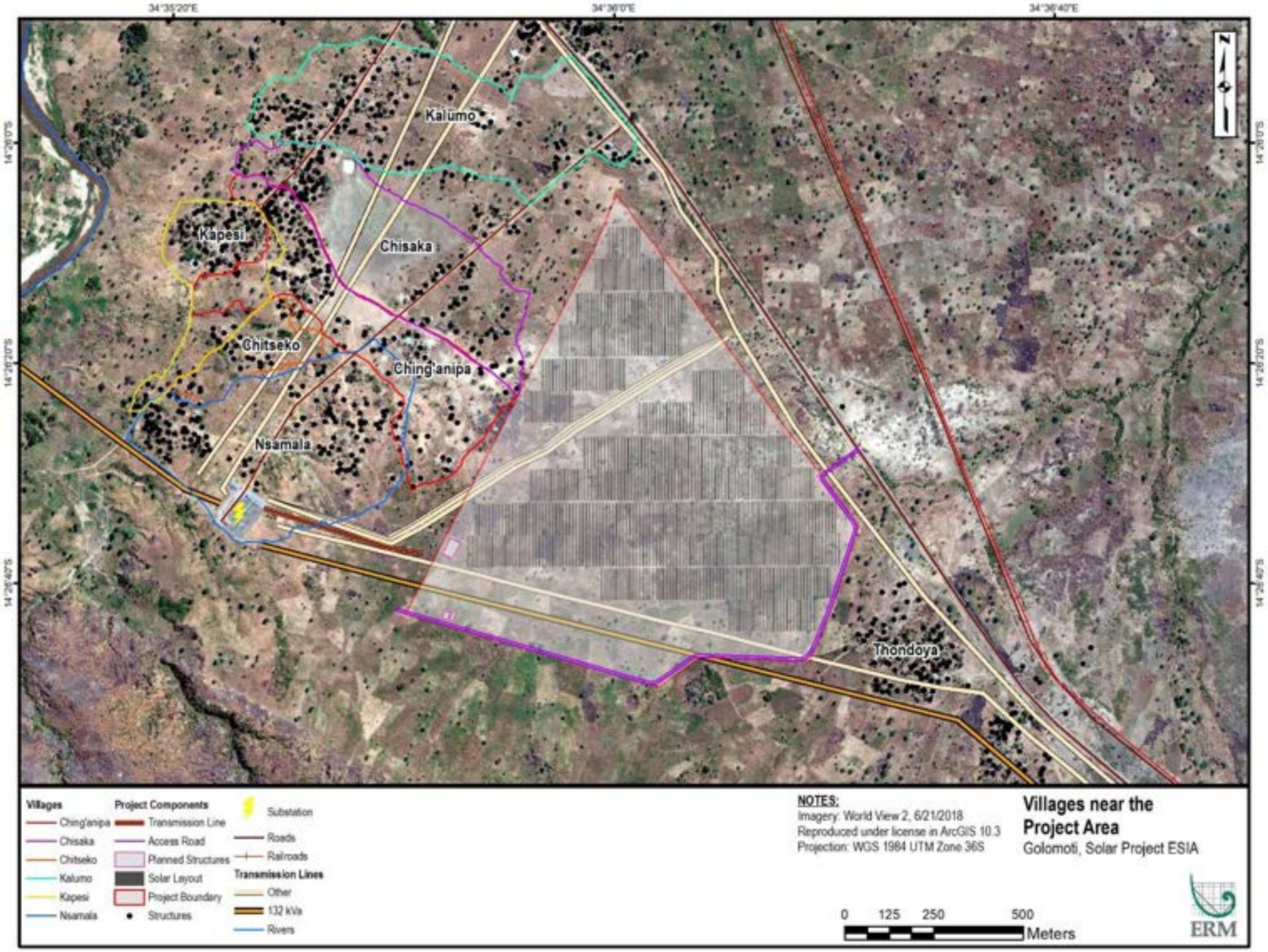
[37] Government of Malawi, Health Sector Strategic Plan 11 (2017-2022). Available at http://www.nationalplanningcycles.org/sites/default/files/planning_cycle_repository/malawi/health_sector_strategic_plan_ii_030417_smt_dps.pdf (accessed March 2019)

communities within their Group Village, supported by each village’s own individual chief or headman.

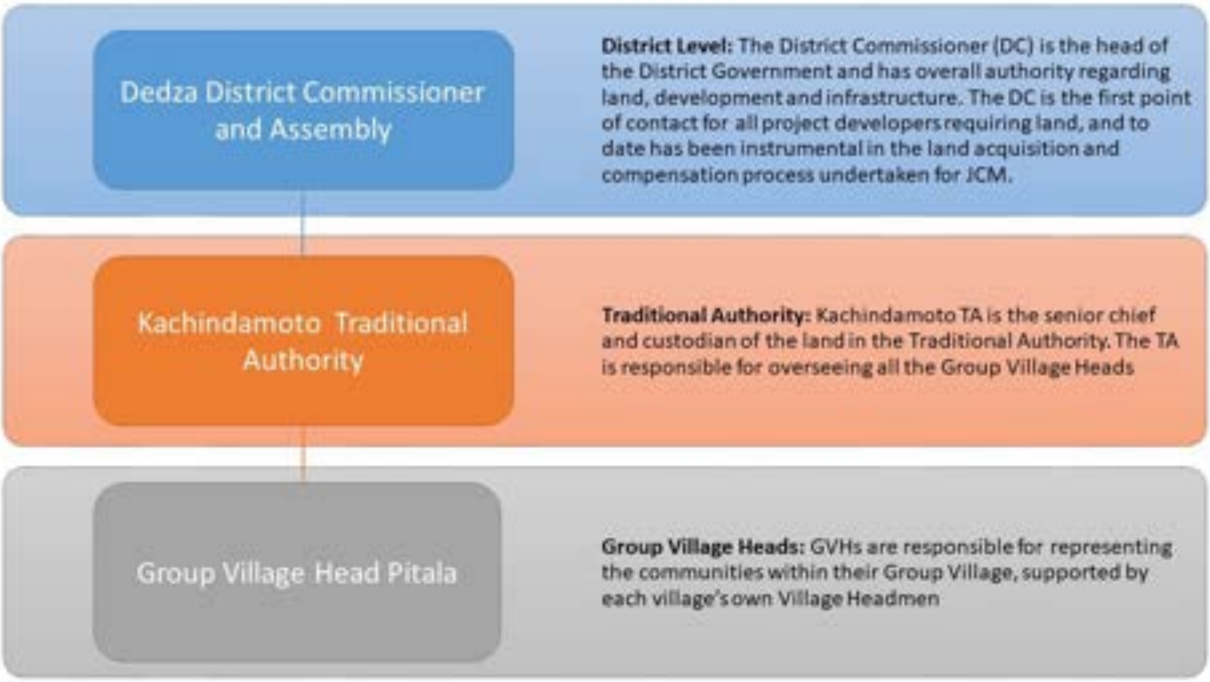
Figure 5-9 illustrates the institutional structure and the key representatives for each level.

Figure 5-8: Villages in the Project Area.



Source: ERM, 2019.

Figure 5-9: Institutional Structure.



District Level: The District Commissioner (DC) is the head of the District Government and has overall authority regarding land, development and infrastructure. The DC is the first point of contact for all project developers requiring land, and to date has been instrumental in the land acquisition and compensation process undertaken for JCM.

Traditional Authority: Kachindamoto TA is the senior chief and custodian of the land in the Traditional Authority. The TA is responsible for overseeing all the Group Village Heads

Group Village Heads: GVHs are responsible for representing the communities within their Group Village, supported by each village's own Village Headmen

Source: ERM, 2019.

5.3.3 Demographics

5.3.3.1 Population

At the local level, the population of the villages in the Project Area varies. Among the villages sampled as part of the Villages Profiles, Chisaka, Ching'anipa and Nsamala have the largest populations. Table 5-11 lists the reported population in the sampled villages. It is important to note that this information was gathered via Village Profiles and thus relies on estimates provided by each village's chief and is not based on actual census or survey data.

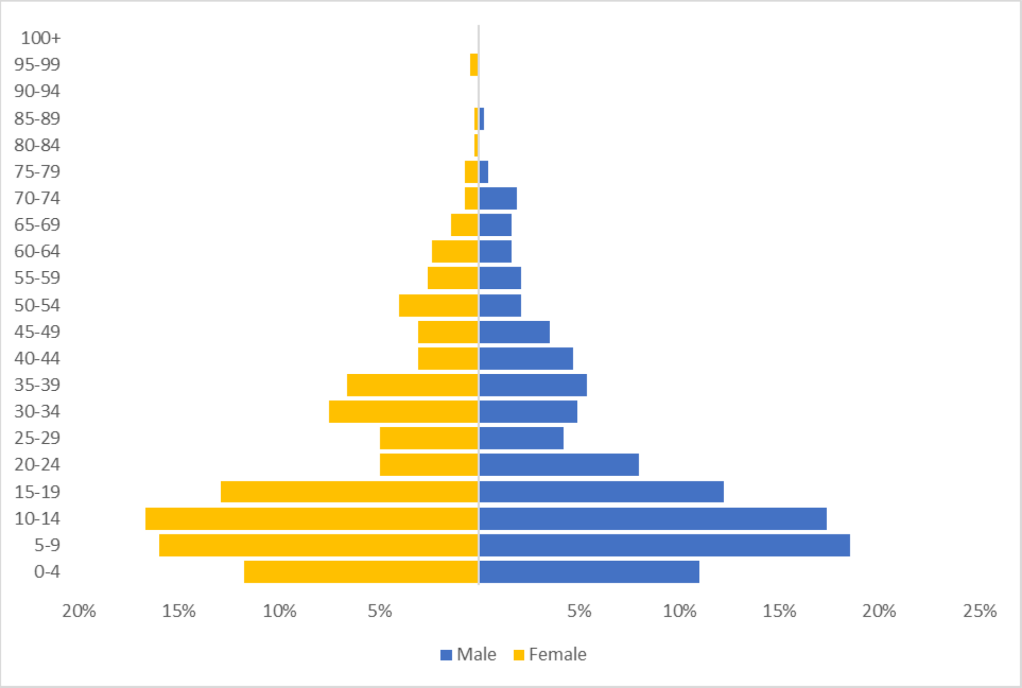
Table 5-11: Reported Population in the Project Area.

Community	Reported Population	Reported Number of Households	Average Household Size	Gender Makeup	
				Male	Female
Ching'anipa	1,100	110	9 to 10 members	25%	75%
Kalumo	500	145	4 members	40%	60%
Nsamala	1,046	123	7 to 8 members	45%	55%
Kapesi	*Not provided*	70	6 members	30%	70%
Chisaka	1,200	116	8 members	40%	60%
Chitseko	266	38	7 members	40%	60%

Source: ERM, 2019.

Figure 5-10 illustrates the population distribution by age and sex among members of those households surveyed. Similar to the national distribution, the local population is very young, with approximately 46% under the age of 15 and just 4% aged 65 and older.

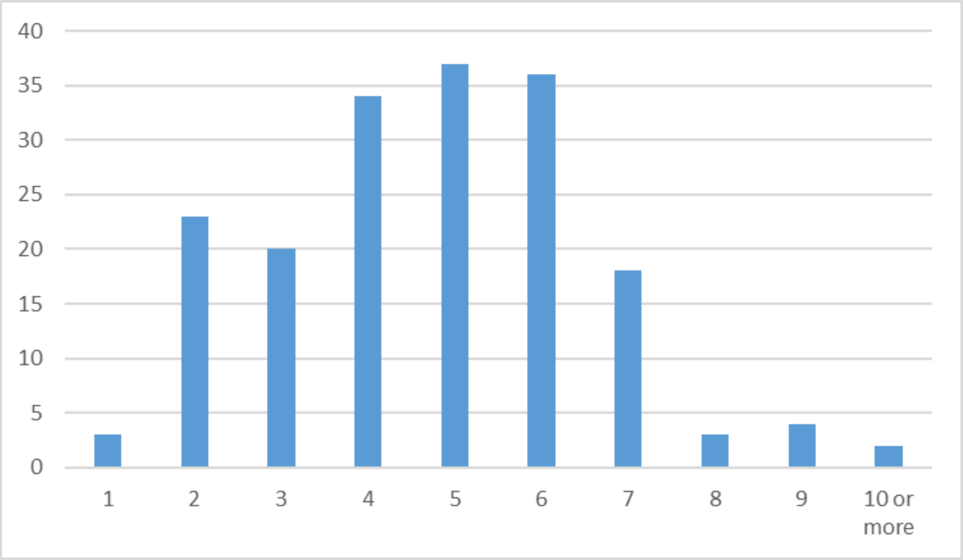
Figure 5-10: Local Population Pyramid by Age and Sex.



Source: ERM, from household survey data.

In terms of household membership, households in the Project Area have on average of 4.75 members, a figure slightly higher than the district average. The distribution of the reported number of household members per household is presented in Figure 5-11.

Figure 5-11: Number of People per Household in the Project Area.



Source: ERM, from household survey data.

5.3.3.2 Migration

As part of the household surveys, interviewees were asked how long each member of the household had been living in their community. The majority of household members (84%) reported being born in the community. Among more recent arrivals, just 8% of heads of households reported being in the community five years or less. During the Village Profiles, no recent notable population increases or decreases in migration were reported.

5.3.3.3 Ethnicity, Religion and Language

The primary religion in the villages is Christianity, with 97% of surveyed households reporting it as their religion. The primary ethnicity is Ngoni, representing 59% of the surveyed households, with a significant portion (37%) belonging to the Chewa ethnicity. Chichewa is the main language spoken in the households surveyed.

5.3.3.4 Community Cohesion and Community Networks

All the villages under GVH Pitala generally have close ties, and although villages are considered distinct, in practice community members move about, not always residing in the village of their birth. Some members from Group Village Pitala have moved to Thondoya village due to marriages, and still have active ties with family from their villages of origin, and still consider themselves part of these villages. Community members in the area reported helping one another with development activities, such as maintaining local roads, and supporting one another during celebrations or mourning (e.g., during weddings and funerals). Women reported relying on one another for child care support, lending money, and sharing ideas for small business opportunities. Men said they relied on other men for financial support, farming inputs, and to exchange knowledge on matters such as water, sanitation, and hygiene.

Men reported gathering to socialize at beer drinking points within the community and at game playing points, which are usually in someone’s home or in the nearby trading centre. Women did not report special gathering places for socializing but can commonly be viewed socializing in the queues for water. Women did note that “Tsimba” is a cultural gathering point in Nsamala village where women gather for cultural initiations when girls reach puberty.

5.3.4 Gender Context

5.3.4.1 Gender Roles

It was reported through household surveys and FGDs that men are generally considered the primary breadwinners and are mainly responsible for providing food for the family and caring for livestock. Meanwhile, women were reported to be primarily responsible for preparing food, fetching water and firewood, cutting thatch grass, cleaning, and other household chores. Both males and females were reported to contribute to farming and other income generating activities. During the FGD, women reported that their roles in providing for family income has increased in recent years, citing that men tend to spend their money on unnecessary expenses, such as alcohol. Women said they accomplish this through small business activities, as well as performing piece work. During the men’s and women’s FGDs, both groups stated that in recent years gender roles were changing and women have more opportunity to participate in labour activities once considered for men only, especially in piece work and labour considered more physical in nature, like building houses. Likewise, during the FGD with youth, youngsters reported that they believe gender roles are not as pronounced for the younger generations, stating that household chores were not differentiated greatly between boys and girls.

Men and women described their day-to-day activities as part of the participatory rural appraisal tools used during the FGDs. As can be observed in Table 5-13 summarizing the discussions, women’s responsibilities for both income and non-income activities result in a notably unequal distribution of labour and greater burdens on women’s time.

Table 5-12: Division of Labour.

Gender	Activity	Approximate Time Input	Resources Required	Socio-Cultural Factors/ Barriers that Influence Behaviour
🚹	1. Farming	6 hours (wet season) 4 hours (dry season)	Hoe, seeds, fertilizer, land, agrochemicals	• Unavailability of inputs
	2. Artisanal reed cutting	2 hours	Sickle, panga knife	• Health • Tiredness
	3. Kabadza (bicycle taxi/transportation)	3 hours	Bicycles	• Tiredness • Some customers don't pay
	4. Small business/selling of goods	6 hours	Capital	• Lack of credit facilities
	5. Digging holes for electricity poles	4 hours	Hoe, Chisel, Shovel	• Delay in receiving payments
	6. Looking after animals	6 hours	Grazing land	• Lack of enough land to graze animals
	7. Hunting	1 hour	Spear and Dogs	• Injuries and wild animals
🚺	1. Farming	4 hours	Hoe, seeds, fertilizer, land, agrochemicals, panga knife, axe, slasher	• Unavailability of inputs • Labour issues/ resources to pay • Illness • Shortage of water for irrigation (dry season)
	2. Caring for household,	3 hours	Soap, basin, water, brush	• Money for buying soap • Water shortages

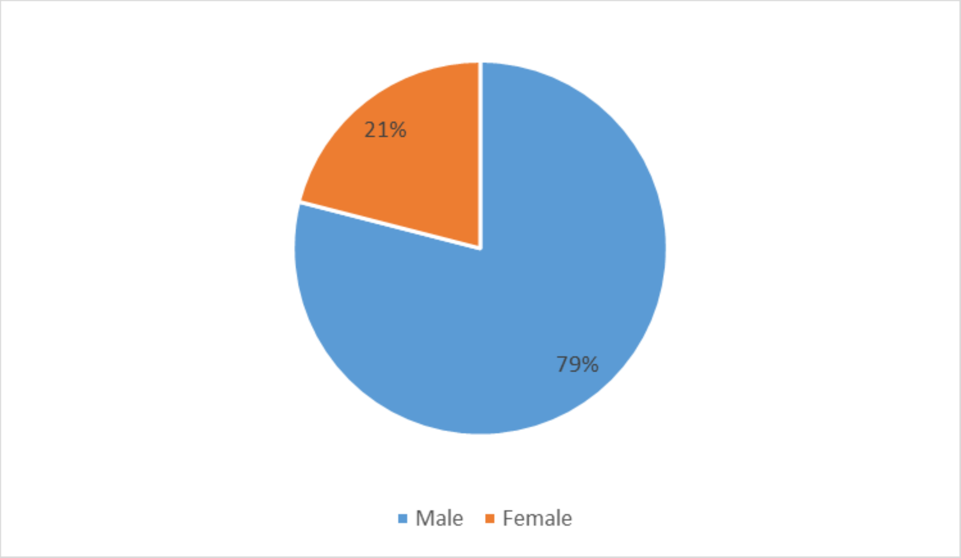
Gender	Activity	Approximate Time Input	Resources Required	Socio-Cultural Factors/ Barriers that Influence Behaviour
	including bathing children			
	3. Cleaning the homestead	5 hours	Broom, clay soils for the floor, buckets	• Being hurt by grass when applying the mud (soil) • Houses are not durable
	4. Fetching water	4 hours	Buckets	• Queue at the borehole • Long distances
	5. Collecting firewood	7 hours	Hoe, seeds, fertilizer, land, agrochemicals, panga knife, axe, slasher	• Accessibility • Availability (at times) • Distance
	6. Cooking	7 hours	Pot, cups, basin, water, maize flour, firewood	• Lack of enough firewood • Lack of money to buy food
	7. Cutting grass for thatching houses and for sale	6 hours	Panga knife, axe, sickle, slasher	• Availability (at times) • Distance
	8. Piece works (agricultural labour)	4 hours	Hoe, seeds, fertilizer, land, agrochemicals, panga knife, axe, slasher	• Not been paid after doing the work
	9. Small business/selling of goods	5 hours	Sack bags, baskets, money, pots	• Not making profits • Confiscation of properties because of not paying back loans on time • Money being stolen • Don’t have a place to get a loan

Source: ERM FGDs with Men and Women.

Note: Participants in the FGDs were asked to describe usual day-to-day activities, even if they don’t engage in these each day, and the time taken for each. As such, the time inputs sum to far more than 24 hours (26-28 in the case of men and 45 for women).

In married households, men were almost exclusively reported to be the head of household. Among the total households interviewed as part of the household surveys, however, there were a significant number of female-headed households, as seen in Figure 5-12.

Figure 5-12: Head of Household by Gender.



Source: ERM, from household survey data.

Among the female-headed households, the primary status of those household heads were separated/divorced (47%), followed by widowed (37%).

5.3.4.2 Access and Control of Resources / Gender Equality

During the FGDs, men, women and youth were engaged about their perceptions of gender equality and access and control of key resources in the Project Area. The results of a participatory rural appraisal tool on access and control of resources can be viewed in Table 5-13. Generally, men cited having control of key household assets such as livestock, farming equipment, the home, and their wives, and being the decision-maker for the household. The only major asset that women compete with men in terms of access and control is land, due to the matrilineal land ownership system, but women still perceived that men ultimately controlled the land.

According to women, boys have more educational opportunities than girls. Women reported that when money for school fees is lacking, boys will be favoured over girls to be sent to school. In addition, women reported that boys have the opportunity to do piece work to get money for their education, which most girls cannot manage, as they are considered weaker than boys. Men agreed that they make decisions about spending for school fees, but felt that because other assistance is targeted at keeping girls in school that boys can be disadvantaged as they receive less support for their schooling.

Table 5-13: Access and Control of Resources

Resource	Men's Perceptions		Women's Perceptions		Comments Raised During FGDs
	Access	Control	Access	Control	
Land	Women	Women	Women	Men	• Both groups cited that women have access to land as this is the matrilineal cultural system, but men viewed that women also controlled land, while women viewed that men did
Education and training	Men	Men	Men & Women	Men	• Women commented that because men control spending, they are the ones to decide spending on school fees and who gets to go to school • Men also said they decided who in the family got to go to school • Women commented that men don't want them receiving training because of jealousy/fear that they will meet other men
Technology	Men	Men	Men	Men	• Both men and women mentioned that women don't usually have phones because men are jealous
Cash	Men	Women	Men & Women	Men	• Women mentioned that men are not transparent about how much they earn selling goods in the market • Men believe that women have control of cash because they do all the household budgeting
Credit/Loans	Men	Women	Men & Women	Men	• Women stated that sometimes their husbands ask them to

					take out a loan so they don't have to be responsible for its repayment
Marketing/ selling of goods	Men	Men	Men	Men	• Men tend to be the ones to control decisions about significant sales, like livestock
Hiring of labour	Men	Women	Men	Men	• Women said that men are not honest when it comes to paying labour; that paying of labour is used as an excuse to hide spending on other things, like alcohol

Source: ERM FGDs.

5.3.4.3 Challenges Faced by Men and Women

Cases of gender-based violence against women also fell in Kachindamoto TA over the five year period between 2008 and 2012.[38] The TA, a woman named Theresa Kachindamoto, has focused on child marriages and developed programs locally to keep young girls in school. The TA recently achieved an agreement in the district to end child marriage, and over a three year period (approximately 2013-2016) annulled over 850 child marriages. She has additionally made efforts to abolish "cleansing rituals" that require girls as young as seven to go to sexual initiation camps.[39] The FGD held with youth revealed that the TA has empowered the local Youth Network to support her initiatives to identify and abolish child marriages and support one another to stay in school. Youth felt that peer-to-peer support on this important issue was aiding in reducing these challenges.

During the FGDs, women also noted that keeping girls in school was a challenge. Especially when young girls become pregnant, there is a pressure for them to marry and drop out of school to start a home. Women also complained of time poverty for both women and girls, highlighting that though females engage at similar rates to males in work and school, females have more household work while males engage in leisure activities or rest. Women cited jealously as a source of conflict in local households, at times leading to domestic violence when husbands fear their wives may be associating with other men. Men did not feel they had many challenges, but did cite unemployment and the lack of job opportunities as challenges. They tended to agree that jealously was an issue in households and caused them to exert control over their wives and certain resources (e.g., cell phones).

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[38] Dedza District Socio-Economic Profile 2013-2018. https://issuu.com/dedzaeast/docs/dedza_sep_final (accessed March 2019)

[39] Inhabitat, Female chief in Malawi breaks up 850 child marriages and sends girls back to school, https://inhabitat.com/inhabitots/female-chief-in-malawi-breaks-up-850-child-marriages-and-sends-girls-back-to-school/ (accessed March 2019)

5.3.5 Governance, Security and Human Rights

5.3.5.1 Governance and Security

During the FGDs and KIIs, interviewees overwhelmingly reported that save for occasional minor theft issues, security in the community is very good and there have never be any significant security concerns.

5.3.5.2 Human Rights Context

At the local level, household surveys did not indicate that child labour is a significant issue, with just 4% of people under the age of 18 reported as having a livelihood occupation or seeking employment. Nevertheless, it should be noted that many households do not consider chores to constitute labour for children, even though children routinely engage in cattle rearing, agriculture, and small business opportunities in the area.

5.3.6 Vulnerability

Vulnerability is dependent on the level of resilience of individuals to cope with socioeconomic or bio-physical change or shocks. Resilience is based on having access to the necessary resources (e.g., savings, assets such as crops, shelter) and physical/mental capacity (e.g., strength to relocate, skills to rebuild a business) to cope and adapt to changes. Vulnerable groups are consequently more susceptible to negative impacts and/or may be disproportionately affected by such impacts. Similarly, vulnerable groups may have a limited ability to take advantage of positive impacts. Vulnerability may stem from an individual’s or group’s race, colour, sex, language, religion, political or other opinions, national or social origin, property, birth, or other status.

Based on household survey data and stakeholder engagement activities to validate vulnerability categories in the local context and perceptions, the list below presents groups that can be considered vulnerable in the Project Area. It is important to note that during stakeholder engagements, many stakeholders stated that they believe most people in the Project Area have similar standards of living, and most have struggled at times to meet their basic needs, especially with regard to food security. Nevertheless, the groups highlighted below were considered particularly vulnerable to shocks with limited ability to recover quickly from negative impacts.

- **Women and girls:** Women were routinely described as disadvantaged in comparison to men with regard to economic opportunity, especially for wage-earning labour. Men dominate access and control of most key resources, and are generally the decision-makers for households. Domestic violence and early pregnancy were cited as challenges that further disadvantage females compared to males. Girls were less likely to finish their education than boys, at times because fathers prioritize the education of sons when resources are short.
- **Female-headed households:** Female headed households (many widows) are more likely to experience significant poverty than dual parent/male-headed households due to more pressure balancing domestic and livelihood activities and less income earners to support children.

- **Orphans:** Though not reportedly common in the area, orphans are considered vulnerable as their network for support is extremely limited and they are not as well positioned as adults to earn adequate incomes.
- **Physically handicapped:** Those with physical impairments are considered more disadvantaged as they require more support, especially with regard to agriculture. They are often not able to be productive or work in agriculture at all, even though this is the main livelihood in the area.
- **Elderly and others with serious medical conditions (e.g., HIV/AIDS):** This group is considered vulnerable as they are more limited in terms of their physical ability to engage in livelihood and income generating activities. Most require additional care and support for their daily needs, which can be an extra hardship on their families.

Most households in the Project Area can generally be considered somewhat vulnerable as a result of poor food security, low education levels, and low levels of income, coupled with limited ability to absorb shocks (e.g., having little to no savings, ability to access credit).

5.3.7 Education and Literacy

5.3.7.1 Access to Education

In Kachindamoto TA, there were 34 total primary schools (10 government and 24 mission) in 2012. Between 2008 and 2012, boys in Kachindamoto enrolled in primary school at slightly higher rates than girls each year, making up 52.1% of enrolees in 2012. Kachindamoto had 4 secondary schools (all government schools) in 2012. Within the Project Area, all the villages utilize the same schools for local children. These are listed and briefly described in Table 5-14. No tertiary education facilities were available in the area, and community members were generally unaware of any locals who had been successful in continuing their education past the secondary level. Options for tertiary education are available in Dedza or Salima town centres, which are located far from the Project Area.

Table 5-14: Access to Education.

Type of educational facility	Name	Approximate distance	Comments/ Observations
Pre-school/ nursery	Nsamala or “Bongolola” Nursery School	0.2 km	A private nursery school which meets under a tree in Nsamala Village.
Primary	Chipuzi Primary School	0.5 km	This primary school has up to standard 7. Pupils have to move to another school which is far away (estimated between 2 to 3km) for standard 8.

Type of educational facility	Name	Approximate distance	Comments/ Observations
Secondary	Golomoti CDSS	7-8 Kilometres	It is in Chikololele village, also sometimes referred to as "Chikolele CDSS". The schools is very far away from the area and the distance was frequently cited as a hardship for students.

Source: ERM Village Profiles.

According to household surveys, most children walk to school along a trajectory that takes 30 minutes or less (69%), with some walking more than 30 minutes and up to an hour (25%) and very few cases of longer distances. Among factors that limit children attending school, households reported that costs/financial reasons were primary limiting factors (50%), followed by illness (29%) and distance (12%). Males and females were reported to both be affected by such factors, with females reported as being somewhat more affected (58%).

Interviewees during FGDs with men, women, and youth emphasized that school fees were a limiting factor for most families and constitute the primary reason children miss school. When families lack money for school fees, youth reported they typically miss two weeks of school until the family is able to pay again. Parents believed the quality of the primary school was very good, and recounted that on average 70% of pupils in standard 8 are selected to attend good government secondary schools, including boarding schools. All groups cited the distance of the main secondary school, however, as a challenge for local students. Participants in the youth FGD said that schools often lack materials for learning and enough desks, and that the secondary school had just eight teachers, leading to average class sizes of 130 students. Youth and other KIIs stated that the toilet facilities were also lacking in the schools, presenting challenges especially for girls during their menstruations.

5.3.7.2 Literacy Levels

Household survey data suggests that among the population aged 15 to 24, 83% of males and 78% of females are literate. These rates are lower than the reported national literacy rates level. Although low, when compared to the overall literacy rates for all household members aged 15 and older, data indicates that younger generations are more literate on the whole, with a narrower gap between male and female literacy than the overall population (Table 5-15).

Table 5-15: Local Literacy Levels by Gender and Age Range

Age Range	Literacy	Male	Female
All ages over 15	Literate	76%	53%
	Illiterate	24%	47%
	Total	**100%**	**100%**
Ages 15 to 24	Literate	83%	78%
	Illiterate	17%	22%
	Total	**100%**	**100%**

Source: ERM, from household survey data.

5.3.8 Economy and Livelihoods

5.3.8.1 Livelihood Activities and Household Income

Household survey respondents most commonly reported that the primary occupation for household members aged 18 and above was farming (67%), followed by trading/market and selling (10%). Very few reported formal sources of employment. These are consistent with sources of household income, which were stated to be business/trading, agriculture, and informal employment (including piece work or day labour).

Household surveys suggest that the median monthly income is MWK 30,000, or approximately USD 41 per month (using an exchange rate of MWK 732 to USD 1). This equates to approximately USD 1.35 per day for the household, falling well below the international poverty line of USD 1.90 per person per day. Along these lines, most households (65%) reported that their incomes made it either “very difficult” or “difficult” to make ends meet (i.e., to pay necessary expenses). A smaller 28% reported their incomes were satisfactory, while only 7% rated their incomes as easily sufficient to meet their expenses. In terms of prominent expenses borne by most households surveyed, respondents reported the following annual expenses in order of significance: food, farming inputs, clothing, electricity, and healthcare/medication.

Very few households (18%) reported having savings. Of those that did, the most common forms were through Village Savings and Loans (VSL) and cash. To a lesser extent, livestock was considered a form of savings. Formal access to credit is not common in the Project Area, and just 31% of household survey respondents reported that a household member had accessed credit or borrowed money in the past year. Borrowing was mostly done informally through a friend or relative or through a local VSL, a type of savings club. VSLs are very common in Malawi, and generally function based on members pooling savings to be able to offer a source of borrowing funds to fellow members when needed. In the Project area, VSL members reported that loans are typically short-term in nature, with a payback period of a month in most cases, and are provided at 20% interest. Those households that had borrowed money or accessed credit reported the challenges/barriers listed in Table 5-16.

Table 5-16: Barriers to Accessing Credit.

Barriers	Percentage of Households
No barriers	35%
Not available locally	24%
Lack of bank account/credit history	2%
Interest payment too expensive	35%
Other	3%

Source: ERM, from household survey data.

During stakeholder engagement activities, VSLs were cited as the only formal access to credit resource in the local area.

The average monthly household income in the Project area is 45,741 MWK, while the median monthly income is 30,000 MWK. Income quintiles (in which reported incomes in the data set are divided into five equal groups) are an interesting means of drawing comparisons between income groups and to be able to detect where inequalities or vulnerabilities may lie. The quintile mean, shows the average income in each group, while the share shows the percentage of total income held in aggregate by members of a given quintile.[40] As seen in Table 5-17, income quintiles in the community show relatively unequal income distribution highly skewed towards the top quintile.

Table 5-17: Monthly Income Quintiles.

Quintile	Quintile Mean (MWK)	Share of Total Household Incomes
Bottom Quintile	7,861	3%
Second Quintile	16,288	7%
Middle Quintile	27,676	12%
Fourth Quintile	43,285	19%
Top Quintile	131,218	59%

Source: ERM, from household survey data.

The low income levels observed may be partially attributed to the fact that many households engage in livelihood activities for subsistence rather than to generate income. For example, when asked about the top crops produced by the household, most reported that these crops were produced for consumption (52%), followed by sales (24%) or a combination of consumption and sales (23%). Top crops produced by the households are presented in Figure 5-13. The predominance of maize

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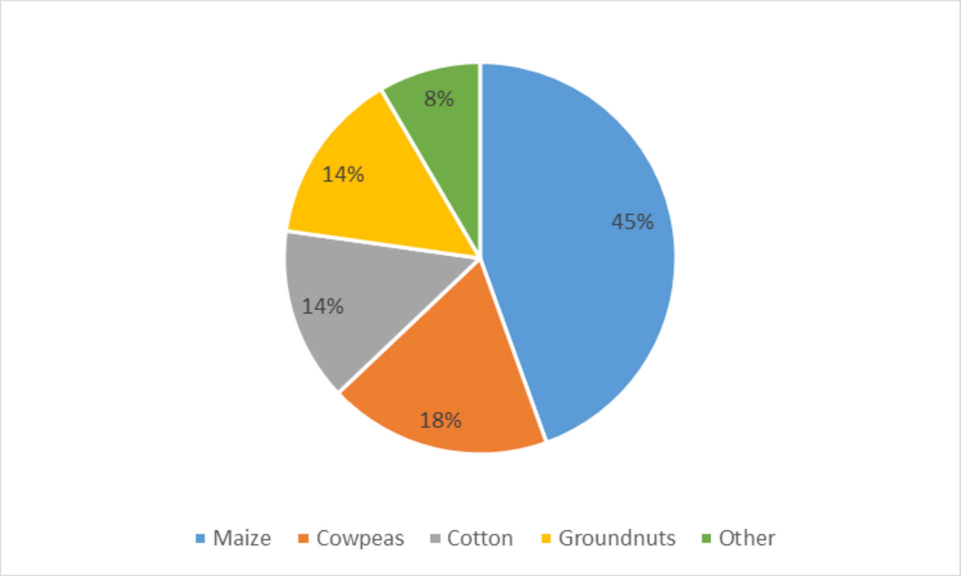
[40] For reference, because each quintile represents 20% of the households, a 20% income share in each quintile would represent a mathematically equal distribution of household income.

production and the subsistence nature of agriculture is further evidenced based on the overwhelmingly most common staple food reported to be consumed by households – Nsima, a maize-based porridge. Meanwhile, cowpeas and cotton are primarily grown to generate income.

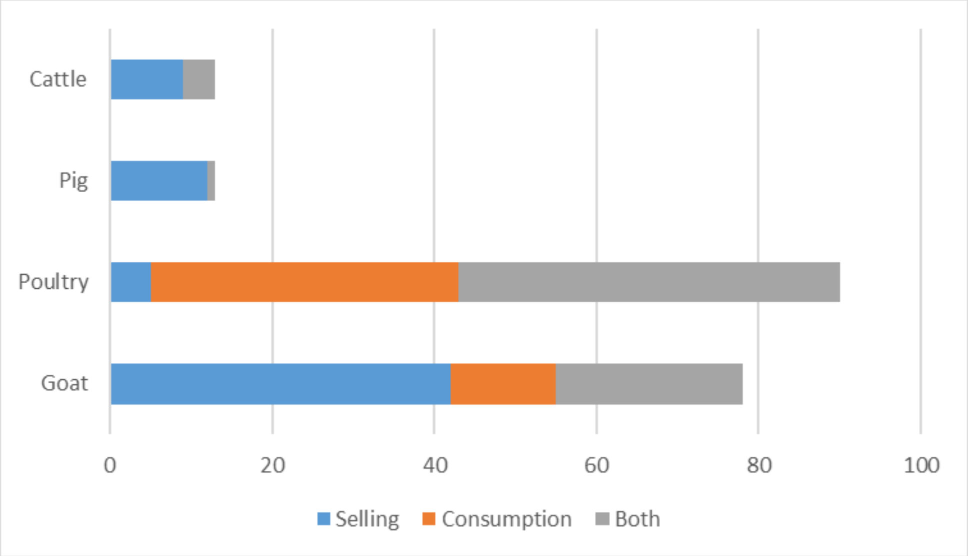
Figure 5-13: Top Crops Produced by Households.



Source: ERM, from household survey data.

Roughly 70% of households keep some livestock, primarily poultry (chickens and ducks) and goats, keeping and average of 16 and six animals, respectively (Figure 5-14). Poultry is primarily kept for household consumption and some sales, while goats tend to be raised more for income generating purposes and some consumption. Caring for livestock and daily herding to graze and water was explained to be primarily the charge of boys, while parents are responsible for ensuring that livestock are penned and safe each day.

Figure 5-14: Livestock Kept by Households and Uses.



Source: ERM, from household survey data.

Food shortages were reported as being very common among respondents to the household surveys, 72% of which stated they experienced food shortages from time to time, including during the last year. The primary reasons for food shortages were said to be limited money to buy food, followed by climate-related challenges, such as drought and flooding, and lack of adequate farming inputs. Consistent with national trends, food shortages were generally reported to last approximately two months, with January and February cited as the most common months, with some shortages occurring in December and March.

Another important source of income for households is small business opportunities, facilitated by the immediate proximity of the Golomoti trading centre on the M5 road just a short walk from most of the villages. Many community members sell goods either through a rented stall or selling on foot on the street. Goods include farm produce, butchered meat, prepared foods, snacks, and other small items. Many community members also reported earning income through casual labour opportunities or bicycle taxi/transportation, especially males.

Further detail on land-based livelihoods is provided in the following section.

5.3.9 Land Ownership and Use

5.3.9.1 Land Ownership

Among the parcels of land held or utilized by the households interviewed in the household surveys, respondents reported that 90% of these were customary land, while 7% of parcels were under a leasehold regime and the rest belonged to another category, including rented or privately owned/purchased. Approximately 85% of the parcels described by household survey respondents were reported to be under one hectare (on average approximately 0.6 hectares). It is common for households to have claim to more than one parcel of land, with the average being two parcels per household. No land conflicts were reported by village leaders or community members.

5.3.9.2 Land Use

Land in the Project Area is generally flat and predominantly used for agricultural purposes. Common crops cultivated in the Project Area include maize, cotton, groundnuts, cowpeas, and sweet potatoes. Trees on the Project Site include native and planted trees, including mango, acacia, and baobab. Local residents report that medicinal plants are collected from the Project Site and elsewhere. There are also several walking paths that traverse the Project Site (Figure 5-15). During the Village Profiles, many of the chiefs noted that while everyone has inherited customary land in their families, some families rent additional land for agricultural purposes because their family land is not enough to support their households, though this typically is explained to be a very small percentage of families.

5.3.9.3 Agriculture

As described in Section 5.1.7.2, maize, cowpeas, cotton, and groundnuts are cultivated by households in the Project Area, primarily for household consumption but also for income generation to a more limited extent. The most common challenge cited by households regarding agriculture was drought/lack of enough water, followed by lack of agricultural inputs and pests/diseases. In terms of watering crops, most crop cultivation relies on rainfall, but some community members reported utilizing the nearby Livulezi River for irrigation.

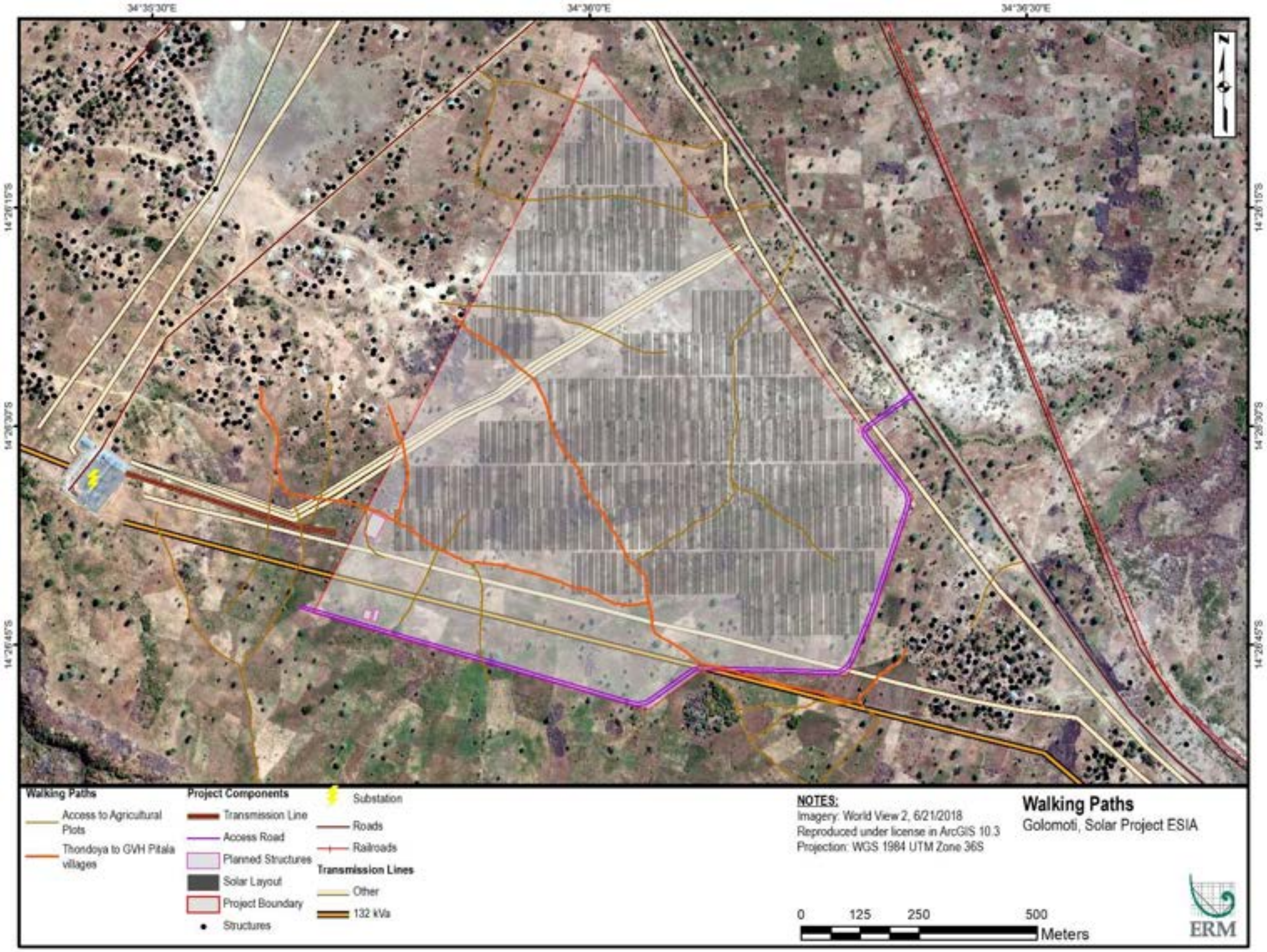
5.3.9.4 Utilisation of Natural Resources / Forest Products

Households reported utilizing various natural resources primarily found outside of their own land. The most important of these are fuelwood (for cooking and charcoal production) and grass (for construction), with some use of timber, medicinal plants, bush meat (e.g., birds and hare), and mushrooms. Of these resources, a majority of households (87%) reported that they are for consumption rather than sale. Viewed by product, however, firewood and grass tend to be primarily for the household, while the sale of charcoal, though illegal, is a significant source of income for families. During the FGDs, community members reported that everyone generally has equal access to natural resources. Women reported that the walk to collect firewood can take up to two hours and that there is a forest that is accessible, but people were beginning to encroach on the protected forest for charcoal production.

5.3.9.5 Livestock

Livestock is also reared in the Project Area, near homes in the case of smaller animals and in nearby areas to for those animals that can be herded. An open field in Chisaka village, which is privately owned but available for community use, is used to graze cattle and has a small pond from which cattle can drink. Cattle are also taken to the Livulezi River to drink. The most common animals kept by households are poultry (chicken and ducks) followed by goats. The most common challenge cited by households regarding livestock was animal health/disease. Other challenges cited were theft and lack of grazing land.

Figure 5-15: Walking Paths in the Project Area.



Source: ERM, 2019.

5.3.10 Health

5.3.10.1 Healthcare System and Access to Healthcare

When ill, residents of the Project Area most commonly frequent community health centres, followed by government hospitals. Among the households surveyed, 67% reported feeling there were barriers to accessing healthcare, for the reasons listed in Table 5-18. During the FGDs and KIIs, interviewees also emphasized overcrowding and long wait times as healthcare challenges.

Table 5-18: Barriers to Accessing Healthcare.

Barrier	Percentage of Households
Lack of finances	27%
Distance	37%
Poor service	36%

Source: ERM, from household survey data.

The median annual amount spent by households on health care was reported to be approximately MWK 12,000. The distances in terms of travel times to health facilities reported by households are presented in Table 5-19.

Table 5-19: Travel Time to Health Facilities.

Time to Reach Health Facility	Percentage of Households
15 minutes or less	3%
16-30 minutes	15%
31-60 minutes	30%
61-90 minutes	43%
More than 90 minutes	9%

Source: ERM, from household survey data.

Despite distances, households reported reaching health facilities with fairly regular frequency as presented in Table 5-20.

Table 5-20: Household Visits to Health Facilities in Last 3 Months.

Number of Visits	Percentage of Households
1-2 times	54%
3-4 times	35%
5-6 times	7%
More than 6 times	4%

Source: ERM, from household survey data.

5.3.10.2 Health Prevalence Rates

At the time of the household surveys, households reported that the following were relatively common illnesses/ailments: malaria/fever, respiratory infection, diarrhoea, skin rash, and bilharzia. Though detailed health indicators are not available for the local level with regard to average life expectancy for men and women, the population distribution of household members, illustrated in Figure 5-17, suggests that local averages are likely similar to Dedza District averages, and much lower than national averages, as observed in the smaller concentrations of the population in upper age brackets.

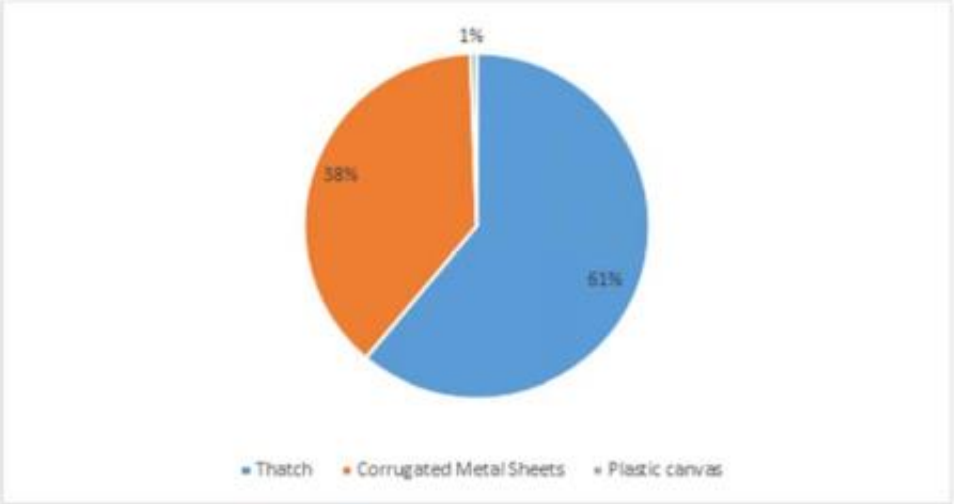
5.3.11 Community Infrastructure and Services

5.3.11.1 Housing

Houses are clustered to the northwest and to the east of the proposed Project Site. There are a variety of housing structures in the community. Most houses are fairly small and have between two and three rooms.

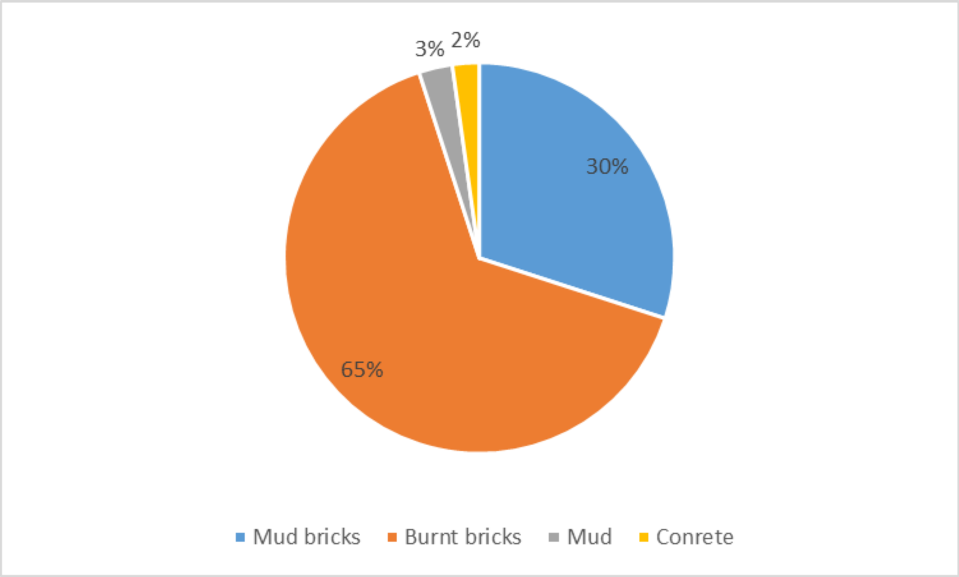
Burnt as well as unburnt bricks, bamboo, and soil are some of the materials utilized for the construction of walls. The main floor types for the structures in the community are mud and cement. Roofing materials for the majority of the structures are grass and corrugated metal (referred to as corrugated iron). Figure 5-16 through Figure 5-17 illustrate the prevalence of the main building materials used for housing in the communities. During FGDs, community members stated that burnt bricks and metal sheet houses are the most desirable for their durability but more costly to build.

Figure 5-16: Building Material for House Roofing.



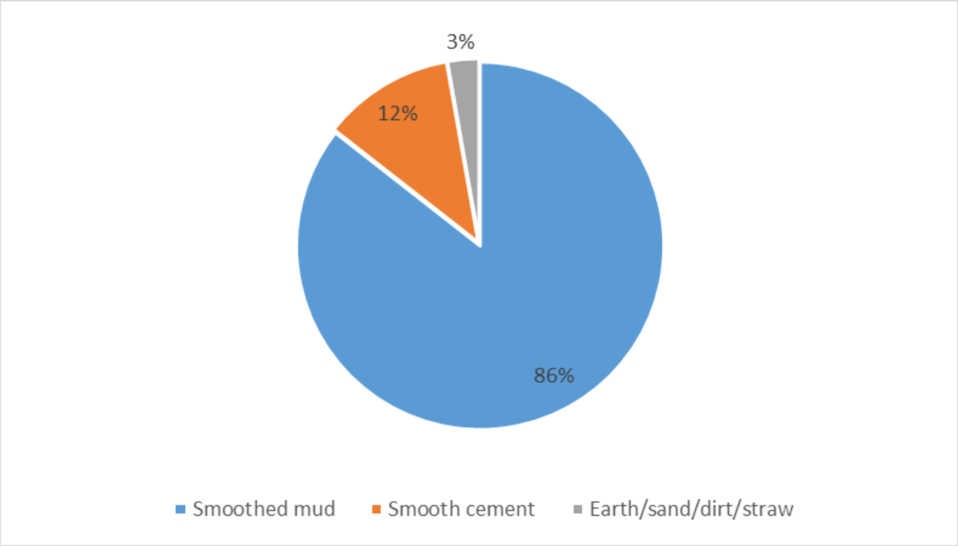
Source: ERM, from household survey data.

Figure 5-17: Building Material for House Walls.



Source: ERM, from household survey data.

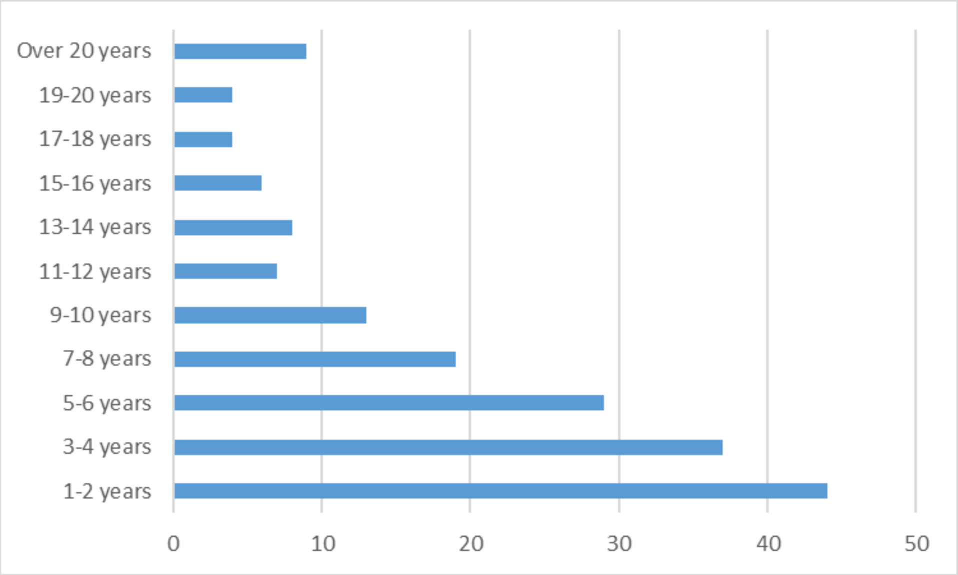
Figure 5-18: Building Material for House Floors.



Source: ERM, from household survey data.

As illustrated in Figure 5-19, these materials often do not weather well and thus houses tend to be "young," with 72% being eight years old or less, with an average age of 7.3 years.

Figure 5-19: Age of Houses.



Source: ERM, from household survey data.

5.3.11.2 Water and Sanitation

According to 2011 estimates for Kachindamoto TA, there were approximately 392 functioning boreholes, representing 1 per every 231 people, a rate better than the national level of 250 people per borehole. There has been a steady increase from 2007 through 2010 in the number of improved sanitary conditions (san plat pit latrines) in Kachindamoto, growing from 390 in 2007/2008 to 2,248 in 2009/2010, which has been attributed to the work of Concern Universal, an NGO that promotes water and sanitation in the district.[41]

According to the household surveys, drinking water is primarily supplied via boreholes, with some use of two taps that belong to ESCOM but are open for community use (Figure 5-20). There are three boreholes in the area, one of which is privately owned but generally open for community members to use. Boreholes are also the primary supply of domestic water used for bathing and cooking, with some additional uses of rain harvesting and river/streams during the wet season. Adult females are nearly exclusively responsible for fetching water. Among households surveyed, 59% reported having challenges with regard to their water supply. The main challenges cited for both seasons were said to be wait times to access water and water shortages, the latter unsurprisingly being more prominent during the dry season. On average, the wait times were said to be approximately 30 minutes, increasing to approximately 2 hours during the dry season when water levels drop. Distances were notably not cited as a significant challenge, with most households reporting water sources to be less than one kilometre from their dwelling. The only source of conflict mentioned during the stakeholder engagement activities were related to disputes arising around boreholes. These seem to be brought on by the long wait times and disagreements over place/rules surrounding the queues. For example a borehole shared between Nsamala and Kalumo villages has a queue for each village and villagers must take turns, interchanging between villages.

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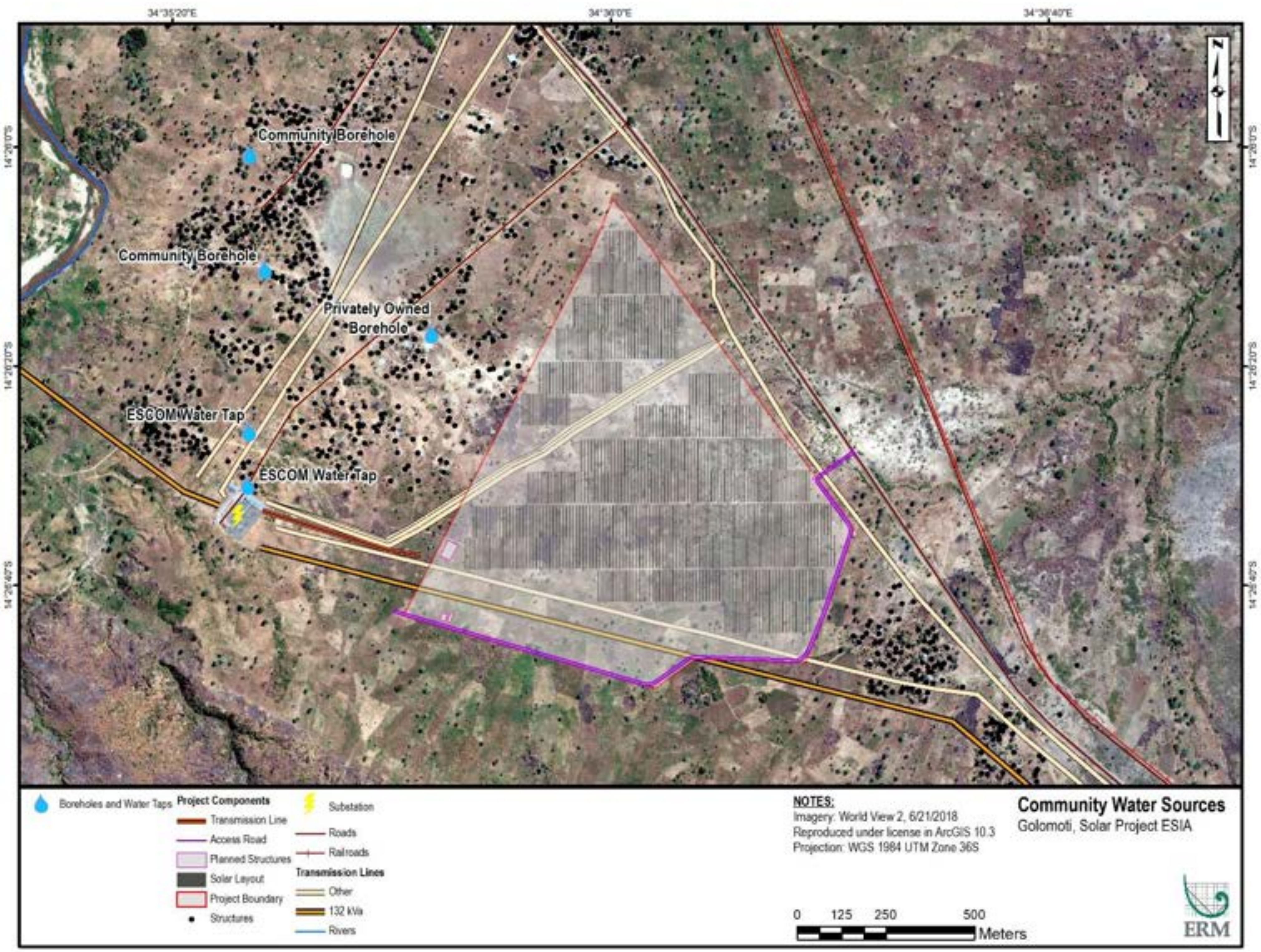
[41] Dedza District Socio-Economic Profile 2013-2018. Available at https://issuu.com/dedzaeast/docs/dedza_sep_final (accessed March 2019)

Figure 5-20: Approximate Location of Community Boreholes.



NOTES:
Imagery: World View 2, 6/21/2018
Reproduced under license in ArcGIS 10.3
Projection: WGS 1984 UTM Zone 36S

Community Water Sources
Golomoti, Solar Project ESIA

Source: ERM, 2019.

Locally, boreholes are typically managed by Water Council Committees. The Nsamala/Kalumo community borehole supplies water to eight villages and is managed collectively by ten committee members. The committee includes representatives from six villages, as well as a Chairman, Vice Chairman, Secretary, and Vice Secretary. The committee collects and manages fees from all of its members, with all users responsible for contributing financially in case the borehole requires repair or maintenance. Each user is responsible for contributing 300 MWK, twice per year. If the user cannot afford the payment, the committee will restrict their access to the borehole and they are required to gather water elsewhere (e.g., river or other community boreholes). According to the committee members interviewed, the water quality was tested once in 2000 (following installation) and has not been tested since. Nevertheless, members feel that the water quality is generally good. Members also expressed content with the level of sanitation around the borehole.

During stakeholder engagement activities in the communities, community members generally reported being satisfied with hygiene and sanitation practices in the local area. Households generally have their own traditional pit latrine constructed from mud, with some having a san plat pit latrine. Very few (4%) reporting having no latrine/using the bush. Households generally reported hand washing, most limited to water only. Some credit this practice to educational support from an NGO that helped to encourage the placement of hand washing provisions near latrines some years past. Men are typically responsible for constructing and maintaining the latrine for the household, using simple tools and materials. During FGD discussions, the main challenges with regard to latrines mentioned by community members were leaks and durability during the rainy season. Latrines were reported to typically last between three to five years before filling up. Once the pit latrines are full, they are closed, filled with soil, and abandoned, and new latrines are built. Other household waste that cannot be composted or fed to animals was reported to be usually disposed of in an allocated rubbish pit in the village.

5.3.11.3 Energy Sources

Lighting/Electricity

Homes in the immediate Project Area are not connected to the grid despite their proximity to the Golomoti Substation. The main source of lighting in households in the Project Area is battery-powered torches. It was reported that the use of battery torches is very expensive. Other sources of lighting include solar home systems and solar lamps.

Approximately 40% of households report having a mobile phone. Most charge their phones in a shop in the Golomoti trading centre, with some utilizing a small solar panel in their homes.

Cooking

Firewood is the most common source of energy used for cooking by households during both the wet and dry seasons. Charcoal is a secondary source of energy. Charcoal is used more in the wet season than in the dry season, likely because it is a dry fuel source. Firewood is almost always collected rather than purchased, and adult females tend to hold the exclusive responsibility for collecting firewood. Women report that walking to areas where they can collect firewood takes approximately two hours each way.

5.3.11.4 Traffic and Transportation

Transportation infrastructure near the Project Site is limited to the national M5 highway, which is tarred and has a single lane in each direction. The remainder of the roads within the villages are dirt roads. The dirt roads are functional for everyday community use, but rains present challenges to these roads. The roads are difficult to pass when they are saturated, and degrade once dry, requiring frequent repair.

The main mode of transportation in communities is overwhelmingly walking, though most households have access to bicycles with some use of motorbikes and buses to travel further distances. During stakeholder engagement activities in the Project Area, many community members cited the favourable location of the villages, especially their proximity to the Golomoti trading centre, and highlighted that villagers generally do not have to travel far to meet their daily needs.

5.3.12 Community Development Priorities

Local development challenges and areas for improvement were discussed as part of FGDs, KIIs, and Village Profiles. During the Women’s FGD, participants commented that quality of life in the community was challenging and that many households struggle to meet basic needs, not least of which is providing food for families. Women stated that vulnerability was primarily linked to a household’s ability to meet basic needs. Women generally viewed that access to credit, improved farming production, and better water access would enable a better quality of life and higher standard of living. During the Men’s FGD, participants commented that the quality of life in the community was good and boasted of good security. Among priorities that would enable community members to have a better quality of life and higher standard of living, men mentioned that increased access to water, access to credit, and a secondary school closer to the villages would be positive. Men viewed that vulnerability was often linked to an overreliance on agriculture and, as such, community members would benefit from building capacity in alternative income generating activities. Youth mentioned it was important for young people to stay in school, and that it was a priority to avoid drop outs due to early pregnancy or families’ inability to pay school fees. In terms of what would help youth in their development, FGD participants thought that technical training/skills development could help reduce youth unemployment and aid in income earning diversification for their families. They also mentioned that there was a lack of recreational activities for youth in the community, and that a sports league would be a positive outlet. As part of the Village Profiles, each chief was asked to provide the top three community development priorities and why each was important. The results of those discussions are summarized in Table 5-21.

Table 5-21: Community Development Priorities.

Village	Priorities	Justification for Priorities
Ching'anipa	1. Water supply	The village wants to have its own borehole, as its population is too high to depend on water from other villages. This will help to reduce disputes at the water points where people from the village currently get water.
	2. Nursery school	Children should start school at a young age to be more prepared and equipped for primary school.
	3. Health care service	People currently have to travel long distances to get health care services. Easier accessibility would help in reducing mortality rates of people including pregnant women because of distance and inadequate health care services at present.
Chitseko	1. Water supply	The village needs a borehole for water supply so that people don't walk long distances to search for water.
	2. Transportation to the hospital	The community would benefit from either bicycles or a vehicle for transportation to the hospitals because health clinics are far from the village.
	3. Nursery school	Children should start school at a young age to be better prepared for primary school.
Nsamala	1. Water supply (borehole)	Another borehole is needed so that water needs are met in the community; one borehole is not enough to support the whole village.
	2. Nursery school	There is already a nursery school in the village but they meet under a tree, so there is a need for a classroom block.
	3. Roads	The community needs permanent roads in the village because when the maintenance or roads projects by government end, the community will goes back to poor road quality.
Chisaka	1. Water	There is only one borehole in the village which is not enough.
	2. Secondary school	There is no secondary school near the community.
	3. Electricity	Many people do not have access to electricity in the village.
Kalumo	1. Hospital	There is no hospital close to the village.

	2. Water	One borehole is not enough for the village.
	3. Ambulance	There is a need for an ambulance for the community.
Kapesi	1. Water	There is only one borehole in the village which is not enough for the village.
	2. Health clinic	There are no nearby health clinics for community members to utilize.
	3. Nursery school	The village does not have a nursery school for young children.

Source: ERM Village Profiles.

5.3.12.1 Community-Based Organizations

Community-Based Organizations are not very common in the Project Area, with approximately 15% of households reporting a member belonging to a CBO. The most prominent CBO is the Village Savings and Loans (VSL).

VSLs are common in rural areas in Malawi and are designed to pool savings among members in order to create a source of lending funds. During stakeholder engagement activities, ERM met with two different VSLs in the Project Area, one composed entirely of women and one mixed gender group. Membership in the VSLs is well defined. Members must contribute capital monthly to participate and must borrow. The mixed VSL has approximately 120 members, and the women's VSL has approximately 18 members. Community members from the VSLs and non-members alike emphasized the VSLs provide the only formal access to credit in the local area, which is much needed to help them with income generating activities such as inputs for agriculture or to increase their market access.

Another CBO in the local area is the Golomoti AIDS Support Organization (GASO). GASO works through schools and other outlets in the communities, such as youth clubs, to provide education on HIV awareness and prevention. At the time of this report, GASO supported 56 youth clubs (approximately 1,983 youth).

5.3.12.1 Non-Governmental Organizations (NGOs)

NGOs are not common in the Project Area. The NGOs listed below are among the few that were mentioned during stakeholder engagement activities.

- **World Food Programme**: Provides food such as legumes, maize, and cooking oil to people to support their nutrition. This aid is provided to the less privileged only.
- **UNICEF**: Provides flour in primary schools for making porridge to help keep children in school.
- **UP (**https://united-purpose.org/malawi): Works in the community on the issues of climate change and agriculture. Locals credited UP with learning new methods of agriculture that have been successful.

5.4 CULTURAL HERITAGE BASELINE

This section provide baseline information on tangible cultural heritage resources in Malawi and on the Project Site. For the purposes of this baseline, tangible cultural heritage is defined using the IFC PS 8 definition of cultural heritage as well as the definitions of "monument" and "relic" contained in the Monuments and Relics Act (MRA) of Malawi (Table 5-22). The types of cultural heritage defined as monuments or relics in the MRA meet the criteria for tangible cultural heritage resources under IFC PS 8.

Table 5-22: IFC PS 8 and MRA Definitions of Cultural Heritage.

Term	Source	Definition
Cultural Heritage	IFC PS 8	(i) Tangible moveable or immovable objects, property, sites, structures, or groups of structures, having archaeological (prehistoric), paleontological, historical,

Term	Source	Definition
		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.
Monument	MRA	a) any area of land which has distinctive scenery or which contains rare or distinctive vegetation; (b) any structure, building, erection, ruin, stone circle, monolith, altar, shrine, pillar, statue, memorial, fortification; (c) any grave, tumulus, cairn, place of interment, pit dwelling, trench, excavation, working, rock, rock-shelter, midden, mound, cave, grotto, rock sculpture, rock painting and wall painting; (d) inscription or any other site or article of a similar kind or associated therewith which is of archaeological, palaeontological, ethnological, prehistorical, historical, artistic or scientific value or interest.
Relic	MRA	a) any fossil of any kind; (b) any artefact, implement, coin, document and manuscript; (c) any chiefly, religious or war regalia; (d) ornament or article (not being a monument), which is of archaeological, palaeontological, geological, anthropological, ethnological, prehistorical, historical, artistic or scientific value or interest.

Sources: IFC PS 8 and the MRA.

As described in Table 5-23, these types of tangible cultural heritage can be broadly divided into three categories: archaeological, built heritage, and living heritage resources.

Table 5-23: Types of Cultural Heritage Resources.

Resource Type	Definition
Archaeological	Concentrated and patterned physical remains of past human activity. A resource may include artefacts, plant and animal remains, structural remains, and soil features. This definition includes prehistoric and historic terrestrial and marine archaeological sites Examples: surface artefact scatters; subsurface, stratified village site; historic/ancient building or structure ruin; prehistoric or historic cemeteries; iron smelting sites.
Built heritage	Above ground, standing structures (buildings, monuments, infrastructure, etc.) with historical, cultural, religious, and/or artistic value to stakeholders. Examples: Traditional/folk houses;

Resource Type	Definition
	historic/colonial buildings; historic railways; historic churches and mosques.
Living heritage	A structure or natural landscape feature that is a part of a living cultural tradition and/or where cultural traditions are performed or practiced. Examples: sacred groves of trees, mountains, waterfalls; historic or modern churches, mosques, shrines; ritual/initiation rite compounds.

Source: ERM, 2019.

The local cultural heritage baseline provides information on the types of cultural heritage found in the districts of Dedza and Ntcheu and within the Project Site. The Malawi Directorate of Antiquities maintains a list of monuments and relics in Dedza and Ntcheu districts that are protected at the national level (i.e., are listed in the National Gazette), as well as monuments and relics that are significant at the district and local level. Table 5-24 provides summary information on national and locally significant cultural heritage in Dedza and Ntcheu districts.

Table 5-24: Nationally and Locally Significant Cultural Heritage in Dedza and Ntche Districts.

District	National or District List	Resource
Dedza	National	Chencherere Rock Shelters with Paintings**:** Six rock shelters on the Chentcherere hill north of Dedza District. Located within the core zone of the Chongoni Rock Art World Heritage Site, the shelters contain two types of paintings, red and white. The red paintings are believed to have been made by the Batwa from as early as the 16th century, while the white are believed to have been by earlier Bantu speaking people.[42]
		Chongoni Rock Art World Heritage Site: The resource covers an area of 126.4 km^2 in central Malawi and consist of 127 rock art sites. The sites include paintings by BaTwa hunter-gatherers who inhabited the area beginning in the Late Stone Age. The majority of the rock art was painted by farmers beginning in the first millennia A.D. during the Iron Age with Chewa agriculturalists continuing to create rock paintings at the site into the 20th century. The art documents the history of the local Chewa population,

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[42] www.culture.gov.mw/index.php/divisions/department-of-antiquities, accessed on 20-May-19.

District	National or District List	Resource
		including the shift from hunting and gathering to agriculture, the invasion of the Ngoni, and the arrival of Europeans. They document the time depth of culturally significant symbols and initiation rites.[43]
	District	Rock Art Sites at Mphunzi and in the Chongoni Forest Reserve, Chencherere Archaeological Excavation Site, Old Diamphwe Bridge, Makhamba Shrine and Archaeological Excavation Site, Mua Museum
Ntcheu	National	Memorial to Chief Gomani Chikuse: Constructed in 1927 by the Ngoni tribe of Ntcheu in memory of their king and one of the greatest pre-colonial rulers of Malawi, Chief Gomani Chikuse I. He was killed on October 27, 1896 by a colonial administrator. After his death, his people constructed a tomb at the place where he was buried (somewhere between Dombole and Chiole) as an indication of growing consciousness of colonial oppression.[44]
	District	Rock Paintings at Mlanda

Source: ERM, 2019.

The nationally and locally significant cultural heritage in Dedza and Ntcheu include archaeological, built heritage, and living heritage resources. The archaeological resources include internationally, nationally, and locally significant rock art sites, as well as a locally significant record of local Chewa history and traditional practices. These two sites, along with the locally significant sites of Mphunzi and Mlanda, are important living heritage sites that form part of the modern Chewa cultural landscape. The Memorial to Chief Gomani Chikuse is both a significant built heritage resource due to its association with a locally and nationally significant historical figure as well as an early monument to colonial resistance.

5.4.1 Project Site

The cultural heritage baseline studies included a cultural heritage field survey of the Project Site. The field survey and subsequent cultural heritage impact assessment was aligned with IFC PS 8 and the government of Malawi's Cultural Policy and the requirements of the Monuments and Relics Act. The field survey consisted of interviews with residents of the villages surrounding the site and a systematic pedestrian survey of the 91.605 ha Solar Plant Site. The cultural heritage survey identified 27 cultural heritage resources: 22 archaeological finds, one local historic

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[43] https://whc.unesco.org/en/list/476.

[44] www.culture.gov.mw/index.php/divisions/department-of-antiquities, accessed on 20-May-19.

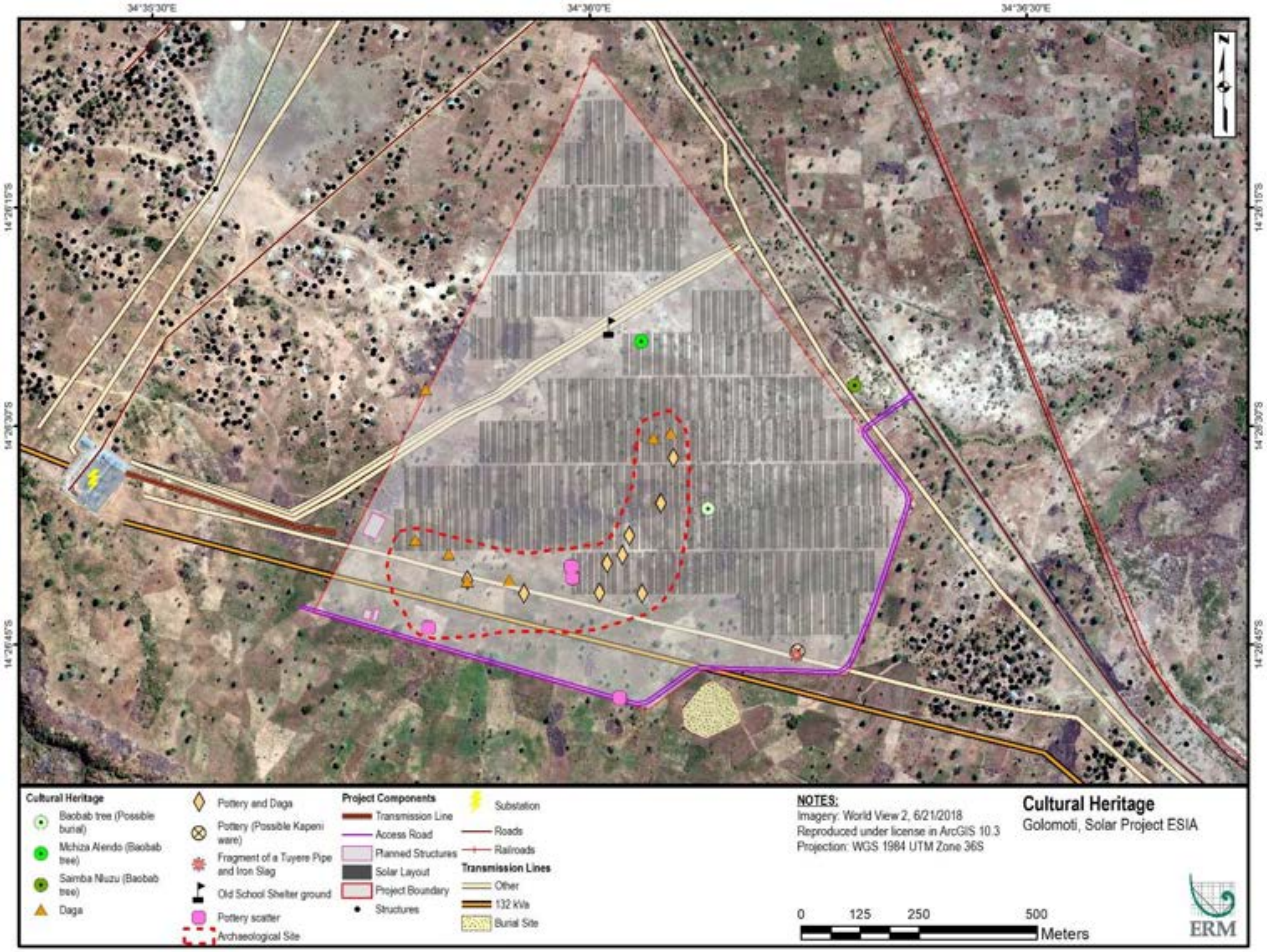
school house site, and four living heritage resources (three baobab trees and one cave) (Figure 5-21).

Interviews with local residents determined that the area around the site is occupied by people from the Yao, Ngoni, and Chewa ethnic groups. The majority of those interviewed stated that the proposed Project Site has been used for agriculture for as long as they could remember. The interviewees, however, stated the Project Site contained the remains of an old school shelter and three baobab trees important in local ritual and folklore. The interviewees also stated there was a cave, locally referred to as M’Bisa or “That Which Hides,” in the nearby hills overlooking the Project Site that was part of local oral traditions and folklore. Additional information about the baobab trees within the Project Site and M’Bisa Cave is provided in Table 5-25.

In addition to the historic and living heritage resources, the field survey team identified 22 archaeological finds within the Project Site. Eighteen of the archaeological finds were concentrated in a roughly crescent-shaped area measuring 600 x 200 m in the southern half of the Solar Plant Site. These finds consisted of isolated or small potsherd scatters, small scatters or isolated finds of “daga” (burnt/baked clay from house walls), and iron slag and a possible tuyere pipe fragment suggesting a possible iron smelting site (Figure 5-22 and Figure 5-23). The field archaeologists identified a possible Kapeni ware potsherd dated to the 9th-15th centuries A.D. Although the majority of the potsherds were undecorated and not indicative of a particular time period, the archaeologists tentatively dated the finds to the 13th-18th century, during the local Iron Age.

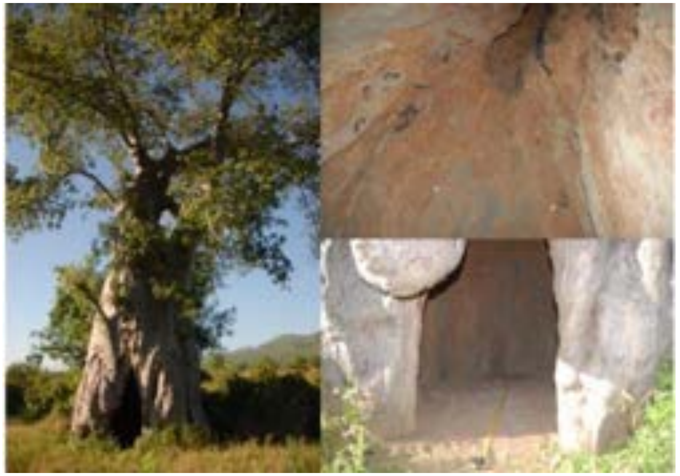
The field archaeologists interpreted the finds as the remains of up to 10 house sites and a possible iron smelting site, which suggest the 600 x 200 m artefact scatter is an archaeological site containing the remains of a small Iron Age village or hamlet. The 600 x 200 m archaeological site incorporates 18 of the individual artefact finds, with the remaining five artefact finds representing isolated finds likely associated with the larger archaeological site. The field archaeologists recommended additional archaeological investigations within the potsherd and daga concentration to determine the extent, integrity, and age of the archaeological finds in the Project Site.

Figure 5-21: Cultural Heritage Resources Identified in the Project Site.



Source: ERM, 2019.

Table 5-25: Living Heritage Sites Identified during the Project Area Cultural Resources Field Survey

Resource Type	Description	Photograph
Baobab Tree	The tree is called "Saimba Nluzu" by the local population, which translates to "do not whistle." Oral traditions state that the area around the tree was dangerous, although most of the informants could not remember what made the place around the tree dangerous. A few local informants stated that the area was inhabited by either spirits, snakes, wild animals, and/or thieves that made the tree dangerous. They stated that local traditions recommended that people passing by the tree should not make any noise or whistle to avoid being attacked by spirits, snakes, wild animals, and/or thieves. Local informants also stated there may be a burial within the cavity at the base of the tree.	
Baobab Tree	The tree is called Mchiza (Mchiritsa) Alendo by the local population, which translates to "healer of visitors." Local informants provided differing narratives about the tree as either healing visitors or that the tree provided baobab seeds for consumption to new arrivals in the area. Informants also stated that the tree was a resting or meeting place or that the tree offered baobab seedlings to boys that grazed their livestock in the adjacent fields.	

Resource Type	Description	Photograph
Baobab Tree	The tree (younger than the other two trees) was never given a name. Local informants stated the tree may have been used as a burial site for people that died from leprosy. Across Malawi, there is a tradition of burying those who died from leprosy in caves or baobab trees. Other informants stated that owls frequently use the tree, which adds to its mystical reputation as owls are believed to foretell death, bring bad luck, and are associated with witchcraft.	
M’bisa Cave	The local name for the cave is M’bisa, which translates to “that which hides.” The cave overlooks the Project Site from a nearby hill. According to most local informants, there is a well-known story associated with the cave that states the population of a village at the foot of the hill fled into the cave to escape attack and the entire village population disappeared into the cave. The local population believes that the souls of the villagers were lost in the cave and still linger nearby. The image on the right is a view of the hillside containing the cave from the Project Site. Follow-up stakeholder engagement meetings determined that the cave is located on the southern slopes of	

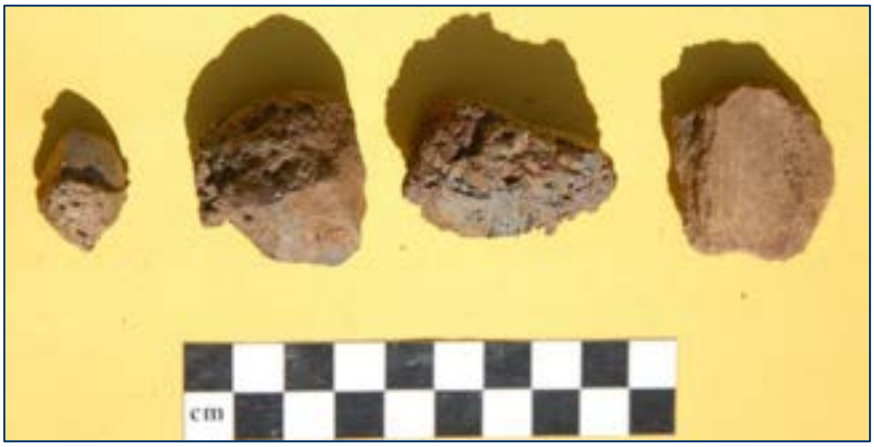
Resource Type	Description	Photograph
	the nearby hills and does not face the Project Area. As a result, the Project will not be visible from the cave.	

Source: Cultural Heritage Baseline Report (WWEC 2019c). Photos are WWEC 2019c: Figures 2, 3, 4, and 5.

Figure 5-22: Potsherd Found during the Field Survey.

Source: Cultural Heritage Baseline Report (WWEC 2019c: Figure 6).

Figure 5-23: Pieces of Slag (left) and a Possible Tuyere Pipe Fragment (far right) Found during the Field Survey.



Source: Cultural Heritage Baseline Report (WWEC 2019c: Figure 11).

6. IMPACT IDENTIFICATION AND ANALYSIS

6.1 IMPACT ASSESSMENT METHODOLOGY

ERM prepared this impact assessment according to its standard methodology, which has been used and refined through hundreds of internationally accepted projects including solar power plants, and is aligned with an approach typically used when conducting an impact assessment to international standards such as the IFC Performance Standards.

6.1.1 Methodology Overview

The purpose of the impact assessment process is to identify any likely significant impacts on environmental or social receptors as a result of the Project and to develop appropriate mitigation measures to effectively manage these impacts. To determine the significance of potential impacts, this ESIA considers two main factors: impact magnitude and receptor sensitivity/vulnerability. Magnitude is a measure of the changes to a receptor that will potentially result from the Project, while sensitivity/vulnerability is a measure of how sensitive or vulnerable a receptor (e.g., people, flora, or fauna) is to these changes.

There is no statutory or internationally agreed upon definition of significance; however, this assessment will use the following practical definition:

> An impact will be judged significant if, in isolation or in combination with other impacts, it will cause a notable change from baseline conditions and may require mitigation to manage the effects on/risks to a receptor from this change.

Evaluating impact significance is an iterative process and follows the cycle depicted in Figure 6-1.

Figure 6-1: Cycle of Impact Significance Evaluation.

Source: ERM, 2018.

6.1.2 Determining Impact Magnitude

This ESIA considers the aspects of magnitude listed below in order to assign a magnitude rating and design appropriate mitigation measures.

- **Nature of impact**: Is it positive/beneficial or negative/adverse?
- **Type of impact**: Does the impact occur as a result of a direct or indirect interaction with an aspect of the Project?
- **Duration**: How long will the impact occur?
  - Temporary: Maintaining for a portion of the construction phase.
  - Short-term: Maintaining for the entire construction phase or a portion of the operation phase.
  - Long-term: Maintaining for the entire operation phase.
  - Permanent: Maintaining indefinitely.
- **Geographic Extent**: What is the geographical extent and distribution of the impact?
  - Limited: Impacts will occur within a relatively small geographic area (e.g., single village).
  - Local: Impacts will occur within a single district (but potentially multiple villages).
  - Regional: Impacts will occur in two or more districts.
  - Transboundary: Impacts will occur beyond Malawi national boundaries.
- **Frequency**: Will the impact be continuous or intermittent?
  - Remote: Occurs once over the entire Project life cycle.
  - Rare: Occurs about once a year.
  - Occasional: Occurs at least once every six months.
  - Often: Occurs at least once a month.
  - Constant: Occurs on a daily basis (construction or operations).
- **Likelihood**: What is the probability of the impact occurring?
  - Unlikely: The event is unlikely but may occur at some time during normal conditions.
  - Possible: The event is likely to occur at some time during normal conditions.
  - Certain: The event will occur at normal conditions (i.e., it is essentially inevitable, for example, construction impacts such as site clearing and grading).

Though the above aspects provide guidance to assessing magnitude, subject matter experts in each discipline evaluate the magnitude rating holistically. Based on these characterizations, one of the following magnitudes is assigned:

- Positive;
- Negligible;
- Small;

- Medium; or
- Large.

6.1.3 Resource/Receptor Vulnerability/Sensitivity

Vulnerability can apply to physical, biological, cultural, or human receptors and considers some combination of sensitivity to change, vulnerability of the receptor with respect to the change, and importance of the receptor. With respect to importance, this is usually based on a consideration of factors such as legal protection, government policy, stakeholder views, and economic value. For example, habitats that meet the definition of "critical habitat," "natural habitat," or "legally protected and internationally recognized areas" under IFC Performance Standard 6 are assigned a high vulnerability rating. Standard vulnerability levels used in this ESIA are summarized below.

- Low: The receptor has ample capacity to assimilate the impact.
- Medium: The receptor has some capacity to assimilate the impact.
- High: The receptor has little to no capacity to assimilate the impact.

Where sufficient information is available, the assignment of a vulnerability rating may take into consideration any identifiable trends in receptor vulnerability. Note that in the case of beneficial/positive impacts, no vulnerability rating is assigned.

6.1.4 Impact Significance Rating

An overall significance rating of **Negligible**, **Minor**, **Moderate**, or **Major** is assigned by combining the magnitude rating and the sensitivity/vulnerability rating using the matrix shown in Table 6-1. These ratings are provided on a pre-mitigation basis (i.e., assuming no implementation of mitigation measures). It is important to note that impact prediction and evaluation take into account any embedded controls (i.e., physical or procedural controls that are already planned as part of the Project design, regardless of the results of the impact assessment process). An example of an embedded control is a standard acoustic enclosure installed around a piece of major equipment. This avoids assigning a magnitude based on a hypothetical version of the Project that disregards the embedded controls. Note that only negative impacts are assigned one of these significance ratings (positive impacts are simply designated "positive").

Table 6-1: Significance Matrix.

Magnitude of Impact	**Sensitivity/ Vulnerability/ Importance of Receptor or Resource**		
	Low	**Medium**	**High**
Negligible	Negligible	Negligible	Negligible
Small	Negligible	Minor	Moderate
Medium	Minor	Moderate	Major
Large	Moderate	Major	Major

Residual significance ratings are also provided, based on re-evaluation of the magnitude and vulnerability ratings after implementation of the recommended mitigation measures. In most cases, the sensitivity/vulnerability/importance of a receptor is unaffected by proposed mitigation measures. The mitigation measure is typically intended to reduce the magnitude of a predicted impact, thereby reducing its overall significance.

6.2 OUTCOME OF SCOPING

The scope of the assessment falls under three broad categories:

- Spatial scope (the Area of Influence, or AoI, as defined in Section 6.2.1);
- Temporal scope (the time periods over which the impacts may be experienced, as described in Section 6.2.2); and
- Technical scope (the Project activities and how they interact with potentially relevant environmental and social resources and receptors as described in Section 6.2.3).

Potential environmental and social issues have been evaluated as part of the scoping exercise in order to determine whether they are likely to give rise to significant risks and impacts and, therefore, the extent to which they should be included in the ESIA. Based on an understanding of the design and location of the Project and the local and regional environmental issues that are likely to be relevant, ERM has identified and reviewed those issues that may be material considerations. These have been “scoped in” to this ESIA and will form the technical scope of the ESIA. Some impacts have been “scoped out” of the ESIA and will not be investigated further.

6.2.1 Spatial Scope

The baseline section of the ESIA will present an overview of the biophysical and socioeconomic characteristics of the area in which the development will take place (i.e., within the Project “footprint”), as well as the surrounding areas that may be directly or indirectly affected by the proposed Project. This Area of Influence (AoI) includes the Project Site (i.e., the Solar Plant Site, Transmission Line corridor, and short Access Road), the area surrounding the site potentially affected by the Project, and nearby communities.

The IFC Performance Standards require project proponents to identify and manage environmental and social risks and impacts within their AoI. The AoI is defined in IFC Performance Standard 1 as:

> *The area likely to be affected by: (i) the project and the client’s activities and facilities that are directly owned, operated or managed (including by contractors) and that are a component of the project; (ii) impacts from unplanned but predictable developments caused by the project that may occur later or at a different location; or (iii) indirect project impacts on biodiversity or on ecosystem services upon which Affected Communities’ livelihoods are dependent.*
>
> *Associated facilities, which are facilities that are not funded as part of the project and that would not have been constructed or expanded if the project did not exist and without which the project would not be viable.*

> *Cumulative impacts that result from the incremental impact, on areas or resources used or directly impacted by the project, from other existing, planned or reasonably defined developments at the time the risks and impacts identification process is conducted.*

6.2.1.1 Direct Area of Influence

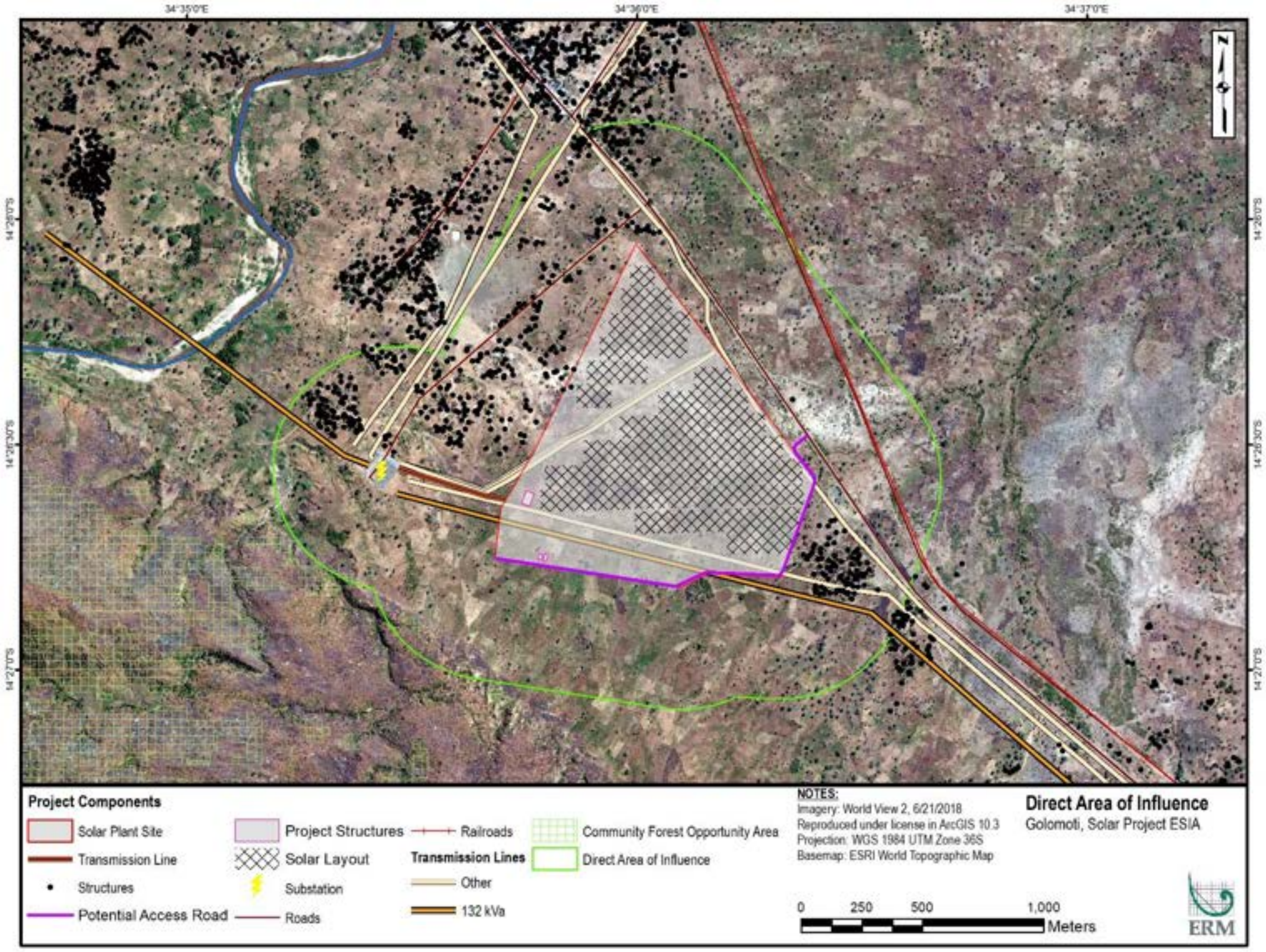
The Direct Area of Influence (DAoI) includes the Project footprint as well as the receiving environment surrounding the site. This encompasses the 92 ha Solar Plant Site, the 0.5 km Transmission Line corridor, the 80 m Access Road, and the surrounding communities likely to be affected by the Project activities during construction, operation, and decommissioning.

ERM proposes that the DAoI be defined as follows:

- 500 metres around the Solar Plant Site, which encompasses the proposed Access Road; and
- 500 metres on either side of the centreline of the transmission line from the Solar Plant Site to the existing Golomoti Substation.

The DAoI encompasses the villages to the northwest and southeast of the Project Site, which will be impacted by the construction of the Access Road, related health and safety impacts (e.g., noise, dust, traffic) during construction of the Project, and potential immigration of job opportunists to the area. The proposed DAoI is depicted in Figure 6-2.

Figure 6-2: Golomoti Direct Area of Influence.



Source: ERM, 2019.

6.2.1.2 Indirect Area of Influence

The Indirect Area of Influence (IAoI) encompasses communities beyond the DAoI that may be affected by the Project, although to a lesser extent. ERM proposes the IAoI to include the Group Village Pitala, which is composed of eight villages, and Golomoti Trading Centre. JCM has developed a Memorandum of Understanding with the Group Village Pitala and the Traditional Authority Kachindamoto, within which the Group Village Pitala is located, regarding social investment programs for the Project. Golomoti Trading Centre is located less than 1 km from the Project Site, and is a likely source of workers.

The DAoI and IAoI are collectively referred to as the Project Area.

6.2.2 Temporal Scope

The temporal scope of the assessment refers to the time periods over which impacts may be experienced. The Project phases to be assessed in the ESIA are:

- Site preparation and construction;
- Operation; and
- Decommissioning.

6.2.3 Technical Scope

The range of environmental and social topics to be addressed in the ESIA is referred to as the technical scope. An assessment has been undertaken by specialists for each of the environmental and social topics that have been scoped in for the ESIA. The environmental and social issues that comprise the technical scope of the ESIA and the reasons for their inclusion are listed in Table 6-2.

Please note that decommissioning impacts have been assumed to be comparable to construction impacts.

Table 6-2: Technical Scope.

Topic	Phase	Potential Source of Impact	Scoped In	Scoped Out	Potential Affected Receptors	Actions Required to Assess Potential Impacts
Employment and the Economy	Construction	Employment opportunities and the need for the supply of goods and services	✓		Neighbouring villages and wider district/regional/national economy	Assess the livelihoods, income sources, and commercial activities in the Project Area to determine the possibility for supplying goods and services. Include livelihood restoration measures in the LRP.
	Operation	Generation of electricity	✓		National economy	Assess the economic impact of the electricity that would be generated by the Project.
Air quality	Construction	Earthworks and vehicle and equipment emissions	✓		Human health (Note: air quality impacts to ecology receptors have been scoped out)	Semi-qualitative assessment of potential impacts from construction dust on human health.
	Operation			✓		The solar plant will produce no emissions, and other emissions (i.e., vehicle emissions) will be minimal during operation.
Noise	Construction	Earthworks, construction activities, and vehicles and equipment	✓		Neighbouring villages	Semi-quantitative assessment of construction noise impacts.
	Operation			✓		The solar plant will produce little noise, and other noise emissions (e.g., periodic maintenance activities) will be minimal during operation.
Soil	Construction	Earthworks	✓		Human health (Note: soil quality impacts to ecology receptors have been scoped out)	Conduct geotechnical study and subsequent impact assessment.
	Operation			✓		No earthworks are anticipated during operation.
Groundwater	Construction	Water consumption and wastewater	✓		Human health (Note: groundwater impacts to ecology receptors have been scoped out)	Conduct hydrogeological study and subsequent impact assessment.
	Operation		✓			
Biodiversity	Construction	Site clearance and construction activities	✓		Flora and fauna	Conduct biodiversity baseline survey to produce a habitat map and species mapping and assess impacts to any identified locally, nationally, or internationally important species.
	Operation			✓		No new areas will be cleared or otherwise disturbed during operation.
Landscape and Visual	Construction	Presence of new solar plant infrastructure	✓		Neighbouring villages	High-level landscape and visual impact assessment and identification of any visual sensitive receptors, if any.
	Operation		✓			
Land Acquisition and Displacement	Construction	Primarily land take, with potential removal of one structure	✓		Land users and community members	Identify project affected people with the support of relevant Group Village/Village Headmen and the District Office. Confirm the land uses in impacted areas.
	Operation			✓		No new land will be acquired during operation.

Topic	Phase	Potential Source of Impact	Scoped In	Scoped Out	Potential Affected Receptors	Actions Required to Assess Potential Impacts
Walking Paths	Construction	Restriction of access to Project Site	✓		Neighbouring villages	Assess the impact of restriction on traversing the Project Site on surrounding communities.
	Operation		✓			
Vector Borne and Communicable Diseases	Construction	Site housekeeping and worker/community interactions	✓		Neighbouring villages	Conduct a household survey and assess the construction impacts of Project activities on surrounding communities.
	Operation			✓		The workforce during operation will be small and locally resident.
STI/HIV Transmission	Construction	Worker/community interactions	✓		Neighbouring villages	Conduct a household survey and assess the construction impacts of Project activities on surrounding communities.
	Operation			✓		The workforce during operation will be small and locally resident.
Community Health and Safety	Construction	Worker/community interactions	✓		Neighbouring villages	Conduct a household survey and assess the impacts of Project activities on surrounding communities.
	Operation		✓			
Labour and Working Conditions	Construction	Presence of workforce	✓		Workforce	Compare and update (if necessary) Project policies so they are in line with Malawian regulations and international best practices.
	Operation		✓			
Cultural Heritage	Construction	Site clearance and earthworks	✓		Cultural heritage resources (archaeological and sacred sites) and neighbouring villages	Conduct a cultural heritage baseline survey, including stakeholder consultation, and assess impacts to identified resources.
	Operation			✓		No site clearance or earthworks are anticipated during operation.
Unplanned Events	Construction	Spills and traffic accidents	✓		Human health (Note: impacts to ecology receptors have been scoped out)	Assess the impact of unplanned spills and traffic accidents (through qualitative traffic assessment).
	Operation		✓			
Climate Change	All phases	Greenhouse gas generating activities		✓	Human health (Note: impacts to ecology receptors have been scoped out)	Scoped out as operational emissions will be below 25,000 tonnes CO_2e per year.

6.3 ASSESSMENT OF POSITIVE IMPACTS

6.3.1 Generation of Electricity

This section assesses the positive impacts that would occur during the operation phase from the generation of electricity.

6.3.1.1 Summary of Baseline Conditions

The current installed capacity of Malawi's grid is 439 MW. The national grid is heavily reliant on hydropower, which makes up 384 MW, or 87.5% of the generation capacity.[45] Due to drought and low rainfall, electricity generation has been reduced by up to 40% due to dwindling water levels.[46] There is also high potential for solar energy development in Malawi, however, which could help support better balance for the grid.

At the household level, the lack of electricity means that much of the population tends to use wood and charcoal for cooking, which contributes to deforestation across the country and poor indoor air quality and associated health effects.

6.3.1.2 Potential Impacts: Operation

The Project will generate 20 MW of power, which will be transmitted to the national grid for distribution in the Central Region of Malawi. The increased power supply from the facility will enable ESCOM to store additional hydropower reserves during the day so that peak demand can be managed more efficiently in the evening. It will also reduce dependency on diesel-powered emergency generation sets, which would lower cost to the end consumer and reduce the impact on climate change.

6.3.1.3 Assessment of Impacts: Operation

The increased power supply to the national grid throughout the operation of the solar PV facility will be a direct, positive impact. The extent of the impact will be regional, as the power generated by the Project will supplement the electricity supply to the Central Region of Malawi. The duration of the impact will be long-term, lasting throughout the operation phase, and the Project will boost the installed capacity of the national grid by approximately 5%.

The overall significance of the generation of electricity is rated as Positive as seen in Table 6-3.

Table 6-3: Impact Assessment: Generation of Electricity

Impact	Generation of Electricity	
Impact Nature	Negative	[✓ Positive]
	The generation of electricity is a positive impact.	
Impact Type	[✓ Direct]	Indirect

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[45] USAID, Malawi, Power Africa Fact Sheet, November 20, 2018. Accessed at: https://www.usaid.gov/powerafrica/malawi

[46] ESCOM (nd) An Update On The Current Water Levels And The Energy Situation In Malawi. Accessed at: http://www.escom.mw/waterlevels-energysituation-malawi.php

<table>
<tr><th>Impact</th><th colspan="60">Generation of Electricity</th></tr>
<tr><td></td><td colspan="60">The additional energy is a direct impact of the Project, constituting its primary purpose.</td></tr>
<tr><td rowspan="2">Impact Duration</td><td colspan="15">Temporary</td><td colspan="15">Short Term</td><td colspan="15">[✓ Long Term]</td><td colspan="15">Permanent</td></tr>
<tr><td colspan="60">The impact is considered long term since it will maintain for the duration of the operation life of the Project (expected to be 20 years).</td></tr>
<tr><td rowspan="2">Impact Extent</td><td colspan="15">Limited</td><td colspan="15">Local</td><td colspan="15">[✓ Regional]</td><td colspan="15">Transboundary</td></tr>
<tr><td colspan="60">The impact extent is regional, as the energy from the Project will supplement the Central Region’s power supply.</td></tr>
<tr><td rowspan="2">Frequency</td><td colspan="12">Remote</td><td colspan="12">Rare</td><td colspan="12">Occasional</td><td colspan="12">Often</td><td colspan="12">[✓ Constant]</td></tr>
<tr><td colspan="60">The generation of electricity will be constant throughout the lifetime of the Project.</td></tr>
<tr><td rowspan="2">Likelihood</td><td colspan="20">Unlikely</td><td colspan="20">Possible</td><td colspan="20">[✓ Certain]</td></tr>
<tr><td colspan="60">Power generation is certain to occur during operation.</td></tr>
<tr><td rowspan="2">Impact Magnitude</td><td colspan="12">[✓ Positive]</td><td colspan="12">Negligible</td><td colspan="12">Small</td><td colspan="12">Medium</td><td colspan="12">Large</td></tr>
<tr><td colspan="60">Based on the parameters above, and the stated methodology for this exercise, the magnitude is considered positive.</td></tr>
<tr><td>Resource/ Receptor Vulnerability</td><td colspan="60">Not vulnerability rating is assigned as the impact is positive.</td></tr>
<tr><td>Impact Significance</td><td colspan="60">The impact is positive.</td></tr>
</table>

6.3.1.4 Enhancement Measures

The distribution of electricity in Malawi falls within the remit of ESCOM. Given this, JCM does not have any authority with regard to the distribution of power, thus no enhancement measures are recommended.

6.3.1.5 Residual Impact Significance

The residual impact of increased power supply for the Malawian national grid during the operational phase will remain a positive impact as seen in Table 6-4.

Table 6-4: Residual Impact of Generation of Electricity

Impact	Project Phase	Significance (Pre-enhancement)	Residual Impact Significance (Post-enhancement)
Generation of Electricity	Operation	Positive	Positive

6.3.2 Employment

This assessment identifies the positive impacts that will occur during the construction and operation phases as a result of direct employment and third-party services required for the construction and operation of the Project.

6.3.2.1 Summary of Baseline Conditions

Nationally, Malawi's economy is primarily agriculture based and formal job opportunities are scarce, with 89% of employed persons engaged in informal employment. In the Project Area, community members have little job opportunities beyond agriculture, and almost all income-earning opportunities are the result of informal employment. Many livelihood activities that consume the time of community members, in particular women, do no generate income but rather are carried out primarily for subsistence purposes, such as farming, food processing, and collection of natural resources such as firewood. Most households reported that their incomes were insufficient, making it difficult to meet their expenses. Among those households suffering from food shortages, a primary reason cited for such shortages was a lack of money to buy food when needed.

6.3.2.2 Potential Impacts: Construction and Operation

Approximately 200 workers would be required during the construction phase including skilled and unskilled workers. During the operation phase, the number would reduce to approximately 20. JCM estimates that 65% to 70% of positions will be appropriate for unskilled labour, and plans to hire locally as much as possible. In addition, there would be possibilities to engage local small and medium enterprises (SMEs) in the local and broader district area with procurement opportunities.

The majority of the jobs and procurement opportunities in which residents of the Project Area may be engaged will be short term in nature, mostly during the construction phase, lasting approximately 10 months.

6.3.2.3 Assessment of Impacts: Construction and Operation

Table 6-5 provides an assessment of potential impacts related to job creation during construction and operation.

Table 6-5: Impact Assessment: Employment

<table>
<tr><th>Impact</th><th colspan="60">Employment and the Economy</th></tr>
<tr><td rowspan="2">Impact Nature</td><td colspan="30">Negative</td><td colspan="30">[✓ Positive]</td></tr>
<tr><td colspan="60">Job creation and use of local SMEs to supply goods and services will create a positive impact for some individuals, households, and businesses in the local community and in Dedza District.</td></tr>
<tr><td rowspan="2">Impact Type</td><td colspan="30">[✓ Direct]</td><td colspan="30">Indirect</td></tr>
<tr><td colspan="60">Where individuals are hired through JCM or the EPC Contractor, the impact would be direct, while the impact on SMEs would be indirect.</td></tr>
<tr><td rowspan="2">Impact Duration</td><td colspan="15">Temporary</td><td colspan="15">[✓ Short Term]</td><td colspan="15">Long Term</td><td colspan="15">Permanent</td></tr>
<tr><td colspan="60">The impact would largely be concentrated during the construction phase, as the need for workers and goods and services would reduce significantly during operation.</td></tr>
<tr><td rowspan="2">Impact Extent</td><td colspan="15">Limited</td><td colspan="15">[✓ Local]</td><td colspan="15">Regional</td><td colspan="15">Transboundary</td></tr>
<tr><td colspan="60">The impact is likely to be felt to some degree by some households and small businesses in most if not all of the villages in the Project Area.</td></tr>
<tr><td rowspan="2">Frequency</td><td colspan="12">Remote</td><td colspan="12">Rare</td><td colspan="12">[✓ Occasional]</td><td colspan="12">Often</td><td colspan="12">Constant</td></tr>
<tr><td colspan="60">The benefits will largely be limited to just before (recruitment) and during construction, when there will be the greatest concentration of the need for workers and goods and services.</td></tr>
<tr><td rowspan="2">Likelihood</td><td colspan="20">Unlikely</td><td colspan="20">Possible</td><td colspan="20">[✓ Certain]</td></tr>
<tr><td colspan="60">Though exact levels of hiring are yet unknown, it is certain that many community members and small businesses would benefit from job creation associated with the Project.</td></tr>
<tr><td rowspan="2">Impact Magnitude</td><td colspan="12">[✓ Positive]</td><td colspan="12">Negligible</td><td colspan="12">Small</td><td colspan="12">Medium</td><td colspan="12">Large</td></tr>
<tr><td colspan="60">Based on the parameters above, and the stated methodology for this exercise, the magnitude is considered positive.</td></tr>
<tr><td>Resource/ Receptor Vulnerability</td><td colspan="60">No vulnerability rating is assigned as the impact is positive.</td></tr>
<tr><td>Impact Significance</td><td colspan="60">The impact is positive.</td></tr>
</table>

6.3.2.4 Enhancement Measures

In order to enhance the positive impact related to job creation, the following measures will be implemented:

- A recruitment strategy will be established and implemented for staff required before and during construction to enable the community to access job opportunities.
- Although recruits will require a basic level of skills prior to recruitment, training opportunities and apprenticeships will be provided to males and females in local communities in order to enhance their skills, increasing employability and career development opportunities at a later stage.
- A Gender Development Plan will be developed and implemented to promote gender equality in job opportunities as well as to support the mitigation of gender-based violence and other gender-related issues within the workforce and externally (e.g., in Project-affected communities).
- Goods and services required for construction and operation will be sourced in Dedza District as much as possible. If a good or service is not available in Dedza District, it will be sourced in Lilongwe and at a national level prior to sourcing outside of Malawi.

6.3.2.5 Residual Impact Significance

With the enhancement measures listed above, the impact significance is expected to remain positive.

Table 6-6: Residual Impact of Job Creation

Impact	Project Phase	Significance (Pre-enhancement)	Residual Impact Significance (Post-enhancement)
Job Creation	Construction and Operations	Positive	Positive

6.4 ASSESSMENT OF POTENTIAL NEGATIVE IMPACTS

6.4.1 Air Quality

Air emissions from construction activities will be temporary and associated with the following activities:

- Combustion emissions from the operation of construction machinery and generators;
- Particulate (dust) emissions from exposed areas and earthmoving activities;
- Vehicle emissions from supply vehicles and generator operation; and
- Welding operations.

Little to no emissions are anticipated during the operational phase through management of on-site vehicle speed, vegetation, and soil landscaping. As indicated in Section 6.2, air quality impacts during operations have been scoped out of further assessment.

The assessment of potential impacts to air quality is limited to the assessment of dust generated during construction from both construction traffic movements and earthworks/construction works.

6.4.1.1 Summary of Baseline Conditions

Due to the rural nature of the Project Area, there are no existing (or continuous) air emissions within close proximity to the Project Site. Occasional air emissions result from burning or clearing activities, however, that occur within residential communities around the Project Area (communities exist within 200 m of the Project Site).

6.4.1.2 Potential Impacts: Construction

Dust emissions would arise during construction from the following activities:

- Site clearance and grading of the Project Site;
- Traffic and movement of vehicles over open ground and on unpaved roads; and
- Material stockpiles from clearance and related site preparation activities.

Dust emissions may result in nuisance issues at nearby sensitive receptors due to airborne and dust deposition, causing temporary increases in ambient concentrations of particulate matter (PM_{10}). In addition, dust emissions would arise due to traffic along unpaved roads during the construction phase.

The vehicles used during the construction of the Project would primarily be Heavy Goods Vehicles associated with bringing in materials and equipment. During construction, the primary Project components would be delivered in the following way:

- Inverters - truck deliveries;
- Main transformer - specialised abnormal load deliveries;
- LV/MV transformers – truck deliveries;
- PV modules – truck deliveries;
- Tracker/structure – truck deliveries; and
- Miscellaneous – truck deliveries.

6.4.1.3 Assessment of Impacts: Construction

The construction of the Project would take approximately 10 months and predominantly occur during the dry season, beginning in April 2020. During the wet season (December to late March), the conditions within the Project Area are not conducive for dust emissions. In addition, emissions would not occur constantly over the construction period, but would instead peak during site clearance and delivery of panels and mounting structures. Exposure to dust generating activities and associated dust emissions are therefore likely to primarily occur in the dry season and over a short period during the construction phase. The villages of Kalumo, Msamala, Kapesi, Chisaka, Ching’anipa, and Chitseko are located within 200 m of the Project Site, and Thondoya is located directly adjacent to its south-eastern boundary. These communities would likely have a high sensitivity to Project construction activities. The impact duration for these communities would be short term (over 10 months and primarily during the dry season within this period). The impact magnitude is considered **Small**, and the receptor sensitivity is considered **High**. As a result, the impact significance is assessed as **Moderate** within 200 m of the Project Site (Table 6-7).

Table 6-7: Assessment of Air Quality Impacts during Construction.

<table>
<tr><th>Impact</th><th colspan="60">Dust Emissions</th></tr>
<tr><td rowspan="2">Impact Nature</td><td colspan="30">[✓ Negative]</td><td colspan="30">Positive</td></tr>
<tr><td colspan="60">The potential impacts (dust emissions) are negative.</td></tr>
<tr><td rowspan="2">Impact Type</td><td colspan="30">[✓ Direct]</td><td colspan="30">Indirect</td></tr>
<tr><td colspan="60">The impacts would be a direct result of construction activities.</td></tr>
<tr><td rowspan="2">Impact Duration</td><td colspan="15">Temporary</td><td colspan="15">[✓ Short Term]</td><td colspan="15">Long Term</td><td colspan="15">Permanent</td></tr>
<tr><td colspan="60">The impacts would be short term, occurring only during construction (approximately 10 months).</td></tr>
<tr><td rowspan="2">Impact Extent</td><td colspan="15">[✓ Limited]</td><td colspan="15">Local</td><td colspan="15">Regional</td><td colspan="15">Transboundary</td></tr>
<tr><td colspan="60">The impacts would be confined to within 500 m of the Project Site.</td></tr>
<tr><td rowspan="2">Frequency</td><td colspan="12">Remote</td><td colspan="12">Rare</td><td colspan="12">[✓ Occasional]</td><td colspan="12">Often</td><td colspan="12">Constant</td></tr>
<tr><td colspan="60">During the dry season, there is the potential for dust on a daily basis, but this is less likely during the rainy season (December to April).</td></tr>
<tr><td rowspan="2">Likelihood</td><td colspan="20">Unlikely</td><td colspan="20">Possible</td><td colspan="20">[✓ Certain]</td></tr>
<tr><td colspan="60">Groundworks would produce conditions that could result in dust emissions.</td></tr>
<tr><td rowspan="2">Impact Magnitude</td><td colspan="12">Positive</td><td colspan="12">Negligible</td><td colspan="12">[✓ Small]</td><td colspan="12">Medium</td><td colspan="12">Large</td></tr>
<tr><td colspan="60">Based on the above, the impact magnitude is considered to be small.</td></tr>
<tr><td rowspan="2">Resource/ Receptor Vulnerability/ Sensitivity</td><td colspan="20">Low</td><td colspan="20">Medium</td><td colspan="20">[✓ High]</td></tr>
<tr><td colspan="60">The sensitivity of receptors (residential communities) considered high due to their proximity (the closest being within 20 m of the site boundary).</td></tr>
<tr><td rowspan="2">Impact Significance</td><td colspan="15">Negligible</td><td colspan="15">Minor</td><td colspan="15">[✓ Moderate]</td><td colspan="15">Major</td></tr>
<tr><td colspan="60">Based on the small impact magnitude and the high sensitivity, the impact significance is assessed to be moderate within 200 m from the Project Site and minor from 200-500 m.</td></tr>
</table>

6.4.1.4 Mitigation Measures

The measures listed below would be implemented to mitigate the Project's air quality impacts.

- Removal of vegetation and soil cover will be restricted to that which is necessary for the Project.
- Land clearance will be sequential and the smallest possible area for working will be exposed where ground and earthworks are undertaken.
- Stripping of topsoil will not be conducted earlier than required (i.e., the Project will maintain vegetation cover for as long as possible) in order to prevent the erosion (wind and water) of organic matter, clay, and silt.
- A speed limit of 30 kph on unpaved surfaces will be enforced and national speed limits on public roads will not to be exceeded.
- Transported materials will be covered with tarpaulins to prevent fugitive dust.
- Surface binding agents will be utilized on exposed open earthworks, when feasible.
- Exposed ground and earthworks will be covered as much as possible with sheeting, shade cloth, or tarpaulin where wind generated dust occurs.
- Stockpiles stored longer than six weeks will be vegetated or covered with sheeting, shade cloth, or tarpaulin to reduce soil loss from wind or storm water runoff.
- Stockpiles will be located as far away from receptors as possible and will be covered with sheeting, shade cloth, or tarpaulin.
- Wind breaks will be erected around key construction activities and, if possible, in the vicinity of potentially dusty works to minimise impacts to the nearby temporary residential accommodation and permanent residential receptors.
- Construction vehicles will be regularly maintained to minimise exhaust emissions.
- Vehicles will be switched off when not in use, unless impractical for health and safety reasons (e.g., maintenance of air conditioning).
- Complaints received from local community members through the Community Grievance Mechanism will be reported to the CLO.

6.4.1.5 Residual Impact Significance

With the implementation of the mitigation measures listed above, the residual impact significance during construction is anticipated to be **Minor** (Table 6-8).

Table 6-8: Pre and Post Mitigation Air Quality Impacts.

Impact	Project Phase	Impact Significance (Pre-mitigation)	Residual Impact Significance (Post-mitigation)
Dust Emissions	Construction	Moderate	Minor

6.4.2 Noise

Noise from construction activities will include that produced by diesel mobile construction and earth moving equipment, drilling, and foundation work. Traffic associated with the transportation of construction materials, transformers, generators, other equipment and materials, and construction workers will also result in increased noise levels along transportation routes.

The operation of the solar PV power plant is not expected to generate significant noise emissions. As indicated in Section 6.2, noise impacts during operations have been scoped out of further assessment.

This assessment identifies the potential impacts on the local acoustic environment that may arise as a result of the Project's noise emissions. Emissions would occur during the construction phase and arise from construction activities (e.g., earth moving equipment, welding, traffic).

6.4.2.1 Summary of Baseline Conditions

Due to the rural nature of the Project Area, there are no existing continuous noise emissions near the Project Site. There are residential communities within 200 m of the Project Site, with the closest being within 20 m.

6.4.2.2 Potential Impacts: Construction

During the construction phase, the main potential impacts on the acoustic environment are related to the noise emissions from construction machinery and construction vehicles being utilized for the activities listed below.

- **Site preparation**: This includes significant noise-producing activities such as vegetation clearance and minor earthworks. These activities would require heavy construction vehicles and equipment (e.g., excavators, dozers, dump trucks).
- **Civil works and installation**: This includes noise-producing activities such as drilling for mounting structure frames, construction of inverter and transformer station foundations and installation of inverter stations, and construction of stores, workshop, and office buildings.
- **Road traffic offsite**: The movement of vehicles for transportation of materials and personnel on local roads and/or new access roads close to communities would also generate noise emissions.

All the construction activities mentioned above have the potential to result in an overall increase in the background noise level close to the Project Site and to potentially disturb occupants at the nearest receptors.

Noise would be generated during the construction phase (and potentially at a lower level during decommissioning). The noise during this phase would be short term, over a total construction period of nine months. Based on UK guidance (BS 5228), noise levels that exceed 65 dB LAeq at a receptor would represent significant noise impacts. This assumes that work is carried out during the daytime, and that no noise generating work is required at night. According to the World Bank Group General EHS Guidelines (2007), noise levels should not exceed 55 dBA LAeq during the daytime and 45 dBA LAeq during the night at residential receptors.

Traffic associated with construction activities is highly variable through the various stages of construction and depends on the activities taking place. During construction, the primary Project components would be delivered in the following way:

- Inverters - truck deliveries;
- Main transformer - specialised abnormal load deliveries;
- LV/MV transformers – truck deliveries;
- PV modules – truck deliveries;
- Tracker/structure – truck deliveries; and
- Miscellaneous – truck deliveries.

6.4.2.3 Assessment of Impacts: Construction

Noise impacts from construction activities at the Project Site would persist for the construction period and would therefore be short term in nature. Emissions would be limited to the Project Area and would therefore be limited in nature. Noise emissions associated with construction would be variable in nature and depend on the particular activities being undertaken, as well as the number and type of equipment in operation. All construction work and traffic movements would take place during the day. As a result, there should be no activities with the potential to cause sleep disturbance. In addition, noise emissions would peak during site preparation and delivery of panels and mounting frames.

The exact location of construction equipment has not been confirmed, but community houses/buildings within approximately 100 m from the nearest construction activities (a backhoe loader with a sound level of up to 84 dB LAeq at 10 m) would result in a noise level of 67 dB LAeq at the nearest receptor (façade). There are several houses within 100 m of the Project Site.

In terms of nearby receptors, there are residential communities adjacent to the Project Site. The magnitude of the impact is considered **Small**, as it would be short term, and the sensitivity of the receptors are considered to be **High**. As a result, the impact significance is assessed to be **Moderate** within 100 m of the Project Site (Table 6-9).

Table 6-9: Assessment of Noise Impacts during Construction.

Impact	Noise Emissions			
Impact Nature	[✓ Negative]		Positive	
	The potential impacts (noise emissions) are negative.			
Impact Type	[✓ Direct]		Indirect	
	The impacts would be a direct result of construction activities.			
Impact Duration	Temporary	[✓ Short Term]	Long Term	Permanent
	The impacts would be short term, occurring only during construction (approximately 10 months).			

Impact	**Noise Emissions**				
Impact Extent	Limited	Local	Regional	Transboundary	
	The impacts would be largely confined to within 100 m of the Project Site.				
Frequency	Remote	Rare	Occasional	Often	Constant
	The impacts would be occasional (only during the day).				
Likelihood	Unlikely	Possible	Certain		
	Certain Project activities would produce noise emissions.				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
	Based on the above, the impact magnitude is considered to be small.				
Resource/ Receptor Vulnerability	Low	Medium	High		
	The sensitivity of the receptors (residential communities) is considered to be high due to their proximity (the closest being within 20 m of the site boundary).				
Impact Significance	**Negligible**	**Minor**	**Moderate**	**Major**	
	Based on the small impact magnitude and the high sensitivity, the impact significance is assessed to be moderate within 100 m of the Project Site.				

6.4.2.4 Mitigation Measures

The measures listed below will be implemented to mitigate the Project's noise impacts.

- Machines and equipment will be maintained in good working condition and inspected regularly.
- Equipment and vehicles will be selected in accordance with best available techniques for noise reduction.
- Vehicle movements within and around the site will be minimised as much as possible.
- Local screening/site hoardings will be utilised to screen noise where appropriate.
- Complaints received from local community members through the Community Grievance Mechanism will be reported to the CLO.

6.4.2.5 Residual Impact Significance

With the implementation of the mitigation measures listed above, the residual impact significance is anticipated to be **Minor** (Table 6-10).

Table 6-10: Pre and Post Mitigation Noise Impacts.

Impact	Project Phase	Impact Significance (Pre-mitigation)	Residual Impact Significance (Post-mitigation)
Noise Emissions	Construction	Moderate	Minor

6.4.3 Soils

This assessment identifies potential impacts to soil resources resulting from the Project. Impacts would occur during construction as a result of Project Site and wayleave clearance and preparation.

6.4.3.1 Summary of Baseline Conditions

The Project Site appears to contain mixed soil content, including phaeozems, luvisols, fluvisols, and vertisols. Phaeozems are humus-rich and highly arable soils that are commonly used for agricultural purposes, pasture for cattle, and wood/fuel production. Luvisols contain mixed mineralogy, high nutrient content, and generally have good drainage. Luvisols are also used for various agricultural purposes. Fluvisols are common along rivers and in level topography. They can be cultivated for dryland crops and are commonly used for grazing in the dry season. Vertisols are dark-coloured soils, composed of ≥ 30% clay, and are typically found in climatic zones that have distinct wet and dry seasons. Due to their clay content, vertisols are generally not well suited for cultivation without significant management and labour.

The Project Site is generally flat land and is predominantly used for agricultural purposes. Local residents report that crops cultivated on the Project Site include maize, cotton, soy, cowpeas, and sweet potatoes. Trees on the Project Site include native and planted trees, including mango, acacia, and baobab trees. Local residents report that medicinal plants are collected from the Project Site, although these plants can be collected elsewhere. There are also several footpaths that traverse the Project Site.

6.4.3.2 Potential Impacts: Construction

Site preparation and construction activities would include earthworks and site clearance (including the transmission line wayleave). These activities could lead to the following effects on soil resources within and surrounding the Project footprint:

- Loss of topsoil;
- Soil compaction and rutting; and
- Soil erosion from wind and water runoff (and sediment release to land and water).

The 92 ha Solar Plant Site would be cleared of vegetation and levelled. In addition, approximately 1.5 ha (0.5 km x 30 m) would be cleared for the transmission line wayleave. Compaction and increased erosion from increased exposure of bare ground to wind and water are likely to cause changes and/or degradation to soil structure and quality. Erosion may also occur when surface water flows come into contact with areas of bare soil, especially on sloped terrain. Precipitation within the Project Site would also likely impact the exposed soil and increase surface run-off, resulting in loss of topsoil, which binds the soil together for more stability. Continued loss of topsoil would lead to increased levels of erosion.

Rainstorms during the wet season can increase the potential for erosion. In addition, the compaction of subsoils through site grading and levelling, and the presence of heavy vehicles and machinery during construction, would result in lower permeability of the soil and therefore decrease infiltration and increase run-off. Without appropriate mitigation measures, run-off from hardstanding areas, in addition to exposure to wind and rainfall, may increase erosion and alter the natural drainage characteristics of the soil.

6.4.3.3 Assessment of Impacts: Construction

Impacts to soil would be short term, during the 9 month construction phase, and largely limited to within 100 m of the Project Site. The impacts would be occasional, largely restricted to the site clearance phase of construction. In terms of nearby receptors, there are residential communities adjacent to the Project Site. The magnitude of the impact is considered **Small**, as it would occur over a temporary period, and the sensitivity of the receptors are considered to be **High**. As a result, the impact significance is assessed to be **Moderate** within 100 m of the Project Site (Table 6-11)

Table 6-11: Assessment of Soil Impacts during Construction.

Impact	Soil Erosion				
Impact Nature	[✓ Negative]	Positive			
	The potential impacts (e.g., erosion) are negative.				
Impact Type	[✓ Direct]	Indirect			
	The impacts would be a direct result of construction activities resulting in an impact on the quality of soil in and around the Project Site.				
Impact Duration	Temporary	[✓ Short Term]	Long Term	Permanent	
	The impacts would be short term, occurring only during construction (approximately 10 months).				
Impact Extent	[✓ Limited]	Local	Regional	Transboundary	
	The impacts would be largely confined to the Project Site, with the potential for some erosion in immediately surrounding areas.				
Frequency	Remote	Rare	[✓ Occasional]	Often	Constant
	The impacts would largely be restricted to the site clearance phase of construction.				
Likelihood	Unlikely	Possible	[✓ Certain]		

<table>
<tr><th>Impact</th><th colspan="60">Soil Erosion</th></tr>
<tr><td></td><td colspan="60">Certain construction activities (e.g., grading) would result in soil impacts.</td></tr>
<tr><td rowspan="2">Impact Magnitude</td><td colspan="12">Positive</td><td colspan="12">Negligible</td><td colspan="12">Small</td><td colspan="12">Medium</td><td colspan="12">Large</td></tr>
<tr><td colspan="60">Based on the above, the impact magnitude is considered to be small.</td></tr>
<tr><td rowspan="2">Resource/ Receptor Vulnerability/ Sensitivity</td><td colspan="20">Low</td><td colspan="20">Medium</td><td colspan="20">High</td></tr>
<tr><td colspan="60">The sensitivity of the resource is considered to be high due to the importance of soil quality in the agricultural economy of the Project Area and the low permeability of the clayey soils across the Project Site.</td></tr>
<tr><th rowspan="2">Impact Significance</th><th colspan="15">Negligible</th><th colspan="15">Minor</th><th colspan="15">Moderate</th><th colspan="15">Major</th></tr>
<tr><td colspan="60">Based on the small impact magnitude and high sensitivity, the impact significance is assessed to be moderate.</td></tr>
</table>

6.4.3.4 Mitigation Measures

The first 10 measures listed in Section 6.4.1.4 and those listed below will be implemented to mitigate the Project's soil impacts.

- Erosion control measures such as intercept drains and toe berms will be constructed where necessary.
- Access roads will be well drained in order to limit soil erosion.

6.4.3.5 Residual Impact Significance

With the implementation of the mitigation measures listed above, the residual impact significance is anticipated to be **Minor** (Table 6-12).

Table 6-12: Pre and Post Mitigation Soil Impacts.

Impact	Project Phase	Impact Significance (Pre-mitigation)	Residual Impact Significance (Post-mitigation)
Soil Erosion	Construction	Moderate	Minor

6.4.4 Groundwater

Construction activities that will require water include concrete mixing and sanitary facilities for workers. The Project will drill a borehole at the Project Site during construction to provide the water required for construction activities. In the event that the borehole proves to be insufficient, or use of the borehole significantly impacts the water production of boreholes in adjacent communities, the Project will utilize water bowsers that contain approximately 20,000 L to provide the water required for construction. The source of the water has not yet been identified, but could be from a nearby lake or river. A local consultant, Geoconsult, was retained to conduct a "Hydrology and Flood Risk Assessment" of the Project Site (Appendix B). The report states that the Livulezi River, approximately 1.2 km to the northwest of the Project Site, "is perennial and is a sustainable source of water for all construction and site requirements" (Appendix B, page 9). The Project will obtain the necessary permits to drill the borehole and take water from nearby water bodies.

Water usage during operations will include domestic use and panel cleaning. Panel cleaning will be ad hoc rather than scheduled. The Project will only clean the panels if output starts to decline due to dust. Water will also be required for onsite staff, which is estimated to be 30 L per worker per day.

This assessment identifies potential impacts to groundwater as a result of the Project. Impacts would occur during construction and operations, and primarily relate to the use of groundwater by the Project.

6.4.4.1 Summary of Baseline Conditions

The climate of Malawi is tropical continental and largely influenced by Lake Malawi. There are three main seasons: cool and dry, from May to August; warm and dry, from September to November; and warm and wet, from December to April. Climate recorded at Golomoti indicates that the months of April to November have significant numbers of days with no precipitation.

Groundwater resources within the Project Area are associated with the weathered zone above fractured bedrock. The aquifer thicknesses are commonly 10 to 25 m. The aquifer is partly confined by an overlying thickness of 5 to 20 m of tightly compacted clays and soils that have very low permeability. Where groundwater is encountered, it is commonly near the base of the clays and under pressure, indicating that it is held within a confined aquifer.

Rural areas in Malawi are highly dependent on groundwater to support their livelihoods. In areas that experience a low stream density, groundwater supply plays a leading role in terms of servicing the community domestic and agriculture needs. This is the case for communities in the Project Area. Baseline studies identified the presence of three boreholes in the communities adjacent to the Project Site. In addition, there are two ESCOM water taps near the Golomoti Substation.

6.4.4.2 Potential Impacts: Construction and Operation

Construction activities that would require water include concrete mixing and sanitary facilities for workers. The Project would drill a borehole at the Project Site during construction to provide the water required for construction activities. In the event that the borehole proves to be insufficient, or use of the borehole significantly impacts the water production of boreholes in adjacent communities, the Project will utilize water bowsers that contain approximately 20,000 L to provide the water required for construction. The source of the water has not yet been identified, but could be from a nearby lake or river. A local consultant, Geoconsult, was retained to conduct a "Hydrology and Flood Risk Assessment" of the Project Site (Appendix B). The report states that the Livulezi River, approximately 1.2 km to the northwest of the Project Site, "is perennial and is a sustainable source of water for all construction and site requirements" (Appendix B, page 9). The Project would obtain the necessary permits to drill the borehole and take water from nearby water bodies.

Water usage during operations would include domestic use and panel cleaning. Panel cleaning would be ad hoc rather than scheduled. The Project would only clean the panels if output starts to decline due to dust. Water would also be required for onsite staff, which is estimated to be 30 L per worker per day.

Depending on local aquifer conditions, Project abstractions from the borehole that it intends to drill have the potential to reduce the water level at the three nearby community borehole and two ESCOM water taps.

6.4.4.3 Assessment of Impacts: Construction and Operation

Use of the borehole to be drilled by the Project is expected to be rare. As a result, the magnitude of the potential impact is considered to be **Small** during both the construction and operation phases. The sensitivity of the impacted resource is considered to be **High**, as neighbouring communities rely on the aquifer from which the Project borehole would abstract water, and community members already indicate that the aquifer is not always sufficient to meet their needs. The impact significance is therefore assessed to be **Moderate** (Table 6-13).

Table 6-13: Assessment of Groundwater Impacts during Construction and Operation.

<table>
<tr><th>Impact</th><th colspan="60">Groundwater Abstraction</th></tr>
<tr><td rowspan="2">Impact Nature</td><td colspan="30">[✓ Negative]</td><td colspan="30">Positive</td></tr>
<tr><td colspan="60">The potential impacts (lowering of the water table within village abstraction wells leading to water shortages for other users) are negative.</td></tr>
<tr><td rowspan="2">Impact Type</td><td colspan="30">[✓ Direct]</td><td colspan="30">Indirect</td></tr>
<tr><td colspan="60">The impacts would be a direct result of Project abstraction of water for construction and operational uses.</td></tr>
<tr><td rowspan="2">Impact Duration</td><td colspan="15">Temporary</td><td colspan="15">Short Term</td><td colspan="15">[✓ Long Term]</td><td colspan="15">Permanent</td></tr>
<tr><td colspan="60">The impacts would be long term, occurring during both construction (approximately 10 months) and operation (20 years).</td></tr>
<tr><td rowspan="2">Impact Extent</td><td colspan="15">Limited</td><td colspan="15">[✓ Local]</td><td colspan="15">Regional</td><td colspan="15">Transboundary</td></tr>
<tr><td colspan="60">The impacts would be restricted to the Project Area, impacting the seven neighbouring villages.</td></tr>
<tr><td rowspan="2">Frequency</td><td colspan="12">Remote</td><td colspan="12">[✓ Rare]</td><td colspan="12">Occasional</td><td colspan="12">Often</td><td colspan="12">Constant</td></tr>
<tr><td colspan="60">The impacts would be rare, as the Project intends to truck in water for most of their construction needs and intends to minimize panel cleaning.</td></tr>
<tr><td>Likelihood</td><td colspan="20">Unlikely</td><td colspan="20">[✓ Possible]</td><td colspan="20">Certain</td></tr>
</table>

<table>
<tr><th>Impact</th><th colspan="60">Groundwater Abstraction</th></tr>
<tr><td></td><td colspan="60">The impacts are considered to be possible, as the Project intends to truck in water for most of their construction needs and intends to minimize panel cleaning.</td></tr>
<tr><td rowspan="2">Impact Magnitude</td><td colspan="12">Positive</td><td colspan="12">Negligible</td><td colspan="12">Small</td><td colspan="12">Medium</td><td colspan="12">Large</td></tr>
<tr><td colspan="60">Based on the above, the impact magnitude is considered to be small.</td></tr>
<tr><td rowspan="2">Resource/ Receptor Vulnerability</td><td colspan="20">Low</td><td colspan="20">Medium</td><td colspan="20">High</td></tr>
<tr><td colspan="60">The sensitivity of the resource is considered to be high due to the importance of groundwater to neighbouring communities.</td></tr>
<tr><td rowspan="2">Impact Significance</td><td colspan="15">Negligible</td><td colspan="15">Minor</td><td colspan="15">Moderate</td><td colspan="15">Major</td></tr>
<tr><td colspan="60">Based on the small impact magnitude and the high sensitivity, the impact significance is assessed to be moderate.</td></tr>
</table>

6.4.4.4 Mitigation Measures

The embedded controls will need to be enhanced if the Project borehole has to be located within the radius of influence and a response is observed in any village wells during drilling and pump testing of the Project borehole.

The measures listed below will be implemented to mitigate the Project's groundwater impacts.

- Water storage solutions (e.g., tanks) will be utilised for water abstracted from the Project borehole and/or brought in by bowsers during the wet season for use during the dry season.
- Regular monitoring of affected village supplies will be conducted and Project abstraction will cease if the Project has a significant impact on the community boreholes.

6.4.4.5 Residual Impact Significance

With the implementation of the mitigation measures listed above, the residual impact significance is anticipated to be **Minor** (Table 6-14).

Table 6-14: Pre and Post Mitigation Groundwater Impacts.

Impact	Project Phase	Impact Significance (Pre-mitigation)	Residual Impact Significance (Post-mitigation)
Groundwater Abstraction	Construction and operations	Moderate	Minor

6.4.5 Biodiversity: Loss of Habitats and Fauna Disturbance

6.4.5.1 Summary of Baseline Conditions

The habitats on the Project Site qualify as Modified Habitat based on definitions in IFC PS 6. In general, no plant or tree species of high ecological value are expected to be displaced or lost, and these habitats are therefore considered to have a low sensitivity. The baobabs trees discussed below are the only species to be removed that could be considered sensitive.

PS 6 states that where Modified Habitats occur, mitigation is required to address impacts to significant biodiversity values, and the client should minimize impacts on such biodiversity and implement mitigation measures as appropriate.

6.4.5.2 Potential Impacts: Construction

Construction of the proposed Project would require the removal of vegetation and would impact associated habitats. As discussed in the biodiversity baseline (Section 5.2), site habitats have long been transformed from their original state through many years of cultivation and livestock grazing that has led to extensive alteration of ecological processes. The Project Site still provides habitat to common species of the region, however, adapted to human-dominated landscapes, in particular the slightly less transformed Secondary Mixed Deciduous Woodland (2.9 ha/3.15% of the site) and Seasonal Wetland (3.8 ha/4.14% of the site).

As discussed in Section 5.2.2.4, on July 18, 2019, the Ministry of Lands conducted a detailed land and asset survey of the Project Site. The survey identified five species listed as protected under the Forestry (Amendment) Rules, 2012, as gazetted in Government Notice No. 23 (December 31, 2012). Of the five species, baobab trees (*Adansonia digitata*), of which two specimens were identified, were deemed irreplaceable and sensitive due to their age, cultural value, and keystone role within the ecosystem. The remaining species (Ghost Tree, Natal Mahogany, Peacock Flower, and African Sausage Tree) were not deemed as irreplaceable as they are relatively fast growing (reaching full maturity within 30-50 years) and do not have any specific cultural value apart from the provisioning ecosystem services they provide (see “Tree Use” in Table 5-5). These species are listed as protected due to their unsustainable use in Malawi.

The original Project design required removal of both baobab trees, as they were located in the solar panel layout. Due to their protected status and cultural value, JCM applied the mitigation hierarchy by conducting an alternative analysis to determine if the two baobab trees could be avoided/protected while still fulfilling Project objectives for electricity production. The alternative analysis indicated that one of the two trees could be avoided by moving panels to an alternate location within the Project Site. The alternative analysis determined that the other baobab tree could not be avoided without significantly diminishing the Project’s electricity production, as it is located in the centre of the solar panel layout (Appendix I). As a result, the Project will now only impact a single baobab tree.

6.4.5.3 Assessment of Impacts: Construction

Loss of habitat would be permanent, as lost habitat would not be restored. Replacement trees would be planted in adjacent areas, but this would not be a direct replacement of the lost habitat. The impact would be limited to the Solar Plant Site

(92 ha) and the transmission line wayleave (1.5 ha). The impact would be caused by site clearance, which would occur once during the initiation of construction. As a result, the magnitude of the potential impact is considered to be **Small**. The sensitivity of the impacted resource is considered to be **Low**, as the habitat is classified as modified. The impact significance is therefore assessed to be **Minor** (Table 6-15).

Table 6-15: Assessment of Loss of Habitat and Fauna Disturbance Impacts during Construction.

<table>
<tr><th>Impact</th><th colspan="60">Loss of Habitat and Faunal Disturbance during Construction</th></tr>
<tr><td rowspan="2">Impact Nature</td><td colspan="30">[✓ Negative]</td><td colspan="30">Positive</td></tr>
<tr><td colspan="60">The loss of habitat is considered negative.</td></tr>
<tr><td rowspan="2">Impact Type</td><td colspan="30">[✓ Direct]</td><td colspan="30">Indirect</td></tr>
<tr><td colspan="60">The impact would be a direct result of Project activities (site clearance).</td></tr>
<tr><td rowspan="2">Impact Duration</td><td colspan="15">Temporary</td><td colspan="15">Short Term</td><td colspan="15">Long Term</td><td colspan="15">[✓ Permanent]</td></tr>
<tr><td colspan="60">The impact duration would be permanent, as lost habitat would not be restored. Replacement trees would be planted in adjacent areas, but this would not be a direct replacement of the lost.</td></tr>
<tr><td rowspan="2">Impact Extent</td><td colspan="15">[✓ Limited]</td><td colspan="15">Local</td><td colspan="15">Regional</td><td colspan="15">Transboundary</td></tr>
<tr><td colspan="60">The impact would be limited to the Project Site, an area of approximately 93.5 ha.</td></tr>
<tr><td rowspan="2">Frequency</td><td colspan="12">[✓ Remote]</td><td colspan="12">Rare</td><td colspan="12">Occasional</td><td colspan="12">Often</td><td colspan="12">Constant</td></tr>
<tr><td colspan="60">Site clearance would occur once during the initiation of construction.</td></tr>
<tr><td rowspan="2">Likelihood</td><td colspan="20">Unlikely</td><td colspan="20">Possible</td><td colspan="20">[✓ Certain]</td></tr>
<tr><td colspan="60">The Project would require site clearance.</td></tr>
<tr><td rowspan="2">Impact Magnitude</td><td colspan="12">Positive</td><td colspan="12">Negligible</td><td colspan="12">[✓ Small]</td><td colspan="12">Medium</td><td colspan="12">Large</td></tr>
<tr><td colspan="60">Despite the permanent loss of habitat, the natural vegetation to be cleared is limited and patchy because of cultivation and grazing usage, and the impact magnitude is therefore considered to be of small.</td></tr>
<tr><td rowspan="2">Resource/ Receptor Vulnerability</td><td colspan="20">[✓ Low]</td><td colspan="20">Medium</td><td colspan="20">High</td></tr>
<tr><td colspan="60">The habitat is classified as modified, which qualifies it as low sensitivity.</td></tr>
<tr><td></td><td colspan="15">Negligible</td><td colspan="15">[✓ Minor]</td><td colspan="15">Moderate</td><td colspan="15">Major</td></tr>
</table>

Impact	Loss of Habitat and Faunal Disturbance during Construction
Impact Significance	Based on the small impact magnitude and the low sensitivity, the impact significance is assessed to be minor.

6.4.5.4 Mitigation Measures

The measures listed below will be implemented to mitigate the Project's biodiversity impacts of loss of habitats and fauna disturbance.

- Provisions that prohibit staff and contractors from engaging in all forms of hunting in the Project Area will be included in the Worker Code of Conduct.
- Vegetation will be methodically cleared from the Project Site and excavations will be undertaken per designs to avoid unwarranted clearance of vegetation.
- If feasible, clearance of the 2.9 ha of Secondary Mixed Deciduous Woodland will be removed gradually from one side such that any resident wildlife is provided an opportunity to exit the site.
- Planning will be conducted in advance to determine the minimum feasible extent required. Predetermined areas will be clearly demarcated on the ground, fenced where appropriate, and enforcement measures will be taken to avoid footprint creep into surrounding areas.
- Rehabilitation of all disturbed areas (e.g., temporary access tracks and laydown areas) will be undertaken following construction. This will be done in such a way as to facilitate natural regeneration of vegetation.
- Five or more seedlings of the same species will be planted in adjacent areas for each protected tree that is cut down.

6.4.5.5 Residual Impact Significance

With the implementation of the mitigation measures listed above, the residual impact significance is anticipated to be **Negligible** (Table 6-16).

Table 6-16: Pre and Post Mitigation Loss of Habitat and Fauna Disturbance Impacts.

Impact	Project Phase	Impact Significance (Pre-mitigation)	Residual Impact Significance (Post-mitigation)
Loss of Habitat and Fauna Disturbance	Construction	**Minor**	**Negligible**

6.4.6 Biodiversity: Risk of Increased Invasive Alien Plants

The Convention on Biological Diversity defines an invasive alien species as one that is established outside of its natural past or present distribution, and whose introduction and/or spread threatens biological diversity.[47] The IUCN Red List of Threatened Species[48] rates the presence of invasive alien species globally as the second most significant threat to biodiversity,[49] and there is a growing global awareness of the problems associated with alien and invasive species. Alien species can be introduced either accidentally or intentionally. Although only a small percentage of alien species have the potential to become invasive, their impact is marked and usually is irreversible, displacing native species and leading to degradation of habitats.

6.4.6.1 Summary of Baseline Conditions

Given the predominantly agricultural usage of the Project Site, there has been ample opportunity for the introduction of invasive species. Accidental introduction of invasive species seeds with imported agricultural seeds is common. The baseline survey identified only two invasive species, however, on the list for Malawi on the Global Invasive Species Database (Table 6-17).[50] Invasive species in the Project Area are associated with Modified Habitats, which have low ecological sensitivity.

Table 6-17: Invasive and Alien Plants Identified on the Project Site.

Species Name	English / Local Name	Comment
Commelina baanghelensis	Tropical spiderwort	Common weed, typically occurring in disturbed land and is invasive in some cases.
Bidens pilosa	Black jack	Introduced annual herb, present as a result of soil disturbances, causes losses to agriculture and livestock.

6.4.6.1 Potential Impacts: Construction

Site clearance and soil disturbances create opportunities for invasive alien plants to establish. Extensive soil disturbance would occur during the construction phase, creating abundant potential for the establishment of invasive plants. Large infestations can develop, and if not controlled can serve as source populations for the spread into new areas.

Construction vehicles can accidentally gather invasive plant material and disperse seeds through normal movements. Construction equipment and vehicles, landscaping, or rehabilitation could potentially introduce invasive alien plants.

6.4.6.2 Assessment of Impacts: Construction

The risk of increased invasive alien plants would be long term, as invasive plants would gradually disappear. The impact would be limited to the Solar Plant Site (92 ha) and

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[47] Convention for Biological Diversity, invasive species page. Available at: https://www.cbd.int/invasive/WhatareIAS.shtml

[48] IUCN Red List of Threatened Species. Available at http://www.iucnredlist.org/

[49] IUCN Website, invasive species page. Available at: https://www.iucn.org/theme/species/our-work/invasive-species

[50] http://issg.org/database/species/search.asp?sts=sss&st=sss&fr=1&sn=&rn=Malawi&hci=-1&ei=-1&lang=EN&x=27&y=6

the transmission line wayleave (1.5 ha). A limited number of invasive alien plants are already present due to the modified nature of the affected and surrounding habitats. As a result, the magnitude of the potential impact is considered to be **Small**. The sensitivity of the impacted resource is considered to be **Low**, as the habitat is classified as modified. The impact significance is therefore assessed to be **Minor** (Table 6-18)

Table 6-18: Assessment of Risk of Increased Invasive Alien Plants Impacts during Construction.

<table>
<tr><th>Impact</th><th colspan="60">Risk of Increased Invasive Alien Plants</th></tr>
<tr><td rowspan="2">Impact Nature</td><td colspan="30">[✓ Negative]</td><td colspan="30">Positive</td></tr>
<tr><td colspan="60">An increase in invasive alien plants is considered negative.</td></tr>
<tr><td rowspan="2">Impact Type</td><td colspan="30">[✓ Direct]</td><td colspan="30">Indirect</td></tr>
<tr><td colspan="60">The impact would be a direct result of Project activities (clearance of vegetation, soil disturbances, and vehicle traffic).</td></tr>
<tr><td rowspan="2">Impact Duration</td><td colspan="15">Temporary</td><td colspan="15">Short Term</td><td colspan="15">[✓ Long Term]</td><td colspan="15">Permanent</td></tr>
<tr><td colspan="60">The impact would be long term as invasive plants would gradually disappear.</td></tr>
<tr><td rowspan="2">Impact Extent</td><td colspan="15">[✓ Limited]</td><td colspan="15">Local</td><td colspan="15">Regional</td><td colspan="15">Transboundary</td></tr>
<tr><td colspan="60">The impact would be limited to the Project Site, an area of approximately 93.5 ha.</td></tr>
<tr><td rowspan="2">Frequency</td><td colspan="12">Remote</td><td colspan="12">Rare</td><td colspan="12">Occasional</td><td colspan="12">[✓ Often]</td><td colspan="12">Constant</td></tr>
<tr><td colspan="60">There would be ongoing risk of increased invasive alien plants.</td></tr>
<tr><td rowspan="2">Likelihood</td><td colspan="20">Unlikely</td><td colspan="20">[✓ Possible]</td><td colspan="20">Certain</td></tr>
<tr><td colspan="60">It is possible that Project activities would introduce invasive alien plants.</td></tr>
<tr><td rowspan="2">Impact Magnitude</td><td colspan="12">Positive</td><td colspan="12">Negligible</td><td colspan="12">[✓ Small]</td><td colspan="12">Medium</td><td colspan="12">Large</td></tr>
<tr><td colspan="60">A limited number of invasive alien plants are already present due to the modified nature of the affected and surrounding habitats.</td></tr>
<tr><td rowspan="2">Resource/ Receptor Vulnerability</td><td colspan="20">[✓ Low]</td><td colspan="20">Medium</td><td colspan="20">High</td></tr>
<tr><td colspan="60">The habitat is classified as modified, which qualifies for a low sensitivity, and few of the species are highly invasive.</td></tr>
<tr><td rowspan="2">Impact Significance</td><td colspan="15">Negligible</td><td colspan="15">[✓ Minor]</td><td colspan="15">Moderate</td><td colspan="15">Major</td></tr>
<tr><td colspan="60">Based on the small impact magnitude and the low sensitivity, the impact significance is assessed to be minor.</td></tr>
</table>

6.4.6.3 Mitigation Measures

The measures listed below will be implemented to mitigate the Project's biodiversity impacts of increased invasive alien plants.

- Invasive plant species will be removed from areas controlled by the Project. Manual removal will be favoured over mechanised or chemical control measures.
- Invasive vegetative and/or seed bearing material that is removed through control measures will be contained in a cordoned off area, dried, and burnt on site to prevent the distribution of seeds.
- Vehicles and construction equipment will be washed on a regular basis and kept clean to minimise the distribution of seeds and invasive plant material.
- Source areas such as vehicle parking and construction camps will be kept clean of invasive plants to minimise the presence of seeds that can be dispersed unintentionally.
- Disturbed areas will be rehabilitated at the earliest opportunity to minimise the establishment of invasive plant species.
- Regular and ongoing monitoring of the presence of invasive plant species will be conducted within construction and rehabilitated sites and removal operations implemented according to the results.

6.4.6.4 Residual Impact Significance

With the implementation of the mitigation measures listed above, the residual impact significance is anticipated to be Negligible (Table 6-19).

Table 6-19: Pre and Post Mitigation Risk of Increased Invasive Alien Plants Impacts.

Impact	Project Phase	Impact Significance (Pre-mitigation)	Residual Impact Significance (Post-mitigation)
Risk of Increased Invasive Alien Plants	Construction	**Minor**	**Negligible**

6.4.7 Biodiversity: Disruption of Ecosystem Services

6.4.7.1 Summary of Baseline Conditions

There is a wide diversity of ecosystem services present in the Project Area, many of which are underpinned by biodiversity and all of which are important to community well-being (Table 5-10). Three of these ecosystem services have been prioritised through an assessment of likelihood of impact by the Project, dependence of communities, and lack of available alternatives (i.e., replaceability), namely supporting, regulating, and provisioning.

6.4.7.2 Potential Impacts: Construction

Clearing of vegetation from the Project Site for the construction of the Project is likely to result in loss or reduction of biodiversity ecosystem services that occur at the Project Site. This may eventually result in loss of livelihoods and habitats for fauna, and localized flooding.

6.4.7.3 Assessment of Impacts: Construction

Disruption of ecosystem services would be long term, as biodiversity recovers slowly. The impact would be limited to the Project Site and neighbouring communities (where the people who depend on these ecosystem services live). The impact would be caused by land acquisition and site clearance, which would occur once during the initiation of construction. As a result, the magnitude of the potential impact is considered to be **Small**. The sensitivity of the impacted resource is considered to be **High**, as ecosystem services contribute to livelihoods. The impact significance is therefore assessed to be **Moderate** (Table 6-20).

Table 6-20: Assessment of Disruption of Ecosystem Services Impacts during Construction.

Impact	Disruption of Ecosystem Services during Construction				
Impact Nature	[✓ Negative]	Positive			
	A disruption of ecosystem services is considered negative.				
Impact Type	[✓ Direct]	Indirect			
	The impact would be a direct result of Project activities (i.e., land acquisition and clearance of vegetation).				
Impact Duration	Temporary	Short Term	[✓ Long Term]	Permanent	
	The impact would be long term as biodiversity recovers slowly.				
Impact Extent	Limited	[✓ Local]	Regional	Transboundary	
	The impact would be limited to the Project Site and neighbouring communities.				
Frequency	[✓ Remote]	Rare	Occasional	Often	Constant
	Land acquisition and site clearance would occur once during the initiation of construction.				
Likelihood	Unlikely	Possible	[✓ Certain]		
	The Project would require land acquisition and site clearance.				
Impact Magnitude	Positive	Negligible	[✓ Small]	Medium	Large
	A limited diversity of ecosystem services have been identified.				

<table>
<tr><th>Impact</th><th colspan="12">Disruption of Ecosystem Services during Construction</th></tr>
<tr><td rowspan="2">Resource/ Receptor Vulnerability</td><td colspan="4">Low</td><td colspan="4">Medium</td><td colspan="4">High</td></tr>
<tr><td colspan="12">The sensitivity of ecosystem services is considered to be high as they contribute to livelihoods.</td></tr>
<tr><td rowspan="2">Impact Significance</td><td colspan="3">Negligible</td><td colspan="3">Minor</td><td colspan="3">Moderate</td><td colspan="3">Major</td></tr>
<tr><td colspan="12">Considering the impact magnitude of change is small and the sensitivity is high, the overall significance is considered to be of <i>moderate</i> significance.</td></tr>
</table>

6.4.7.4 Mitigation Measures

The measures listed below will be implemented to mitigate the Project's biodiversity impacts of disruption of ecosystem services.

- Rehabilitation of disturbed areas (e.g., temporary access tracks and laydown areas) will be undertaken following construction. This will be done in such a way as to facilitate natural regeneration of vegetation.
- Piles of woody vegetation cleared for construction activities will be made available to communities to access it for use as wood fuel or other purposes.
- Ongoing engagement will be maintained between the Project and local communities, with communities informed in advance of any vegetation clearing to allow pre-harvesting of resources such has wood fuel, mangoes, and building materials.

Mitigation measures for loss of livelihoods as a result of land acquisition are also applicable to this impact (Section 6.4.9.4).

6.4.7.5 Residual Impact Significance

With the implementation of the mitigation measures listed above, the residual impact significance is anticipated to be Negligible (Table 6-21).

Table 6-21: Pre and Post Mitigation Disruption of Ecosystem Services Impacts.

Impact	Project Phase	Impact Significance (Pre-mitigation)	Residual Impact Significance (Post-mitigation)
Disruption of Ecosystem Services	Construction	**Moderate**	**Minor**

6.4.8 Landscape and Visual

This assessment identifies potential impacts to the existing visual landscape as a result of the Project. Impacts would occur during construction and operations and primarily relate to the presence of construction equipment, materials, and workers during construction and the presence of solar panels and potential for solar reflection during operations.

6.4.8.1 Summary of Baseline Conditions

The Project Area is rural in nature and appearance, and most of the land that would be utilized for the Project Site is already cleared open fields dedicated to agricultural activities. There are settlements adjacent to the planned solar layout to the east and to the west.

6.4.8.2 Potential Impact: Construction and Operation

Temporary construction activities that would have an impact on the visual character of the landscape include the following:

- Clearance of vegetation (in particular clearance of trees and removal of crops);
- Presence of large construction vehicles and equipment on site;
- Fencing of works and restrictions to site access; and
- Construction of the plant.

Impacts during the operation phase include the colour change and a massing effect created by the PV panels covering a large area, limited early morning glare, and some security lights at night. The reflection from PV systems is generally low intensity, similar to the impact from a body of water. Solar glare can have the potential to be hazardous to pilots (typically when panels are located at airports), motorists (when panels are located adjacent to roads), and onlookers. There are no air strips near the Project Site, but the Project Site is located adjacent to a highway (M5).

Once constructed, the solar PV panels are estimated to be no higher than three metres above the ground, and the control room and warehouse building would be no higher than five metres above the ground.

6.4.8.3 Assessment of Impact: Construction

The visual impact of construction would be short term, occurring during construction (approximately 10 months). The impact would be restricted to the Project Area, impacting the seven neighbouring communities and adjacent highway. The impact would be constant during construction. The impact magnitude is therefore considered to be **Small**. The sensitivity of the receptors (neighbouring communities) is considered to be **High** due to their proximity and the significant nature of the visual impacts (heavy machinery and vehicles, construction activities). As a result, the impact significance is assessed to be **Moderate** (Table 6-22).

Table 6-22: Assessment of Landscape and Visual Impacts during Construction.

Impact	Landscape and Visual	
Impact Nature	Negative	Positive
	The change in visual character through on site presence during construction is considered negative.	

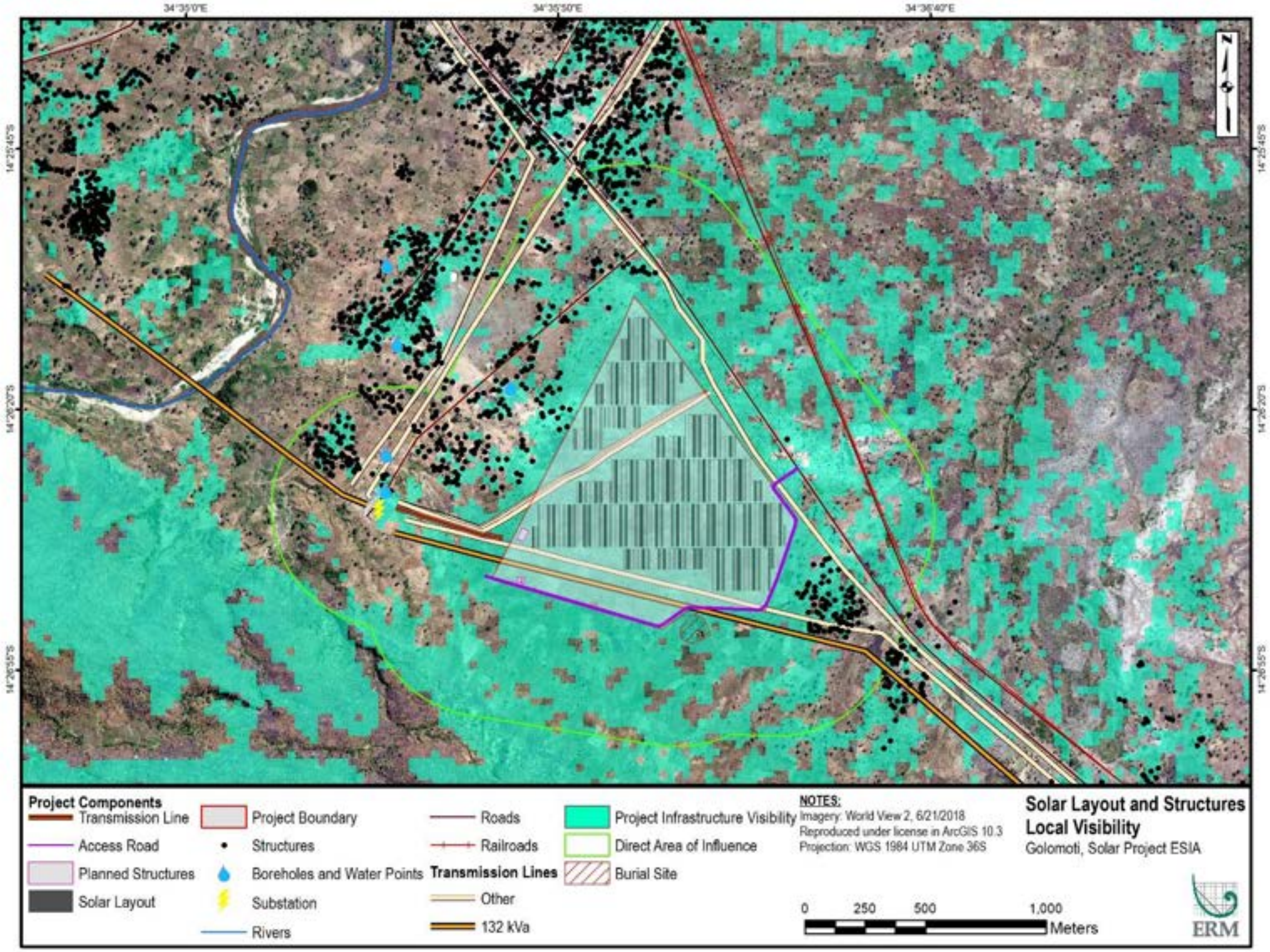
<table>
<tr><th>Impact</th><th colspan="60">Landscape and Visual</th></tr>
<tr><td rowspan="2">Impact Type</td><td colspan="30">[✓ Direct]</td><td colspan="30">Indirect</td></tr>
<tr><td colspan="60">The impact would be a direct result of Project activities (tree removal, presence of machinery and equipment).</td></tr>
<tr><td rowspan="2">Impact Duration</td><td colspan="15">Temporary</td><td colspan="15">[✓ Short Term]</td><td colspan="15">Long Term</td><td colspan="15">Permanent</td></tr>
<tr><td colspan="60">The impact would be short term, occurring during construction (approximately 10 months).</td></tr>
<tr><td rowspan="2">Impact Extent</td><td colspan="15">Limited</td><td colspan="15">[✓ Local]</td><td colspan="15">Regional</td><td colspan="15">Transboundary</td></tr>
<tr><td colspan="60">The impact would be restricted to the Project Area, impacting the seven neighbouring villages and adjacent highway.</td></tr>
<tr><td rowspan="2">Frequency</td><td colspan="12">Remote</td><td colspan="12">Rare</td><td colspan="12">Occasional</td><td colspan="12">Often</td><td colspan="12">[✓ Constant]</td></tr>
<tr><td colspan="60">The impact would be constant during construction activities.</td></tr>
<tr><td rowspan="2">Likelihood</td><td colspan="20">Unlikely</td><td colspan="20">Possible</td><td colspan="20">[✓ Certain]</td></tr>
<tr><td colspan="60">The clearing of vegetation and installation of solar panels and other associated equipment is certain.</td></tr>
<tr><td rowspan="2">Impact Magnitude</td><td colspan="12">Positive</td><td colspan="12">Negligible</td><td colspan="12">[✓ Small]</td><td colspan="12">Medium</td><td colspan="12">Large</td></tr>
<tr><td colspan="60">Based on the above, the impact magnitude is considered to be small.</td></tr>
<tr><td rowspan="2">Resource/ Receptor Vulnerability</td><td colspan="20">Low</td><td colspan="20">Medium</td><td colspan="20">[✓ High]</td></tr>
<tr><td colspan="60">The sensitivity of the receptors (neighbouring communities) is considered to be high due to their proximity (the closest being within 20 m of the site boundary.</td></tr>
<tr><td rowspan="2">Impact Significance</td><td colspan="15">Negligible</td><td colspan="15">Minor</td><td colspan="15">[✓ Moderate]</td><td colspan="15">Major</td></tr>
<tr><td colspan="60">Based on the small impact magnitude and the high sensitivity of receptors, the impact significance is assessed to be moderate.</td></tr>
</table>

6.4.8.4 Assessment of Impacts: Operations

The visual impact of operations would be the same as during construction, except that it would be long term (20 years). The impact magnitude is therefore considered to be **Medium**. Figure 6-3 shows that the solar panels would be visible from multiple Key Observation Points (KOPs) surrounding the Project. It should be noted that the solar panels that have been selected for the Project are designed to absorb as much solar radiation as possible and therefore solar reflection is minimized, which is considered to be an embedded control. The sensitivity of the KOPs and other receptors is considered to be **Medium**. As a result, the impact significance is assessed to be

Moderate. It is important to note that over time, the visual impact would decrease as receptors become accustomed to the Project (Table 6-23).

Figure 6-3: Viewshed of the Project in Relation to Surrounding Receptors.



Source: ERM, 2019.

Table 6-23: Assessment of Landscape and Visual Impacts during Operation.

<table>
<tr><th>Impact</th><th colspan="60">Landscape and Visual</th></tr>
<tr><td rowspan="2">Impact Nature</td><td colspan="30">Negative</td><td colspan="30">Positive</td></tr>
<tr><td colspan="60">The change in visual character through on site presence during operation is considered negative.</td></tr>
<tr><td rowspan="2">Impact Type</td><td colspan="30">Direct</td><td colspan="30">Indirect</td></tr>
<tr><td colspan="60">The impact would be a direct result of Project activities (presence of solar panels).</td></tr>
<tr><td rowspan="2">Impact Duration</td><td colspan="15">Temporary</td><td colspan="15">Short Term</td><td colspan="15">Long Term</td><td colspan="15">Permanent</td></tr>
<tr><td colspan="60">The impact would be long term, occurring during operation (20 years).</td></tr>
<tr><td rowspan="2">Impact Extent</td><td colspan="15">Limited</td><td colspan="15">Local</td><td colspan="15">Regional</td><td colspan="15">Transboundary</td></tr>
<tr><td colspan="60">The impacts would be restricted to the Project Area, impacting the seven neighbouring villages and adjacent highway.</td></tr>
<tr><td rowspan="2">Frequency</td><td colspan="12">Remote</td><td colspan="12">Rare</td><td colspan="12">Occasional</td><td colspan="12">Often</td><td colspan="12">Constant</td></tr>
<tr><td colspan="60">The impact would be constant during the operation phase.</td></tr>
<tr><td rowspan="2">Likelihood</td><td colspan="20">Unlikely</td><td colspan="20">Possible</td><td colspan="20">Certain</td></tr>
<tr><td colspan="60">With the installation of the Project complete, the impact is certain.</td></tr>
<tr><td rowspan="2">Impact Magnitude</td><td colspan="12">Positive</td><td colspan="12">Negligible</td><td colspan="12">Small</td><td colspan="12">Medium</td><td colspan="12">Large</td></tr>
<tr><td colspan="60">Based on the above, the impact magnitude is considered to be medium.</td></tr>
<tr><td rowspan="2">Resource/ Receptor Vulnerability</td><td colspan="20">Low</td><td colspan="20">Medium</td><td colspan="20">High</td></tr>
<tr><td colspan="60">The sensitivity of receptors (neighbouring communities, KOPs) is considered medium as the landscape is largely modified as result of agricultural activities.</td></tr>
<tr><td rowspan="2">**Impact Significance**</td><td colspan="15">**Negligible**</td><td colspan="15">**Minor**</td><td colspan="15">**Moderate**</td><td colspan="15">**Major**</td></tr>
<tr><td colspan="60">Based on the medium impact magnitude and the medium sensitivity of receptors, the impact significance is assessed to be moderate.</td></tr>
</table>

6.4.8.5 Mitigation Measures

Construction

The measures listed below will be implemented to mitigate the Project's landscape and visual impacts during construction.

- Ongoing rehabilitation of cleared areas will be conducted to minimize visual scarring. Maintenance clearing will be kept to a minimum and will not extend beyond the Project Site boundary.
- Excavated and cut and fill areas will be shaped and allowed to revegetate;
- No debris or waste materials will be left at work sites.
- Appropriate directional and intensity settings will be utilised for lighting.

Operations

The measures listed below will be implemented to mitigate the Project's landscape and visual impacts during operation.

- Rehabilitation of all disturbed areas (e.g., temporary access tracks and laydown areas) will be undertaken following construction. This should be done in such a way as to facilitate natural regeneration of vegetation.
- Ongoing engagement will be maintained between the Project and local communities with regards to potential solar reflection impacts.

6.4.8.6 Residual Impact Significance

With the implementation of the mitigation measures listed above, the residual impact significance is anticipated to be Minor during both construction and operation (Table 6-24).

Table 6-24: Pre and Post Mitigation Landscape and Visual Impacts.

Impact	Project Phase	Impact Significance (Pre-mitigation)	Residual Impact Significance (Post-mitigation)
Landscape and Visual Changes	Construction	Moderate	Minor
Landscape and Visual Changes	Operation	Moderate	Minor

6.4.9 Land Acquisition and Displacement

This assessment identifies potential impacts from land acquisition for the Project. The land acquisition impact would occur during construction and would result in a loss of livelihoods (economic displacement) for affected people.

6.4.9.1 Summary of Baseline Conditions

The villages in the Project Area rely on subsistence farming for their household food consumption, with some households generating income from the sale of their crops. In addition, livestock rearing, particularly of poultry and goats, is common. Following crop harvests, livestock (goats and cattle) freely roam the Project Area to graze crop remnants.

Approximately 154 residents from six villages in Group Village Pitala are expected to be directly affected by the land acquisition for the Project (Table 6-25). Exact data on the size of each parcel to be acquired and assets contained thereon would be confirmed via the asset inventories currently in progress with the Ministry of Lands, but most agricultural plots on the Project Site are reported to be less than a hectare in size and are likely to be acquired in whole by the Project. It is important to note, however, that it is common for residents in the Project Area to have access/customary rights to more than one plot, many of which may fall outside the Project Site and can continue to be used uninterrupted for livelihood purposes.

Table 6-25: Approximate Number of PAPs per Village

Village	Approximate Number of PAPs
Nsamala	63
Ching'anipa	19
Chisaka	27
Kapesi	15
Kalumo	21
Chitseko	9
Total	**154**

Source: ERM, from household survey data.

In combination with small land plots, a lack of irrigation, and limited productivity due to soil conditions and adverse climate conditions some years, communities often suffer food shortages during the dry seasons, especially in January and February. In addition, malnutrition is a major cause of death among adults and children in Dedza District.

6.4.9.2 Potential Impacts: Construction

Land acquisition would trigger economic displacement of land users, affecting subsistence and income generating farming. Availability of spare agricultural land for sale or rent is reportedly scarce in the area. Of household survey respondents, 40% believed it would be possible to find more suitable land in the area, while 60% did not.

6.4.9.3 Assessment of Impacts: Construction

The impact of economic displacement caused by land acquisition would be long term, occurring during construction (approximately 10 months) and through operation (20 years). The impact would be local, experienced by the approximately 154 land users within six villages in Group Village Pitala. The impact would occur once during the land acquisition process prior to construction. Due to existing food shortages in the communities, the impact of land acquisition and economic displacement is likely to exacerbate food insecurity and malnutrition, and heighten poverty levels. As such, economic displacement could lead to further impoverishment if not well managed. As a result, the impact magnitude is considered to be **Large**. Land users are highly vulnerable due to their economic status and lack other income/livelihood streams that would allow them to adapt to diversify away from agriculture. In addition, given that available unoccupied agricultural land is scarce in the area, their land would not be easily replaced. As a result, the sensitivity of receptors (land users) is considered to be **High**. As a result, the impact significance is assessed to be **Major** (Table 6-26).

Table 6-26: Assessment of Economic Displacement Impacts during Construction.

<table>
<tr><th>Impact</th><th colspan="60">Economic Displacement</th></tr>
<tr><td rowspan="2">Impact Nature</td><td colspan="30">[✓ Negative]</td><td colspan="30">Positive</td></tr>
<tr><td colspan="60">The impact is considered negative as it has the potential to create food insecurity, increased malnutrition, and impoverishment.</td></tr>
<tr><td rowspan="2">Impact Type</td><td colspan="30">[✓ Direct]</td><td colspan="30">Indirect</td></tr>
<tr><td colspan="60">The impact would be a direct result of Project activities (land acquisition).</td></tr>
<tr><td rowspan="2">Impact Duration</td><td colspan="15">Temporary</td><td colspan="15">Short Term</td><td colspan="15">[✓ Long Term]</td><td colspan="15">Permanent</td></tr>
<tr><td colspan="60">The impact would be long term, occurring during construction (approximately 10 months) and throughout operation (20 years).</td></tr>
<tr><td rowspan="2">Impact Extent</td><td colspan="15">Limited</td><td colspan="15">[✓ Local]</td><td colspan="15">Regional</td><td colspan="15">Transboundary</td></tr>
<tr><td colspan="60">The impact would be local, experienced by land users within six villages in Group Village Pitala</td></tr>
<tr><td rowspan="2">Frequency</td><td colspan="12">[✓ Remote]</td><td colspan="12">Rare</td><td colspan="12">Occasional</td><td colspan="12">Often</td><td colspan="12">Constant</td></tr>
<tr><td colspan="60">The impact would occur once during the land acquisition process prior to construction.</td></tr>
<tr><td rowspan="2">Likelihood</td><td colspan="20">Unlikely</td><td colspan="20">Possible</td><td colspan="20">[✓ Certain]</td></tr>
<tr><td colspan="60">Land acquisition would be certain.</td></tr>
<tr><td rowspan="2">Impact Magnitude</td><td colspan="12">Positive</td><td colspan="12">Negligible</td><td colspan="12">Small</td><td colspan="12">Medium</td><td colspan="12">[✓ Large]</td></tr>
<tr><td colspan="60">Based on the above, the magnitude is considered to be large as the impact is expected to have a major impact on affected land users.</td></tr>
</table>

<table>
<tr><th>Impact</th><th colspan="12">Economic Displacement</th></tr>
<tr><td rowspan="2">Resource/ Receptor Vulnerability</td><td colspan="4">Low</td><td colspan="4">Medium</td><td colspan="4">High</td></tr>
<tr><td colspan="12">Land users are highly vulnerable due to their economic status and lack other income/livelihood streams that would allow them to adapt to diversify away from agriculture. In addition, given that available unoccupied agricultural land is scarce in the area, their land would not be easily replaced.</td></tr>
<tr><td rowspan="2">Impact Significance</td><td colspan="3">Negligible</td><td colspan="3">Minor</td><td colspan="3">Moderate</td><td colspan="3">Major</td></tr>
<tr><td colspan="12">Based on the large impact magnitude and the high sensitivity of receptors (land users), the impact significance is assessed to be major.</td></tr>
</table>

6.4.9.4 Mitigation Measures

The measures listed below will be implemented to mitigate the Project's land acquisition and displacement impacts.

- A Livelihood Restoration Plan (LRP) will be developed, based on the one developed for the Salima project, that includes the following:
  - Identification of affected land users;
  - Census and asset inventory to assess compensation measures for those affected;
  - Assessment of eligibility and entitlements for those affected;
  - Identification of gender differentiated and sustainable livelihood improvement and/or restoration measures (e.g., financial literacy training, training on improved farming practices);
  - Provisional implementation budgets;
  - Roles and responsibilities, including details of an institutional structure/Livelihood Restoration Steering Committee;
  - Monitoring and evaluation requirements; and
  - Provisional implementation schedule.
- An inclusive and participatory consultation process will be followed that ensures the participation of women, men, youth, elderly, disabled, and other groups in the decision making process regarding replacement land and livelihood restoration programmes.

6.4.9.5 Residual Impact Significance

With the implementation of the mitigation measures listed above, the residual impact significance is anticipated to be Moderate (Table 6-27).

Table 6-27: Pre and Post Mitigation Economic Displacement Impacts.

Impact	Project Phase	Impact Significance (Pre-mitigation)	Residual Impact Significance (Post-mitigation)
Economic Displacement	Construction	Major	Moderate

6.4.10 Walking Paths

This assessment identifies potential impacts to walking paths resulting from the land acquisition for the Project. Impacts would occur during construction and operation and result in a loss of access to the walking paths that currently traverse the Project Site.

6.4.10.1 Summary of Baseline Conditions

Villages in the Project Area have close ties to each other created over generations in which families have farmed the same fields and through marriages that have created bonds across villages. The villages frequently intermingle and gather for cultural and community events, such as weddings and funerals. There are a number of walking paths that transect the Solar Plant Site that would be impacted during construction and operation. Access to these walking paths would be restricted. The village of Thondoya to the east of the Project Site is home to many residents who are originally from villages in Group Village Pitala. The main walking path that connects Thondoya to the villages in Group Village Pitala, which traverses the Project Site, is a quicker and safer route to walk to visit family on the other side than is the main M5 road. Walking along M5 is approximately 1 km longer, depending on destination, and not as pedestrian friendly due to vehicular traffic.

6.4.10.2 Potential Impacts: Construction and Operation

During construction, safety fencing, security, and equipment would block access to several walking paths that transect the current agricultural fields. Once such fields are no longer utilized for agriculture, it is likely that they would no longer be needed by local villagers, with the exception of the pathway that is used to travel from Thondoya to the villages in Group Village Pitala. These impacts are expected to persist during operations.

6.4.10.3 Assessment of Impacts: Construction and Operation

Restricted access to walking paths would be long term, occurring during construction (approximately 10 months) and throughout operations (20 years). The impact would be restricted to the Project Area, impacting the seven neighbouring villages. The impact would be constant throughout construction and operation. The impact magnitude is considered to be **Small**, as the impact to the paths used to reach agricultural fields would no longer be needed, and the path from Thondoya to the villages in Group Village Pitala is the only one likely to be felt by community members. While not as desirable, walking along M5 is an alternative method to travel between these areas. The sensitivity of receptors (neighbouring community members) is considered to be **Medium** due to their reliance on community support networks. As a result, the impact significance is assessed to be **Minor** (Table 6-28).

Table 6-28: Assessment of Restricted Access to Walking Paths Impacts during Construction and Operation.

Impact	Restricted Access to Walking Paths	
Impact Nature	Negative	Positive
	Restricted access to walking paths is considered to be negative.	

<table>
<tr><th>Impact</th><th colspan="60">Restricted Access to Walking Paths</th></tr>
<tr><td rowspan="2">Impact Type</td><td colspan="30">[✓ Direct]</td><td colspan="30">Indirect</td></tr>
<tr><td colspan="60">The impact would be a direct result of Project activities (land acquisition and subsequent restriction of access).</td></tr>
<tr><td rowspan="2">Impact Duration</td><td colspan="15">Temporary</td><td colspan="15">Short Term</td><td colspan="15">[✓ Long Term]</td><td colspan="15">Permanent</td></tr>
<tr><td colspan="60">The impact would be long term, occurring during construction (approximately 10 months) and throughout operations (20 years).</td></tr>
<tr><td rowspan="2">Impact Extent</td><td colspan="15">Limited</td><td colspan="15">[✓ Local]</td><td colspan="15">Regional</td><td colspan="15">Transboundary</td></tr>
<tr><td colspan="60">The impact would be restricted to the Project Area, impacting the seven neighbouring villages.</td></tr>
<tr><td rowspan="2">Frequency</td><td colspan="12">Remote</td><td colspan="12">Rare</td><td colspan="12">Occasional</td><td colspan="12">Often</td><td colspan="12">[✓ Constant]</td></tr>
<tr><td colspan="60">The impact would be constant throughout construction and operation.</td></tr>
<tr><td rowspan="2">Likelihood</td><td colspan="20">Unlikely</td><td colspan="20">Possible</td><td colspan="20">[✓ Certain]</td></tr>
<tr><td colspan="60">The Project would require acquisition of and restriction of access to the Project Site.</td></tr>
<tr><td rowspan="2">Impact Magnitude</td><td colspan="12">Positive</td><td colspan="12">Negligible</td><td colspan="12">[✓ Small]</td><td colspan="12">Medium</td><td colspan="12">Large</td></tr>
<tr><td colspan="60">Based on the above, the magnitude is considered to be small, as the impact to the paths used to reach agricultural fields would no longer be needed, and the path from Thondoya to the villages in Group Village Pitala is the only one likely to be felt by community members.</td></tr>
<tr><td rowspan="2">Resource/ Receptor Vulnerability</td><td colspan="20">Low</td><td colspan="20">[✓ Medium]</td><td colspan="20">High</td></tr>
<tr><td colspan="60">The sensitivity of receptors (neighbouring community members) are considered to be medium due to their reliance on community support networks.</td></tr>
<tr><td rowspan="2">Impact Significance</td><td colspan="15">Negligible</td><td colspan="15">[✓ Minor]</td><td colspan="15">Moderate</td><td colspan="15">Major</td></tr>
<tr><td colspan="60">Based on the small impact magnitude and the medium sensitivity of receptors, the impact significance is assessed to be minor.</td></tr>
</table>

6.4.10.4 Mitigation Measures

The measures listed below will be implemented during both construction and operation to mitigate the Project’s impacts to walking paths.

- Consultation with take place with communities to assess the possibility/need for an alternative walking path that could connect settlements to minimize impacts related to access restrictions without compromising the design of the facility.

6.4.10.5 Residual Impact Significance

With the implementation of the mitigation measures listed above, the residual impact significance is anticipated to be **Negligible** during both construction and operation (Table 6-29).

Table 6-29: Pre and Post Mitigation Restricted Access to Walking Paths Impacts.

Impact	Project Phase	Impact Significance (Pre-mitigation)	Residual Impact Significance (Post-mitigation)
Restricted Access to Walking Paths	Construction and Operation	Minor	Negligible

6.4.11 Vector Borne and Communicable Diseases

This assessment identifies potential impacts on communities in the Project Area of vector borne and/or communicable diseases. Due to a concentration of Project workers and construction activities, impacts would primarily occur during the construction phase and would result in increased health risks for communities in the Project Area.

6.4.11.1 Summary of Baseline Conditions

Malaria is the most prevalent illness experienced by men, women, and children in the Project Area. It is particularly prevalent during the rainy season, as pools of rainwater accumulate in low lying areas. Though hygiene improvements have been achieved in recent years in the communities, open defecation has not been completely eliminated and handwashing is generally limited to water only, in addition to somewhat precarious conditions of latrines, especially during the rainy season. Gastric illnesses such as diarrhoea, colds, and other illnesses can spread if proper sanitation and hygiene is not effectively managed. In addition, common cooking methods utilizing firewood and charcoal have negative health impacts on local families, especially women, often leading to respiratory infections.

6.4.11.2 Potential Impacts: Construction

Communicable diseases are caused by viral, bacterial, parasitic, and fungal pathogens that are airborne or that are transmitted through an infected person, animal, or environmental source. Communicable diseases include illnesses such as malaria, tuberculosis, measles, and bacterial infections such as colds and gastric infections (e.g., diarrhoea).

It is anticipated that during the construction period the workforce would comprise approximately 200 workers and that approximately 30-35% would be skilled workers coming from outside the local area that would be housed in a controlled camp on the worksite. The biggest risk associated with this impact is workers from outside the local area being more susceptible to communicable diseases or bringing communicable diseases into the area that are currently not prevalent. In addition, in combination with community-worker interaction, inadequate hygiene and waste management controls at the construction site could also enable the increased transmission of communicable diseases.

In the event of an outbreak of an airborne (e.g., tuberculosis) or food-borne illness among workers, the home communities of the local workers and any of those visited by the Project workforce may become susceptible to these infectious diseases.

Moreover, due to the existing high prevalence of malaria, increased transmission due to Project activities is considered to be unlikely but could result if new breeding grounds for mosquitoes are created. This includes creation of wheel ruts from traffic or pools of water in and around land clearance or laydown areas.

Construction activities also have the potential to exacerbate existing high rates of respiratory infections due to dust emissions, which are common among women due to traditional cooking practices. This situation may be exacerbated during construction due to higher levels of dust emissions and also vehicle emissions. In addition, ground preparations and land clearance may create dust particles. Although dust suppression measures would be implemented, additional dust may be associated with any real (or perceived) increase in respiratory diseases.

6.4.11.3 Assessment of Impacts: Construction

A potential increase in vector borne and communicable diseases would be short term, occurring during construction (approximately 10 months). The impact would be restricted to the Project Area, impacting a small portion of neighbouring villages, where the majority of construction activities would occur. The impact would be possible throughout construction, but the greatest likelihood would occur occasionally during more intensive/shorter periods of peak construction. The impact magnitude is considered to be **Small**, as the workforce is not massive in number and would be composed mostly of locals. The sensitivity of receptors (workers and local community members) is considered to be **High,** as communities are vulnerable to an increase in vector borne and communicable diseases as present levels are already high and health indicators are generally low in the district. As a result, the impact significance is assessed to be **Moderate** (Table 6-30).

Table 6-30: Assessment of Vector Borne and Communicable Diseases Impacts during Construction.

Impact	Increase in Vector Borne and Communicable Diseases	
Impact Nature	Negative	Positive
	An increase in vector borne and communicable diseases would be negative.	
Impact Type	Direct	Indirect
	The impact would be a direct result of Project activities (the presence of construction equipment and activities in combination with the workforce, in particular community-worker interaction).	

<table>
<tr><th>Impact</th><th colspan="60">Increase in Vector Borne and Communicable Diseases</th></tr>
<tr><td rowspan="2">Impact Duration</td><td colspan="15">Temporary</td><td colspan="15">Short Term</td><td colspan="15">Long Term</td><td colspan="15">Permanent</td></tr>
<tr><td colspan="60">The impact would be restricted to construction (approximately 10 months).</td></tr>
<tr><td rowspan="2">Impact Extent</td><td colspan="15">Limited</td><td colspan="15">Local</td><td colspan="15">Regional</td><td colspan="15">Transboundary</td></tr>
<tr><td colspan="60">The impact would likely only affect a small portion of neighbouring villages, where the majority of construction activities would occur.</td></tr>
<tr><td rowspan="2">Frequency</td><td colspan="12">Remote</td><td colspan="12">Rare</td><td colspan="12">Occasional</td><td colspan="12">Often</td><td colspan="12">Constant</td></tr>
<tr><td colspan="60">The impact would be present throughout construction, but is only predicted to occur occasionally during more intensive/shorter periods of peak construction.</td></tr>
<tr><td rowspan="2">Likelihood</td><td colspan="20">Unlikely</td><td colspan="20">Possible</td><td colspan="20">Certain</td></tr>
<tr><td colspan="60">The impact is considered to be possible.</td></tr>
<tr><td rowspan="2">Impact Magnitude</td><td colspan="12">Positive</td><td colspan="12">Negligible</td><td colspan="12">Small</td><td colspan="12">Medium</td><td colspan="12">Large</td></tr>
<tr><td colspan="60">Based on the above, the impact magnitude is considered to be small, as the workforce is not massive in number and would be composed mostly of locals.</td></tr>
<tr><td rowspan="2">Resource/ Receptor Vulnerability</td><td colspan="20">Low</td><td colspan="20">Medium</td><td colspan="20">High</td></tr>
<tr><td colspan="60">The sensitivity of receptors (workers and local community members) is considered to be high as communities are vulnerable to an increase in vector borne and communicable diseases as present levels are already high and health indicators are generally low in the district.</td></tr>
<tr><td rowspan="2">Impact Significance</td><td colspan="15">Negligible</td><td colspan="15">Minor</td><td colspan="15">Moderate</td><td colspan="15">Major</td></tr>
<tr><td colspan="60">Based on the small impact magnitude and the high sensitivity of receptors, the impact significance is assessed to be moderate.</td></tr>
</table>

6.4.11.4 Mitigation Measures

The measures listed below will be implemented to mitigate the Project’s vector borne and communicable disease impacts.

- Workforce training will be provided on communicable diseases, disease prevention, and treatment to raise awareness.
- Workers will be provided with appropriate gender considerate sanitary facilities that are properly designed to prevent contamination.
- A waste handling system will be developed that is sufficient to avoid the creation of new vector breeding grounds.

- Environmental controls will be established that reduce the presence of standing water on site during the site preparation to avoid the creation of new breeding grounds.
- Project areas, especially the camp, toilet, and eating facilities, will be kept clean and free from accumulation of wastes as well as supplied with clean potable water. This includes ensuring appropriate food preparation and monitoring measures are in place.
- There will be a first aid area on site to avoid adding pressure on local health facilities. Arrangements will be made with nearby hospitals and clinics, however, so sick Project workers who cannot be fully treated at the Project first aid area can be referred for treatment.
- Pre-employment screening measures will be developed to ensure that workers are fit for work, as well as to identify any pre-existing conditions. Individuals found to be suffering from communicable diseases will need to seek treatment prior to mobilisation to the Project Site. No one will be denied employment, however, on the basis of their health status as long as they are able to undertake the required duties (following treatment if relevant).
- A worker Code of Conduct will be established that includes guidelines on worker-worker interactions, worker-community interactions, and development of personal relationships with members of local communities.

6.4.11.5 Residual Impact Significance

With the implementation of the mitigation measures listed above, the residual impact significance is anticipated to be **Negligible** (Table 6-31).

Table 6-31: Pre and Post Mitigation Vector Borne and Communicable Diseases Impacts.

Impact	Project Phase	Impact Significance (Pre-mitigation)	Residual Impact Significance (Post-mitigation)
Increase in Vector Borne and Communicable Diseases	Construction	Moderate	Negligible

6.4.12 STI/HIV Transmission

This assessment identifies potential impacts on communities in the Project Area of sexually transmitted infection (STI) and human immunodeficiency virus (HIV) transmission. Impacts would primarily occur in the construction phase and result in increased health risks for communities in the Project Area.

6.4.12.1 Summary of Baseline Conditions

Nationally, HIV/acquired immune deficiency syndrome (AIDS) is a leading cause of death among adults, and in Dedza District HIV/AIDs-related infections are a leading causes of death in the under 5 aged population. Though contraceptives were reported to be available through a local health centre, during stakeholder engagement activities, many community members discussed early/unwanted pregnancies as an issue in the local area, highlighting inadequate use of contraceptives. Stakeholders, especially women and youth, expressed concern that rates of STIs, including HIV, could increase as a result of the Project attracting sex workers and/or worker-community sexual activity. In the women's FGD, participants mentioned that girls and women are at times enticed by men with money and other valuable things like cell phones in exchange for sex, which is another factor that contributes to increased risk of the spread of STIs, with a disproportionate impact on females.

6.4.12.2 Potential Impact: Construction

Increased income due to job opportunities for locals and the influx of non-local workers has the potential to create an increase in STI/HIV prevalence due to worker-community interactions, with young women seeking to exchange sexual favours for payment or valuables, and through other relationships with the workforce (expatriates or Malawians).

6.4.12.3 Assessment of Impacts: Construction

A potential increase in STI/HIV transmission would be short term, occurring during construction (approximately 10 months). The impact would be restricted to the Project Area, impacting neighbouring villages. The impact would be possible throughout construction, but the greatest likelihood would occur occasionally during more intensive/shorter periods of peak construction. The impact magnitude is considered to be **Small**, as the Project is not expected to create a significant increase in the population and the non-locals would be small in comparison to the local workforce. The sensitivity of receptors (workers and local community members) is considered to be **High.** At a national and district level, there is evidenced vulnerability of the population at large to the spread of STIs and especially illness and death cause by HIV and AIDS. Women in particular are disproportionately vulnerable due to the potential to be drawn to exchange sexual favours for monetary or other economic incentives. As a result, the impact significance is assessed to be **Moderate** (Table 6-32).

Table 6-32: Assessment of Increase in STI/HIV Transmission Impacts during Construction.

Impact	Increase in STI/HIV Transmission	
Impact Nature	Negative	Positive
	An increase in STI/HIV transmission would be negative.	
Impact Type	Direct	Indirect
	The impact would be indirect, as it can result as a follow on effect of an increase of people in the Project Area in combination with young women perceiving this increase as an economic opportunity.	

<table>
<tr><th>Impact</th><th colspan="60">Increase in STI/HIV Transmission</th></tr>
<tr><td rowspan="2">Impact Duration</td><td colspan="15">Temporary</td><td colspan="15">[✓ Short Term]</td><td colspan="15">Long Term</td><td colspan="15">Permanent</td></tr>
<tr><td colspan="60">The impact would be restricted to construction (approximately 10 months).</td></tr>
<tr><td rowspan="2">Impact Extent</td><td colspan="15">Limited</td><td colspan="15">[✓ Local]</td><td colspan="15">Regional</td><td colspan="15">Transboundary</td></tr>
<tr><td colspan="60">The impact would likely only affect neighbouring communities.</td></tr>
<tr><td rowspan="2">Frequency</td><td colspan="12">Remote</td><td colspan="12">Rare</td><td colspan="12">[✓ Occasional]</td><td colspan="12">Often</td><td colspan="12">Constant</td></tr>
<tr><td colspan="60">The impact would be present throughout construction, but is only predicted to occur occasionally or rarely during more intensive/shorter periods of peak construction.</td></tr>
<tr><td rowspan="2">Likelihood</td><td colspan="20">Unlikely</td><td colspan="20">[✓ Possible]</td><td colspan="20">Certain</td></tr>
<tr><td colspan="60">The impact in considered to be possible.</td></tr>
<tr><td rowspan="2">Impact Magnitude</td><td colspan="12">Positive</td><td colspan="12">Negligible</td><td colspan="12">[✓ Small]</td><td colspan="12">Medium</td><td colspan="12">Large</td></tr>
<tr><td colspan="60">Based on the above, the impact magnitude is considered to be small, as the Project is not expected to create a significant increase in the population and the non-locals would be small in comparison to the local workforce.</td></tr>
<tr><td rowspan="2">Resource/ Receptor Vulnerability</td><td colspan="20">Low</td><td colspan="20">Medium</td><td colspan="20">[✓ High]</td></tr>
<tr><td colspan="60">The sensitivity of receptors (workers and local community members) is considered to be high, as there is evidenced vulnerability of the population at large to the spread of STIs and especially illness and death cause by HIV and AIDS. Women in particular are disproportionately vulnerable due to the potential to be drawn to exchange sexual favours for monetary or other economic incentives.</td></tr>
<tr><td rowspan="2">Impact Significance</td><td colspan="15">Negligible</td><td colspan="15">Minor</td><td colspan="15">[✓ Moderate]</td><td colspan="15">Major</td></tr>
<tr><td colspan="60">Based on the small impact magnitude and the high sensitivity of receptors, the impact significance is assessed to be moderate.</td></tr>
</table>

6.4.12.4 Mitigation Measures

The measures listed below will be implemented to mitigate the Project’s STI/HIV transmission impacts.

- An STI/HIV Management Plan will be developed and implemented. The plan will include the following measures:
  - STI and HIV prevention training to all employees, through workshops, posters, and informal information sessions;

  - Medical examinations to determine level of health; workers should also be encouraged to determine their HIV status;
  - Supply of condoms at the construction site;
  - Development of a Code of Conduct and/or rules for worker-community interaction and onsite behaviour; and
  - Support to workers and affected communities to access treatment for STIs, particularly HIV/AIDS, through existing health facilities or NGO campaigns or programmes.
- A women's NGO that is addressing gender and GBV issues in Golomoti and in Project affected communities will be supported to raise awareness of such issues and to encourage prevention.
- Work camp control protocols, while respecting freedom of movement, will be put in place to limit the interactions between non-local workers and the local community
- GBV and sexual abuse will be monitored through general stakeholder engagement and grievance management.

6.4.12.5 Residual Impact Significance

With the implementation of the mitigation measures listed above, the residual impact significance is anticipated to be **Negligible** (Table 6-33).

Table 6-33: Pre and Post Mitigation STI/HIV Transmission Impacts.

Impact	Project Phase	Impact Significance (Pre-mitigation)	Residual Impact Significance (Post-mitigation)
Increase in STI/HIV Transmission	Construction	Moderate	Negligible

6.4.13 Community Safety and Security

This assessment identifies potential impacts of the Project on community safety and security. Impacts would primarily occur in the construction phase and result in increased safety risks for communities in the Project Area.

6.4.13.1 Summary of Baseline Conditions

Villages in the Project Area are generally considered to be very safe, and there is no known past conflicts or significant safety or security issues. Security incidents in the Project Area are infrequent and limited to minor theft, including theft of livestock. Though not totally accustomed to major construction activity, the local communities do live near the trading centre and just off a main road, as well as in close proximity to the Golomoti Substation, so they are accustomed to vehicular traffic and possible related safety risks.

6.4.13.2 Potential Impacts: Construction and Operation

Project safety hazards may arise from the presence of construction equipment and activities, infrastructure, and traffic. The presence of such equipment and infrastructure may trigger risk/temptation of theft due to high levels of poverty in communities in the Project Area. Incidents may also arise as a result of worker-community interactions with security guards or other staff, influx, and perceptions that other people are benefitting from the Project more than others, especially PAPs receiving significant sums of money for their lands, causing tension among communities.

During operation, security risks are potentially associated with the presence of the Project including the Transmission Line, which could pose a threat to trespassers if they attempt to encroach on the solar farm to steal panels or attempt to connect to the Transmission Line.

6.4.13.3 Assessment of Impact: Construction

A potential decrease in community safety and security would be short term, occurring during construction (approximately 10 months). The impact would be restricted to the Project Area, impacting neighbouring villages. The impact would be present throughout construction, but incidents are likely to occur occasionally. Given the general safe current environment in the communities and nature of construction needs for a solar plant, the impact is unlikely. The impact magnitude is therefore considered to be **Small**. The sensitivity of receptors (local community members) is considered to be **Medium** for safety and security impacts**.** As a result, the impact significance is assessed to be **Minor** (Table 6-34).

Table 6-34: Assessment of Community Safety and Security Impacts during Construction.

Impact	Decreased Community Safety and Security				
Impact Nature	[✓ Negative]	Positive			
	Decreased community safety and security would be negative.				
Impact Type	[✓ Direct]	Indirect			
	The impact would be a direct result of Project activities (presence of equipment and infrastructure, traffic).				
Impact Duration	Temporary	[✓ Short Term]	Long Term	Permanent	
	The impact would be short term, occurring during construction (approximately 10 months).				
Impact Extent	Limited	[✓ Local]	Regional	Transboundary	
	The impact would likely only affect neighbouring communities.				
Frequency	Remote	Rare	[✓ Occasional]	Often	Constant

Impact	Decreased Community Safety and Security				
	The impact would be present throughout construction, but incidents are likely to occur occasionally.				
Likelihood	Unlikely	Possible	Certain		
	Given the general safe current environment in the communities and nature of construction needs for a solar plant, the impact may occur but is unlikely.				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
	Based on the above, the impact magnitude is considered to be small.				
Resource/ Receptor Vulnerability	Low	Medium	High		
	The sensitivity of receptors (local community members) is considered to be medium for safety and security impacts.				
Impact Significance	**Negligible**	**Minor**	**Moderate**	**Major**	
	Based on the small impact magnitude and the medium sensitivity of receptors, the impact significance is assessed to be minor.				

6.4.13.4 Assessment of Impacts: Operation

The impact would be the same as during construction, except that it would be indirect and long term (occurring throughout operations). The impact magnitude is therefore considered to be **Small**. The sensitivity of receptors (local community members) is considered to be **Medium** for safety and security impacts**.** As a result, the impact significance is assessed to be **Minor** (Table 6-35).

Table 6-35: Assessment of Community Safety and Security Impacts during Operation.

Impact	Decreased Community Safety and Security			
Impact Nature	Negative	Positive		
	Decreased community safety and security would be negative.			
Impact Type	Direct	Indirect		
	Security and safety risk are associated with the presence of the solar farm and the transmission lines, which may create temptations to trespass onto the site or attempt to connect to the transmission line. This impact would be indirect.			
	Temporary	Short Term	Long Term	Permanent

<table>
<tr><th>Impact</th><th colspan="60">Decreased Community Safety and Security</th></tr>
<tr><td>Impact Duration</td><td colspan="60">The impact would be long term, occurring throughout operation (20 years).</td></tr>
<tr><td rowspan="2">Impact Extent</td><td colspan="15">Limited</td><td colspan="15">Local</td><td colspan="15">Regional</td><td colspan="15">Transboundary</td></tr>
<tr><td colspan="60">The impact would likely only affect neighbouring communities.</td></tr>
<tr><td rowspan="2">Frequency</td><td colspan="12">Remote</td><td colspan="12">Rare</td><td colspan="12">Occasional</td><td colspan="12">Often</td><td colspan="12">Constant</td></tr>
<tr><td colspan="60">The impact would be present throughout operation, but incidents are likely to occur occasionally or rarely.</td></tr>
<tr><td rowspan="2">Likelihood</td><td colspan="20">Unlikely</td><td colspan="20">Possible</td><td colspan="20">Certain</td></tr>
<tr><td colspan="60">Given that there are not major security concerns at present in the community and that once constructed the site is geographically contained in a single area, safety and security impacts may occur but are unlikely.</td></tr>
<tr><td rowspan="2">Impact Magnitude</td><td colspan="12">Positive</td><td colspan="12">Negligible</td><td colspan="12">Small</td><td colspan="12">Medium</td><td colspan="12">Large</td></tr>
<tr><td colspan="60">Based on the above, the impact magnitude is considered to be small.</td></tr>
<tr><td rowspan="2">Resource/ Receptor Vulnerability</td><td colspan="20">Low</td><td colspan="20">Medium</td><td colspan="20">High</td></tr>
<tr><td colspan="60">The sensitivity of receptors (local community members) is considered to be medium for safety and security impacts.</td></tr>
<tr><td rowspan="2">Impact Significance</td><td colspan="15">Negligible</td><td colspan="15">Minor</td><td colspan="15">Moderate</td><td colspan="15">Major</td></tr>
<tr><td colspan="60">Based on the small impact magnitude and the medium sensitivity of receptors, the impact significance is assessed to be minor.</td></tr>
</table>

6.4.13.5 Mitigation Measures

Construction

The measures listed below will be implemented to mitigate the Project's community safety and security impacts during construction.

- Security personnel will be trained in safeguarding the community in high tension situations such as any type of protest or community conflicts. This will include training on human rights concepts and include information on local resources that could assist in such situations such as the GVH and TA.
- Security measures will be implemented to minimise safety risks and the possibility of theft in construction and storage areas.
- Clear and visible signage will be established in construction areas to warn the community of any risks and hazards and other engagement/communication efforts

will be employed to ensure community members are aware of safety risks, as needed.

- Security personnel will not carry firearms and will comply with Malawian laws and regulations as well as the requirements of the Voluntary Principles on Security and Human Rights. Security procedures will include selection of personnel based on a careful background screening and monitoring of performance.
- A community engagement programme will be established to provide information about safety hazards and raise awareness of how these are being managed. This includes visits to neighbouring communities and local schools.
- Community awareness will be raised regarding the Project's Community Grievance Mechanism to address community concerns and issues in a timely manner to avoid issues escalating. This will include the use of the CLO, who will be present around the Project Site before and during construction.

Operation

The measures listed below will be implemented to mitigate the Project's community safety and security impacts during operation.

- The solar farm will be fenced and have security personnel present at all times to avoid trespassers entering the site.
- Security personnel will not carry firearms and will comply with Malawian laws and regulations as well as the requirements of the Voluntary Principles on Security and Human Rights. Security procedures will include selection of personnel based on a careful background screening and monitoring of performance.
- Clear and visible signage will be established in hazardous areas to warn the community of any risks and hazards and engagement/communication efforts will be employed to ensure community members are aware of safety risks, as needed.

6.4.13.6 Residual Impact Significance

With the implementation of the mitigation measures listed above, the residual impact significance is anticipated to be **Negligible** during both construction and operation (Table 6-36).

Table 6-36: Pre and Post Mitigation Community Safety and Security Impacts.

Impact	Project Phase	Impact Significance (Pre-mitigation)	Residual Impact Significance (Post-mitigation)
Decrease in Community Safety and Security	Construction	Minor	Negligible
Decrease in Community Safety and Security	Operation	Minor	Negligible

6.4.14 Labour and Working Conditions

This assessment identifies potential impacts on workers from the working conditions they will experience. Impacts would occur in the construction and the operation phase and result in increased health and safety risks for workers. Please note that occupational health and safety issues are also covered in this section.

6.4.14.1 Summary of Baseline Conditions

According to the 2018 Malawi Human Rights Country Report, the main human rights issues prevalent in the country include some labour-related issues, such as:

- Rights in relation to establishing unions and collective bargaining in the informal sector;
- Forced labour, including children subjected to domestic servitude and other forms of forced labour including rural/agricultural labour;
- Child labour, including worst forms, where children often receive low or no wages with as many as 38% of children aged 5-17 engaged in some form of child labour;
- Discrimination in employment and occupation with respect to gender and disability; and
- Acceptable conditions of work, including minimum wages, working hours, and occupational health and safety.[51]

Regardless of these issues, Malawi has ratified all eight of the core International Labour Organisation Conventions listed below.[52]

- C029 - Forced Labour Convention, 1930 (No. 29), 19 Nov 1999.
- C087 - Freedom of Association and Protection of the Right to Organise Convention, 1948 (No. 87), 19 Nov 1999.
- C098 - Right to Organise and Collective Bargaining Convention, 1949 (No. 98), 22 Mar 1965.
- C100 - Equal Remuneration Convention, 1951 (No. 100), 22 Mar 1965.
- C105 - Abolition of Forced Labour Convention, 1957 (No. 105), 19 Nov 1999.
- C111 - Discrimination (Employment and Occupation) Convention, 1958 (No. 111), 22 Mar 1965.
- C138 - Minimum Age Convention, 1973 (No. 138), Minimum age specified: 14 years, 19 Nov 1999.
- C182 - Worst Forms of Child Labour Convention, 1999 (No. 182), 19 Nov 1999.

Enforcement of labour laws and the ILO conventions is the biggest challenge in regard to labour and working conditions.

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[51] US Department of State. Malawi Human Rights Report 2018. Available at https://www.state.gov/documents/organization/289227.pdf (accessed March 2019)

[52] International Labour Organisation. Available at https://www.ilo.org/dyn/normlex/en/f?p=NORMLEXPUB:11200:0::NO::P11200_COUNTRY_ID:103101 (accessed July 2018)

6.4.14.2 Potential Impact: Construction and Operation

Issues regarding labour and working conditions in Malawi include long working hours, noncompliant wages, gender discrimination, and child labour. If not properly managed, these issues could affect the Project workforce, mainly during construction, and the local communities within the Project Area who are highly vulnerable due to low levels of education and high levels of poverty. In addition, workers have the ability to protest if they perceive working conditions to be unsatisfactory, which could create delays to the Project, reputational risk, and poor worker relationships.

Poor occupational health and safety can cause injuries and even fatalities if not managed, as well affect relationships with the workforce. During construction, activities may include intensive manual labour, the operation of heavy equipment and trucks, working at heights, working in confined spaces, construction traffic, use of electrical devices, handling of hazardous materials, and other hazardous activities. Due to the nature of the activities being undertaken during construction, worker health and safety is a key risk, with the potential for accidents that may result in injuries and fatalities as well as work stoppages. It is anticipated the portion of skilled workers coming from outside the local area for construction activities (approximately 30-35% of the construction phase workforce) will be housed in a controlled camp on the worksite, and thus there is a risk of poor worker accommodation standards.

Activities during operation and regular maintenance activities could include hazardous activities such as the operation of heavy equipment and trucks, working on electrical devices including high voltage, working at heights, maintenance of high pressure pipework and vessels, and handling of hazardous materials. During these activities, workers may be at risk for accidents and injury. Other non-hazardous routine maintenance activities will also be a part of operations phase such as vegetation management, cleaning of panels and site security.

6.4.14.3 Assessment of Impact: Construction

Potential poor labour and working conditions would be long term, and constant during construction (approximately 10 months). The impact would be restricted to the Project Site, impacting workers. The impact is possible, given the generally poor status of labour and working conditions in the country and given that hazardous activities are involved in the construction of the Project. The impact magnitude is considered to be **Small**, as the workforce will comprise approximately 200 people during construction. The sensitivity of receptors (workers) is considered to be **High**, given low levels of education, lack of formal wage-earning opportunities, and high levels of poverty, which could make potential workers prone to accepting poor labour and working conditions, especially the most vulnerable people in the community such as the very poor, women, and some children**.** Likewise, non-local workers housed in the work camp may feel limited in their ability to demand better housing conditions if these prove inadequate. As a result, the impact significance is assessed to be **Moderate** (Table 6-37).

Table 6-37: Assessment of Labour and Working Conditions Impacts during Construction.

Impact	Poor Labour and Working Conditions	
Impact Nature	Negative	Positive

<table>
<tr><th>Impact</th><th colspan="60">Poor Labour and Working Conditions</th></tr>
<tr><td></td><td colspan="60">Poor labour and working conditions are negative. Discrimination and non-compliant labour and working conditions have the ability to create delays to the Project, cause reputational risk, and create poor worker relations. In addition, poor occupational health and safety can cause injury or fatalities.</td></tr>
<tr><td rowspan="2">Impact Type</td><td colspan="30">[✓ Direct]</td><td colspan="30">Indirect</td></tr>
<tr><td colspan="60">The impact would be a direct result of Project activities (presence of equipment and infrastructure, traffic).</td></tr>
<tr><td rowspan="2">Impact Duration</td><td colspan="15">Temporary</td><td colspan="15">Short Term</td><td colspan="15">[✓ Long Term]</td><td colspan="15">Permanent</td></tr>
<tr><td colspan="60">The impact would be long term, occurring during construction (approximately 10 months).</td></tr>
<tr><td rowspan="2">Impact Extent</td><td colspan="15">[✓ Limited]</td><td colspan="15">Local</td><td colspan="15">Regional</td><td colspan="15">Transboundary</td></tr>
<tr><td colspan="60">The impact would be restricted to the Project Site.</td></tr>
<tr><td rowspan="2">Frequency</td><td colspan="12">Remote</td><td colspan="12">Rare</td><td colspan="12">Occasional</td><td colspan="12">Often</td><td colspan="12">[✓ Constant]</td></tr>
<tr><td colspan="60">The impact would be constant during the construction phase.</td></tr>
<tr><td rowspan="2">Likelihood</td><td colspan="20">Unlikely</td><td colspan="20">[✓ Possible]</td><td colspan="20">Certain</td></tr>
<tr><td colspan="60">The impact is possible, given the generally poor status of labour and working conditions in the country and given that hazardous activities are involved in the construction of the Project.</td></tr>
<tr><td rowspan="2">Impact Magnitude</td><td colspan="12">Positive</td><td colspan="12">Negligible</td><td colspan="12">[✓ Small]</td><td colspan="12">Medium</td><td colspan="12">Large</td></tr>
<tr><td colspan="60">The impact magnitude is considered to be small, as the workforce would comprise approximately 200 people during construction.</td></tr>
<tr><td rowspan="2">Resource/ Receptor Vulnerability</td><td colspan="20">Low</td><td colspan="20">Medium</td><td colspan="20">[✓ High]</td></tr>
<tr><td colspan="60">The sensitivity of receptors (workers) is considered to be high, given low levels of education, lack of formal wage-earning opportunities, and high levels of poverty, which could make potential workers prone to accepting poor labour and working conditions, especially the most vulnerable people in the community such as the very poor, women, and some children. Likewise, non-local workers who may come from countries other than Malawi may be vulnerable to poor labour and working conditions due to their non-local status and limited ability to seek other employment.</td></tr>
<tr><td></td><td colspan="15">Negligible</td><td colspan="15">Minor</td><td colspan="15">[✓ Moderate]</td><td colspan="15">Major</td></tr>
</table>

Impact	**Poor Labour and Working Conditions**
Impact Significance	Based on the small impact magnitude and the high sensitivity of receptors, the impact significance is assessed to be moderate.

6.4.14.4 Assessment of Impacts: Operation

During the operations phase, the workforce will be greatly reduced to approximately 20 workers. These workers will be direct employees of JCM, and almost entirely skilled labourers. Regular operation and maintenance activities may still include some hazardous activities (high voltage electrical work, working at heights, etc.), but are less manual labour intensive and include general site maintenance tasks that are not high risk (such as vegetation management and the cleaning of panels). The impact magnitude is considered **Small** as the workforce is limited to just approximately 20 workers, and the work will become less frequent, as most will not need to be on site regularly. Receptor vulnerability is considered **Medium** given that these workers are skilled and directly employed by JCM they are expected to have reasonable levels of education and/ or technical training and employment opportunity, and thus less prone to accept poor labour and working conditions.

As a result, the impact significance is assessed to be **Minor** (Table 6-38).

Table 6-38: Assessment of Labour and Working Conditions Impacts during Operation.

<table>
<tr><th>Impact</th><th colspan="20">Poor Labour and Working Conditions</th></tr>
<tr><td rowspan="2">Impact Nature</td><td colspan="10">[✓ Negative]</td><td colspan="10">Positive</td></tr>
<tr><td colspan="20">Poor labour and working conditions are considered negative. Hazardous/risky operations activities can pose health and safety risks that can cause injury or fatalities.</td></tr>
<tr><td rowspan="2">Impact Type</td><td colspan="10">[✓ Direct]</td><td colspan="10">Indirect</td></tr>
<tr><td colspan="20">The impact would be a direct result of Project operation activities (e.g. working on high-voltage electrical equipment)</td></tr>
<tr><td rowspan="2">Impact Duration</td><td colspan="5">Temporary</td><td colspan="5">[✓ Short Term]</td><td colspan="5">Long Term</td><td colspan="5">Permanent</td></tr>
<tr><td colspan="20">The impact would be short term, given that operations activities will not be needed constantly during the 20 year operation period.</td></tr>
<tr><td rowspan="2">Impact Extent</td><td colspan="5">[✓ Limited]</td><td colspan="5">Local</td><td colspan="5">Regional</td><td colspan="5">Transboundary</td></tr>
<tr><td colspan="20">The impact would be restricted to the Project Site.</td></tr>
<tr><td rowspan="2">Frequency</td><td colspan="4">Remote</td><td colspan="4">Rare</td><td colspan="4">Occasional</td><td colspan="4">[✓ Often]</td><td colspan="4">Constant</td></tr>
<tr><td colspan="20">The impact would be often, or perhaps even occasional, given the need for workers and site maintenance is greatly reduced during operations</td></tr>
</table>

<table>
<tr><th>Impact</th><th colspan="60">Poor Labour and Working Conditions</th></tr>
<tr><td rowspan="2">Likelihood</td><td colspan="20">Unlikely</td><td colspan="20">[✓ Possible]</td><td colspan="20">Certain</td></tr>
<tr><td colspan="60">The impact is possible, given the generally poor status of labour and working conditions in the country and given that hazardous activities are still involved in the operation of the Project.</td></tr>
<tr><td rowspan="2">Impact Magnitude</td><td colspan="12">Positive</td><td colspan="12">Negligible</td><td colspan="12">[✓ Small]</td><td colspan="12">Medium</td><td colspan="12">Large</td></tr>
<tr><td colspan="60">The impact magnitude is considered to be small, as the workforce would comprise approximately 20 workers during operation.</td></tr>
<tr><td rowspan="2">Resource/ Receptor Vulnerability</td><td colspan="20">Low</td><td colspan="20">[✓ Medium]</td><td colspan="20">High</td></tr>
<tr><td colspan="60">The sensitivity of receptors (workers) is considered to be medium, given that operations phase workers will be direct employees of JCM and generally will be skilled workers with some education and/or technical training and are likely to have the ability to pursue other economic opportunities if desired.</td></tr>
<tr><td rowspan="2">Impact Significance</td><td colspan="15">Negligible</td><td colspan="15">[✓ Minor]</td><td colspan="15">Moderate</td><td colspan="15">Major</td></tr>
<tr><td colspan="60">Based on the small impact magnitude and the medium sensitivity of receptors, the impact significance is assessed to be moderate.</td></tr>
</table>

6.4.14.5 Mitigation Measures

Construction

The measures listed below will be implemented to mitigate the Project's labour and working conditions impacts during construction.

- A Human Resources Policy will be developed, which will include a Labour and Employment Plan and Worker Grievance Mechanism. These will also be reflected in sub-contractor contracts. Key issues within Human Resources (HR) management and contracts will include:
  - Provision of clear and understandable information regarding rights under national labour and employment law, and any applicable collective agreements, including those related to hours of work, wages, overtime, and compensation;
  - Provision of reasonable working conditions and terms of employment;
  - Provision of adequate accommodation (if relevant);
  - Provision of employment, compensation/remuneration, and working conditions, including working hours, equal opportunity and fair treatment, and prohibition of discrimination;
  - Non-discrimination in all aspects of labour recruitment, management and exit;
  - Implementation of a Worker Grievance Mechanism for Project workers (including sub-contractors);

  - Adoption and implementation of a sexual harassment policy; and
  - Freedom of association.
- A Gender Development Plan will be prepared to promote gender equality in job opportunities and the elimination of gender-based violence, as well as to address other gender-related issues within the workforce and Project-affected communities.
- Contractors will be supported in adhering to labour and working conditions in compliance with Malawian labour laws and in alignment with IFC PS 2 through awareness training and information provision, as necessary.
- A fair and transparent worker Grievance Mechanism will be developed and implemented. It will be accessible to all workers, whether permanent or temporary, or directly or indirectly employed. The grievance mechanism will be open to the EPC Contractor and subcontractor workforce in the event that their grievance is not adequately resolved by their direct employer.
- The contractor and supplier selection process will ensure that performance with regards to worker management, worker rights, and health and safety as outlined in Malawian law and international standards will be managed and reported.
- Regular checks of contractors will be undertaken to ensure compliance with applicable labour laws.
- A health and safety programme will be developed that includes risk assessments (e.g., working at heights, confined space, machine guarding), work permit systems, and a H&S management system, in line with industry best practice, including worker performance safety tracking (safety observations) to assure worker safety. Workers will receive induction and regular training regarding this system.
- A hiring mechanism will be established to ensure no employee or job applicant is discriminated against on the basis of gender, marital status, nationality, ethnicity, age, religion, or sexual orientation.
- Workers (including contractors and subcontractors) will, as part of their induction, receive training on worker rights in compliance with Malawian legislation and in alignment with international standards.
- Workers (including contractors and subcontractors) will have contracts that clearly state the terms and conditions of their employment and their legal rights. Contracts will be verbally explained to workers in their native language when necessary for them to understand their rights. Contracts must be in place prior to workers leaving their home location, if applicable.
- Workers (including contractors and subcontractors) will have access to training on communicable diseases, STIs, and community interactions in general. This training will be developed in collaboration with local health institutions and local NGOs, if feasible.

Operation

The measures listed below will be implemented to mitigate the Project’s labour and working conditions impacts during operation.

- The Human Resources Policy, Labour and Employment Plan, and Worker Grievance Mechanism developed for construction will continue to be implemented.
- The Gender Development Plan developed for construction will continue to be implemented during operation.
- Contractors will be supported in adhering to labour and working conditions in compliance with Malawian labour laws and in alignment with IFC PS 2 through awareness raising and information provision, as necessary.
- The Worker Grievance Mechanism developed for construction will continue to be implemented

6.4.14.6 Residual Impact Significance

With the implementation of the mitigation measures listed above, the residual impact significance is anticipated to be **Minor** during construction and negligible during operation (Table 6-39).

Table 6-39: Pre and Post Mitigation Labour and Working Conditions Impacts.

Impact	Project Phase	Impact Significance (Pre-mitigation)	Residual Impact Significance (Post-mitigation)
Poor Labour and Working Conditions	Construction	Moderate	Minor
Poor Labour and Working Conditions	Operation	Minor	Negligible

6.4.15 Cultural Heritage

This assessment identifies potential Project impacts to cultural heritage. Based on the results of the cultural heritage baseline study, the Project would cause direct impacts to archaeological and living heritage resources. Construction and operation of the Project would also result in indirect impacts due to changes in the physical environment or “setting” of living heritage resources near the Project Site.

6.4.15.1 Summary of Baseline Conditions

The cultural heritage baseline study identified 26 individual cultural heritage resources within the Solar Plant Site: 22 archaeological finds, one historic school site, and three baobab trees. Seventeen of the 22 archaeological finds are interpreted as representing one, approximately 600 x 200 m archaeological site, with the remaining five isolated artefact finds likely associated with the site. The three baobab trees are locally significant living heritage resources due to their role in local traditions, oral history, folklore, and, in one case, a potential burial site. The M’Bisa cave site identified during the baseline study is located on the south side of the hills near the Project Area, but the Solar Plant Site would not be visible from the cave.

The cultural heritage resources identified during the baseline study that could be subject to direct or indirect Project impacts have been grouped into the following two cultural heritage resources: the archaeological site and five associated isolated finds; and one of the three baobab tree living heritage sites.

The historic school house site is not considered in the impact assessment. Interviews with local stakeholders and the field survey determined that, while members of the local community remember using the site, they did not state it had any historical or cultural significance. During the field survey, the field team was able to locate the site but determined there were no structural remains of the former shelter.

The M'Bisa cave site is not considered in the impact assessment because through follow-up stakeholder engagement interviews ERM determined that the Project would not be visible from the cave site. A review of the Project layout and cultural heritage survey results determined that one of the baobab living heritage sites, the tree called Saimba Nluzu by the local population, is not located within the Solar Plant Site. As a result, ERM does not anticipate that the tree would be subject to direct impacts. Local tradition states that individuals should avoid this tree and if they pass by it they should remain quiet. Since the local population avoids the tree and does not use it for traditional activities or religious ceremonies/rituals, ERM does not anticipate that construction of the solar plant would indirectly impact the cultural value or use of the tree.

As discussed in Section 6.4.5.2, the original Project design required removal of two baobab trees, Mchiza Alendo and the unnamed tree with a possible burial. Due to their protected status and cultural value, JCM applied the mitigation hierarchy by conducting an alternative analysis to determine if the two baobab trees could be avoided/protected while still fulfilling Project objectives for electricity production. The alternative analysis indicated that one of the two trees, Mchiza Alendo, could be avoided by moving panels to an alternate location within the Project Site. The alternative analysis determined that the other baobab tree, the unnamed tree with a possible burial, could not be avoided without significantly diminishing the Project's electricity production, as it is located in the centre of the solar panel array (Appendix I). As a result, the Project will now only impact the unnamed baobab tree.

6.4.15.2 Potential Impacts: Construction

Construction of the proposed Project would require extensive ground disturbing activities within the Solar Plant Site. Examples of ground disturbing activities with the potential to impact the archaeological and living heritage resources in the Solar Plant Site include vegetation clearance, grading or levelling the site, excavation of cable trenches, ramming or drilling mounting structure frames, and other infrastructure and facility construction. These activities would likely result in the removal of one baobab tree living heritage site and the partial or complete destruction of the archaeological site and associated isolated finds.

Construction activities within the Solar Plant Site would also temporarily alter the setting of the cave site overlooking the Solar Plant Site by the introduction of new visual elements to the landscape (i.e., construction equipment and facilities) as well as increased noise from construction activities. These temporary, indirect impacts are considered relatively low to the impacts to the setting of the cave resource during Project operation.

6.4.15.3 Assessment of Impacts: Construction

Damage to Archaeological Resources

Damage to the archaeological site identified within the Solar Plant Site would be permanent. The impact would be restricted to a portion of the Solar Plant Site. The impact would occur once but result in the permanent loss of the resource. The impact would be certain, as ground-disturbing activities within the archaeological site would be required by construction. Due to the complete loss of the resource, the impact magnitude is considered to be **Large**. The archaeological resource is not a protected monument at the local or national level and, based on the number of similar Iron Age sites found across Malawi, meets the criteria for replicable cultural heritage under IFC PS 8.[53] The sensitivity of the resources is therefore considered to be **Low**. As a result, the impact significance is assessed to be **Moderate** (Table 6-40).

Table 6-40: Assessment of Damage to Archaeological Resources Impacts during Construction.

<table>
<tr><th>Impact</th><th colspan="60">Damage to Archaeological Site</th></tr>
<tr><td rowspan="2">Impact Nature</td><td colspan="30">[✓ Negative]</td><td colspan="30">Positive</td></tr>
<tr><td colspan="60">Partial to complete destruction of the archaeological site in the Solar Plant Site would be negative.</td></tr>
<tr><td rowspan="2">Impact Type</td><td colspan="30">[✓ Direct]</td><td colspan="30">Indirect</td></tr>
<tr><td colspan="60">The impact would be a direct impact of construction activities (site clearance and other ground disturbing activities).</td></tr>
<tr><td rowspan="2">Impact Duration</td><td colspan="15">Temporary</td><td colspan="15">Short Term</td><td colspan="15">Long Term</td><td colspan="15">[✓ Permanent]</td></tr>
<tr><td colspan="60">The impact would be permanent due to the removal of the archaeological site during construction.</td></tr>
<tr><td rowspan="2">Impact Extent</td><td colspan="15">[✓ Limited]</td><td colspan="15">Local</td><td colspan="15">Regional</td><td colspan="15">Transboundary</td></tr>
<tr><td colspan="60">The Impact would be limited to the Solar Plant Site.</td></tr>
<tr><td rowspan="2">Frequency</td><td colspan="12">[✓ Remote]</td><td colspan="12">Rare</td><td colspan="12">Occasional</td><td colspan="12">Often</td><td colspan="12">Constant</td></tr>
<tr><td colspan="60">The impacts would occur once but result in the permanent loss of all or part of the resource.</td></tr>
<tr><td>Likelihood</td><td colspan="20">Unlikely</td><td colspan="20">Possible</td><td colspan="20">[✓ Certain]</td></tr>
</table>

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[53] “Replicable cultural heritage is defined as tangible forms of cultural heritage that can themselves be moved to another location or that can be replaced by a similar structure or natural features to which the cultural value can be transferred by appropriate measures. Archaeological or historical sites may be considered replicable where the particular eras and cultural values they represent are well represented by other sites and/or structures” (IFC Performance Standard 8, Footnote 3).

<table>
<tr><th>Impact</th><th colspan="60">Damage to Archaeological Site</th></tr>
<tr><td></td><td colspan="60">Ground disturbing activities within the 600 x 200 m area of the archaeological site would be required during construction.</td></tr>
<tr><td rowspan="2">Impact Magnitude</td><td colspan="12">Positive</td><td colspan="12">Negligible</td><td colspan="12">Small</td><td colspan="12">Medium</td><td colspan="12">[✓ Large]</td></tr>
<tr><td colspan="60">Due to the complete loss of the resource, the impact magnitude would be large.</td></tr>
<tr><td rowspan="2">Resource/ Receptor Vulnerability</td><td colspan="20">[✓ Low]</td><td colspan="20">Medium</td><td colspan="20">High</td></tr>
<tr><td colspan="60">The archaeological resource is not a protected monument at the local or national level and, based on the number of similar Iron Age sites found across Malawi, meets the criteria for replicable cultural heritage under IFC PS 8. It does, however, meet the legal definition of a “monument” under the Monuments and Relic Act (1990) and could be eligible for local or national protection. If the site is intact it could contain valuable scientific information about the Iron Age in Malawi.</td></tr>
<tr><td rowspan="2">Impact Significance</td><td colspan="15">Negligible</td><td colspan="15">Minor</td><td colspan="15">[✓ Moderate]</td><td colspan="15">Major</td></tr>
<tr><td colspan="60">Based on the large impact magnitude and the low sensitivity of the resource, the impact significance is assessed to be moderate.</td></tr>
</table>

Loss of Baobab Tree

Damage to the baobab tree identified as cultural heritage within the Solar Plant Site would be permanent. The impact would be restricted to a small portion of the Solar Plant Site. The impact would occur once but result in the permanent loss of the resources. The impact would be certain, as vegetation removal within the Solar Plant Site would be required by construction. Due to the complete loss of the resource, the impact magnitude is considered to be **Large**. The baobab tree is not a protected monument at the local or national level and, based on the number of similar resources found across Malawi, meets the criteria for replicable cultural heritage under IFC PS 8. Stakeholder interviews do not suggest the tree is used on a regular basis for ritual or other traditional practices. The tree is part of local traditions, oral histories, and folklore and appears to serve as a historic site, a possible burial site, and a significant point within the local cultural landscape. The sensitivity of the resource is therefore considered to be **Medium**. As a result, the impact significance is assessed to be **Moderate** (Table 6-41).

Table 6-41: Assessment of Loss of Baobab Tree Impacts during Construction.

<table>
<tr><th>Impact</th><th colspan="2">Loss of Baobab Tree</th></tr>
<tr><td rowspan="2">Impact Nature</td><td>[✓ Negative]</td><td>Positive</td></tr>
<tr><td colspan="2">Removal of the baobab tree living heritage resource would be negative.</td></tr>
</table>

<table>
<tr><th>Impact</th><th colspan="60">Loss of Baobab Tree</th></tr>
<tr><td rowspan="2">Impact Type</td><td colspan="30">[✓ Direct]</td><td colspan="30">Indirect</td></tr>
<tr><td colspan="60">The impact would be a direct result of construction activities (site clearance).</td></tr>
<tr><td rowspan="2">Impact Duration</td><td colspan="15">Temporary</td><td colspan="15">Short Term</td><td colspan="15">Long Term</td><td colspan="15">[✓ Permanent]</td></tr>
<tr><td colspan="60">The impact would be permanent due to the removal of the baobab tree during vegetation removal.</td></tr>
<tr><td rowspan="2">Impact Extent</td><td colspan="15">[✓ Limited]</td><td colspan="15">Local</td><td colspan="15">Regional</td><td colspan="15">Transboundary</td></tr>
<tr><td colspan="60">The impact would be limited to the Solar Plant Site.</td></tr>
<tr><td rowspan="2">Frequency</td><td colspan="12">[✓ Remote]</td><td colspan="12">Rare</td><td colspan="12">Occasional</td><td colspan="12">Often</td><td colspan="12">Constant</td></tr>
<tr><td colspan="60">The impact would occur once but result in the permanent loss of the baobab tree.</td></tr>
<tr><td rowspan="2">Likelihood</td><td colspan="20">Unlikely</td><td colspan="20">Possible</td><td colspan="20">[✓ Certain]</td></tr>
<tr><td colspan="60">Vegetation removal would require the removal of the baobab tree.</td></tr>
<tr><td rowspan="2">Impact Magnitude</td><td colspan="12">Positive</td><td colspan="12">Negligible</td><td colspan="12">Small</td><td colspan="12">Medium</td><td colspan="12">[✓ Large]</td></tr>
<tr><td colspan="60">Due to the complete loss of the resource, the impact magnitude would be large.</td></tr>
<tr><td rowspan="2">Resource/ Receptor Vulnerability</td><td colspan="20">Low</td><td colspan="20">[✓ Medium]</td><td colspan="20">High</td></tr>
<tr><td colspan="60">The baobab tree is not a protected monument at the local or national level and, based on the number of similar resources found across Malawi, meets the criteria for replicable cultural heritage under IFC PS 8. Stakeholder interviews do not suggest the tree is used on a regular basis for ritual or other traditional practices. The tree is part of local traditions, oral histories, and folklore and appears to serve as a historic sites, a possible burial site, and a significant points within the local cultural landscape.</td></tr>
<tr><td rowspan="2">Impact Significance</td><td colspan="15">Negligible</td><td colspan="15">Minor</td><td colspan="15">[✓ Moderate]</td><td colspan="15">Major</td></tr>
<tr><td colspan="60">Based on the large impact magnitude and the medium sensitivity of the resource, the impact significance is assessed to be moderate.</td></tr>
</table>

6.4.15.4 Mitigation Measures

The measures listed below will be implemented to mitigate the Project’s cultural heritage impacts:

- Additional, limited archaeological excavations will be conducted within the boundaries of the archaeological site identified in the Solar Plant Site. The purpose of these excavations will be to evaluate the integrity and potential significance of the site and to determine, in consultation with the MITC and the Chief Antiquities Officer, if additional archaeological excavations are warranted. Investigations at the site will be done in consultation with the MITC and Chief Antiquities Officer and with required government-issued permits and approvals.

- Additional stakeholder engagement will be conducted with the local community to develop a plan to transfer the cultural significance/value of the baobab tree living heritage site to another location, if feasible, or otherwise compensate for the loss of this resource.
- A Chance Find Procedure (CFP) will be developed and implemented. The CFP will set for the procedures to implement in the event that archaeological resources are encountered during ground disturbing activities. Workers will be trained in identifying chance finds and implementing the CFP.

6.4.15.5 Residual Impact Significance

With the implementation of the mitigation measures listed above, the residual impact significance is anticipated to be **Minor** for both the archaeological site and baobab tree (Table 6-42).

Table 6-42: Pre and Post Mitigation Cultural Heritage Impacts.

Impact	Project Phase	Impact Significance (Pre-mitigation)	Residual Impact Significance (Post-mitigation)
Damage to Archaeological Resources	Construction	**Moderate**	**Minor**
Loss of Baobab Tree	Construction	**Moderate**	**Minor**

6.4.16 Unplanned Events: Soil and Groundwater Impacts from Spill Events and Improper Disposal of Waste

6.4.16.1 Summary of Baseline Conditions

Baseline conditions are summarized for soils in Section 6.4.3.1 and for groundwater in Section 6.4.4.1.

6.4.16.2 Potential Impacts

Spills and improper disposal of waste have the potential to affect terrestrial environments and could lead to the deterioration of soil and groundwater quality. This could lead to impacts on flora and fauna and local community users.

During construction, there is the potential for spills of fuels and oils during construction activities, fuelling, maintenance of machinery and vehicles, and improper waste storage and disposal. Spills/improper disposal of waste could occur within the Project footprint resulting in soil and groundwater degradation.

During operation of the Project, there is the potential for improper waste storage and disposal (for example of broken panels).

6.4.16.3 Assessment of Impacts

Accidental Spills and Improper Disposal of Waste to Soils

The impact of spill events and improper disposal of waste to soils would be long term due to remediation time expected for contaminated soils. The impact would be limited to the Project Site. Spills are most likely to occur during refilling and transportation of substances. There would be no large-scale storage of fuels or chemicals on the Project Site. Large releases of hazardous materials would therefore be rare and it is considered unlikely that a spill of emergency scale would occur. Improper disposal of waste can occur throughout the construction phase if appropriate disposal measures are not put in place. The impact magnitude is therefore considered to be **Small**. The sensitivity of the resource is considered to be **High** due to the importance of soil quality in the agricultural economy of the Project Area and the low permeability of the clayey soils across the Project Site. As a result, the impact significance is assessed to be **Moderate** (Table 6-43).

Table 6-43: Assessment of Accidental Spills and Improper Disposal of Waste to Soils Impacts.

<table>
<tr><th>Impact</th><th colspan="60">Accidental Spills to Soils</th></tr>
<tr><td rowspan="2">Impact Nature</td><td colspan="30">[✓ Negative]</td><td colspan="30">Positive</td></tr>
<tr><td colspan="60">Accidental spills and improper disposal of waste to soils would negative.</td></tr>
<tr><td rowspan="2">Impact Type</td><td colspan="30">[✓ Direct]</td><td colspan="30">Indirect</td></tr>
<tr><td colspan="60">The impact would be a direct result of Project activities (spillage during maintenance of machinery, improper storage of hazardous materials, spillage during transfers of fuel, improper disposal of waste).</td></tr>
<tr><td rowspan="2">Impact Duration</td><td colspan="15">Temporary</td><td colspan="15">Short Term</td><td colspan="15">[✓ Long Term]</td><td colspan="15">Permanent</td></tr>
<tr><td colspan="60">The impact would be long term due to remediation time expected for contaminated soils.</td></tr>
<tr><td rowspan="2">Impact Extent</td><td colspan="15">[✓ Limited]</td><td colspan="15">Local</td><td colspan="15">Regional</td><td colspan="15">Transboundary</td></tr>
<tr><td colspan="60">The impact would be limited to the Project Site.</td></tr>
<tr><td rowspan="2">Frequency</td><td colspan="12">Remote</td><td colspan="12">Rare</td><td colspan="12">Occasional</td><td colspan="12">Often</td><td colspan="12">Constant</td></tr>
<tr><td colspan="60">Not Applicable.</td></tr>
<tr><td>Likelihood</td><td colspan="20">[✓ Unlikely]</td><td colspan="20">Possible</td><td colspan="20">Certain</td></tr>
</table>

<table>
<tr><th>Impact</th><th colspan="60">Accidental Spills to Soils</th></tr>
<tr><td></td><td colspan="60">The impact is unanticipated and the likelihood is therefore small.</td></tr>
<tr><td rowspan="2">Impact Magnitude</td><td colspan="12">Positive</td><td colspan="12">Negligible</td><td colspan="12">[✓ Small]</td><td colspan="12">Medium</td><td colspan="12">Large</td></tr>
<tr><td colspan="60">Based on the above, the impact magnitude is considered to be small.</td></tr>
<tr><td rowspan="2">Resource/ Receptor Vulnerability</td><td colspan="20">Low</td><td colspan="20">Medium</td><td colspan="20">[✓ High]</td></tr>
<tr><td colspan="60">The sensitivity of the resource is considered to be high due to the importance of soil quality in the agricultural economy of the Project Area and the low permeability of the clayey soils across the Project Site.</td></tr>
<tr><td rowspan="2">Impact Significance</td><td colspan="15">Negligible</td><td colspan="15">Minor</td><td colspan="15">[✓ Moderate]</td><td colspan="15">Major</td></tr>
<tr><td colspan="60">Based on the small impact magnitude and the high sensitivity of the resource, the impact significance is assessed to be moderate.</td></tr>
</table>

Accidental Spills and Improper Disposal of Waste to Groundwater

The impact of spill events and improper disposal of waste to groundwater would be long term due to remediation time expected for contaminated groundwater. The impact would be limited to the Project Area. Spills are most likely to occur during refilling and transportation of substances. There would be no large-scale storage of fuels or chemicals on the Project Site except for a 22,000 l Above-ground Storage Tank (AST). Large releases of hazardous materials would therefore be rare and it is considered unlikely that a spill would occur of emergency scale. Improper disposal of waste can occur throughout the construction phase if appropriate disposal measures are not put in place. Due to the larger impact extent (local vs. limited), the impact magnitude is considered to be **Medium**. The sensitivity of the resource is considered to be **High** due to the importance of groundwater to neighbouring communities. As a result, the impact significance is assessed to be **Major** (Table 6-44).

Table 6-44: Assessment of Accidental Spills and Improper Disposal of Waste to Groundwater Impacts.

<table>
<tr><th>Impact</th><th colspan="2">Accidental Spills to Groundwater</th></tr>
<tr><td rowspan="2">Impact Nature</td><td>[✓ Negative]</td><td>Positive</td></tr>
<tr><td colspan="2">Accidental spills and improper disposal of waste to groundwater would negative.</td></tr>
<tr><td rowspan="2">Impact Type</td><td>[✓ Direct]</td><td>Indirect</td></tr>
<tr><td colspan="2">The impact would be a direct result of Project activities (spillage during maintenance of machinery, improper storage of hazardous materials, spillage during transfers of fuel, improper disposal of waste).</td></tr>
</table>

<table>
<tr><th>Impact</th><th colspan="60">Accidental Spills to Groundwater</th></tr>
<tr><td rowspan="2">Impact Duration</td><td colspan="15">Temporary</td><td colspan="15">Short Term</td><td colspan="15">[✓ Long Term]</td><td colspan="15">Permanent</td></tr>
<tr><td colspan="60">The impact would be long term due to remediation time expected for contaminated groundwater.</td></tr>
<tr><td rowspan="2">Impact Extent</td><td colspan="15">Limited</td><td colspan="15">[✓ Local]</td><td colspan="15">Regional</td><td colspan="15">Transboundary</td></tr>
<tr><td colspan="60">The impact would be limited to groundwater in the Project Area.</td></tr>
<tr><td rowspan="2">Frequency</td><td colspan="12">Remote</td><td colspan="12">Rare</td><td colspan="12">Occasional</td><td colspan="12">Often</td><td colspan="12">Constant</td></tr>
<tr><td colspan="60">Not Applicable.</td></tr>
<tr><td rowspan="2">Likelihood</td><td colspan="20">[✓ Unlikely]</td><td colspan="20">Possible</td><td colspan="20">Certain</td></tr>
<tr><td colspan="60">The impact is unanticipated and the likelihood is therefore small.</td></tr>
<tr><td rowspan="2">Impact Magnitude</td><td colspan="12">Positive</td><td colspan="12">Negligible</td><td colspan="12">Small</td><td colspan="12">[✓ Medium]</td><td colspan="12">Large</td></tr>
<tr><td colspan="60">Based on the above, the impact magnitude is considered to be medium.</td></tr>
<tr><td rowspan="2">Resource/ Receptor Vulnerability</td><td colspan="20">Low</td><td colspan="20">Medium</td><td colspan="20">[✓ High]</td></tr>
<tr><td colspan="60">The sensitivity of the resource is considered to be high due to the importance of groundwater to neighbouring communities.</td></tr>
<tr><td rowspan="2">Impact Significance</td><td colspan="15">Negligible</td><td colspan="15">Minor</td><td colspan="15">Moderate</td><td colspan="15">[✓ Major]</td></tr>
<tr><td colspan="60">Based on the medium impact magnitude and the high sensitivity of the resource, the impact significance is assessed to be major.</td></tr>
</table>

6.4.16.4 Preventive Measures

The measures listed below will be implemented to prevent the Project’s unanticipated soil and groundwater impacts from spill events and improper disposal of waste.

- A Hazardous Spill Response Plan will be developed and spill clean-up and response capability adequate for addressing spills for all phases of the Project will be maintained. Spills will be immediately contained and cleaned up. Contaminated areas will be remediated.
- A Waste Management Plan will be developed and implemented.
- Refuelling of equipment and vehicles will be carried out in a designated area (the AST) on hard standing ground to prevent seepage of any spills into the ground. Collection systems will be installed in these areas to manage any spills. Fuels will be collected and either reused or removed by a local contractor. Drip trays will be used when refuelling and servicing vehicles or equipment where there is no hard standing surface.

- Hazardous material storage will be on hard standing and impermeable surface and the storage facility will be bunded. The storage and handling of hazardous materials and fuels will be restricted to bunded areas of sufficient capacity to contain a release.

6.4.16.5 Residual Impact

With the implementation of the preventive measures listed above, the residual impact is reduced to acceptable levels.

6.4.17 Unplanned Events: Traffic Accidents

6.4.17.1 Summary of Baseline Conditions

Baseline conditions are presented in Section 2.6.

6.4.17.2 Potential Impacts

Increased traffic and presence of heavy vehicles on local roads as a result of Project development increases the risk of road traffic accidents involving members of the community. A significant number of trucks would be needed during construction to transport construction equipment (materials, sand, soil, waste) and solar PV components to and from the Project Site. Operational traffic movements would be very low.

6.4.17.3 Assessment of Impacts

The impact of vehicle accidents would be short term, occurring during construction (approximately 10 months). The impacts would be regional, as vehicle accidents could occur along construction and delivery routes. The increased traffic volumes as result of the Project would increase the risk of potential vehicle accidents. The likelihood is possible due to the increase in traffic volume and the current poor state of roads in the area, and the consequence of a potential accident is severe due to the potential for injuries or fatalities. The impact magnitude is therefore considered to be **Medium**. Considering the settlements along roads and the current uses of the roads, and the proximity of community activities and buildings to the roads, the sensitivity of receptors is considered to be **High**. As a result, the impact significance is assessed to be **Moderate** (Table 6-45).

Table 6-45: Assessment of Vehicle Accident Impacts during Construction.

Impact	Vehicle Accidents			
Impact Nature	Negative		Positive	
	Vehicle accidents would be negative.			
Impact Type	Direct		Indirect	
	The impact would be a direct result of Project activities (increased traffic).			
	Temporary	Short Term	Long Term	Permanent

<table>
<tr><th>Impact</th><th colspan="60">Vehicle Accidents</th></tr>
<tr><td>Impact Duration</td><td colspan="60">The impact is short term, occurring during construction (approximately 10 months).</td></tr>
<tr><td rowspan="2">Impact Extent</td><td colspan="15">Limited</td><td colspan="15">Local</td><td colspan="15">[✓ Regional]</td><td colspan="15">Transboundary</td></tr>
<tr><td colspan="60">The impact could occur along construction and delivery routes.</td></tr>
<tr><td rowspan="2">Frequency</td><td colspan="12">Remote</td><td colspan="12">Rare</td><td colspan="12">Occasional</td><td colspan="12">Often</td><td colspan="12">Constant</td></tr>
<tr><td colspan="60">Not Applicable.</td></tr>
<tr><td rowspan="2">Likelihood</td><td colspan="20">Unlikely</td><td colspan="20">[✓ Possible]</td><td colspan="20">Certain</td></tr>
<tr><td colspan="60">While unplanned, the likelihood is considered to be possible.</td></tr>
<tr><td rowspan="2">Impact Magnitude</td><td colspan="12">Positive</td><td colspan="12">Negligible</td><td colspan="12">Small</td><td colspan="12">[✓ Medium]</td><td colspan="12">Large</td></tr>
<tr><td colspan="60">Based on the above, the impact magnitude is considered to be medium.</td></tr>
<tr><td rowspan="2">Resource/ Receptor Vulnerability</td><td colspan="20">Low</td><td colspan="20">Medium</td><td colspan="20">[✓ High]</td></tr>
<tr><td colspan="60">The sensitivity of the receptors (communities along the road network) is considered to be high.</td></tr>
<tr><td rowspan="2">Impact Significance</td><td colspan="15">Negligible</td><td colspan="15">Minor</td><td colspan="15">Moderate</td><td colspan="15">[✓ Major]</td></tr>
<tr><td colspan="60">Based on the medium impact magnitude and the high sensitivity of the receptors, the impact significance is assessed to be major.</td></tr>
</table>

6.4.17.4 Preventive Measures

The measures listed below will be implemented to prevent the Project's unanticipated traffic accidents.

- A Traffic Management Plan, driving codes of conduct, and enhanced driver safety awareness will be implemented.
- Traffic routes will be planned to limit road use by the Project during high traffic periods (including pedestrian traffic) and in sensitive areas such as near schools in order to reduce interaction with public road use.
- Local road conditions will be assessed and road maintenance discussed during Project construction to minimise traffic risks associated with roads deteriorated from Project activities.
- Collaboration with relevant local and regional governments will take place to ensure the roads used by Project vehicles are well maintained, and that potential problems or hazards are communicated to the relevant authority in a timely manner.
- Engagements with local communities and authorities will take place to inform them about plans and procedures.

- Awareness campaigns will be implemented to address traffic and road safety in communities along the transportation corridor.
- Driver training will be provided to promote safe and responsible driving behaviour. The training will include contractors and subcontractors.

6.4.17.5 Residual Impact Assessment Conclusions

With the implementation of the preventive measures listed above, the residual impact is reduced to acceptable levels.

6.4.18 Cumulative Impacts

As described throughout this ESIA Report, the Project Site is relatively isolated and without nearby areas likely to be targeted for development. The Project Site is located approximately 150 km from Blantyre and 100 km from Lilongwe, which are the largest two cities in Malawi and where most future development is likely to be focused. It is located approximately 85 km from JCM's Salima Solar Project, which is currently under construction, and approximately 30 km from the district capital of Dedza. There are no known industrial or other projects that are in development or planned in the vicinity of the Project Site, or within the greater Project Area. As a result, our analysis foresees no impacts beyond those considered in this ESIA and therefore no cumulative impacts to consider.

7. PUBLIC CONSULTATION/STAKEHOLDER ENGAGEMENT

Public participation, also known as stakeholder engagement, is a two-way process of communication between a developer or project proponent and project stakeholders. Stakeholders include individuals or groups that may be impacted directly or indirectly by the project, influence project decisions, or have a specific interest in the project.

Stakeholder engagement for the Golomoti Project has been undertaken in line with the IFC Performance Standards, based on the key objectives of stakeholder engagement listed below.

- **Ensuring understanding**: Provide an inclusive and transparent process of culturally appropriate engagement and communication to ensure that stakeholders are well informed about the planned project.
- **Build relationships**: Through supporting open dialogue, engagement will help establish and maintain a productive relationship between the developer and project affected communities, as well as other key stakeholders.
- **Facilitate participation**: Ensure that all stakeholders participate in decision making regarding the project, regardless of gender, age, ethnicity, status, and other socio-economic factors so that they are not adversely impacted and access project benefits.
- **Engage vulnerable groups**: Identify and engage vulnerable groups to enable equal access to project information and a platform for them voice their concerns so that specific measures are included in project design.
- **Manage expectations**: It is important to ensure that the planned project does not create or allow unrealistic expectations to develop among stakeholders about potential benefits, such as employment or compensation. The engagement process will serve as a mechanism for understanding and managing expectations by disseminating the correct information in an accessible way.
- **Ensure compliance**: The process is designed to ensure compliance with both local regulatory requirements and international best practice.
- **Facilitate free, prior, and informed consultation**: Ensure engagement is free of external manipulation or coercion or intimidation, undertaken in a timely way so that stakeholders are informed prior to the development or implementation of the project, and ensure information is presented in an understandable and accessible way with consideration for literacy and language.

In order to facilitate the stakeholder engagement process for the Project, a Stakeholder Engagement Plan (SEP) has been developed, which provides a detailed engagement framework to minimise social risk and to enhance relationships between the developer and Project affected communities (Appendix H). The SEP is a “live” document and will be updated as the Project progresses.

7.1 NATIONAL AND INTERNATIONAL REQUIREMENTS

This section provides details of national legislative requirements and international best practice standards for stakeholder engagement.

7.1.1 National Requirements

The main stakeholder engagement requirements for development projects are detailed in the Environmental Management Act of 1996. It states that environmental impact assessment reports should be developed in accordance with the requirements set out in the act. The requirements include the following activities related to stakeholder engagement:

> The environmental impact assessment report shall be open for public inspection provided that no person shall be entitled to use any information contained therein for personal benefit except for the purposes of civil proceedings brought under this Act or under any written relating to the protection and management of the environment or the conservation or sustainable utilization of natural resources.
>
> Upon receiving the environmental impact assessment report, the Director shall invite written or oral comments from the public thereon, and where necessary may —
>
>> (a) conduct public hearings at such place or places as the Director deems necessary for purposes of assessing public opinion thereon;
>>
>> (b) require the developer to redesign the project or to do such other thing as the Director considers desirable taking into account all the relevant environmental concerns highlighted in the environmental impact assessment report, any comments made by the public and the need to achieve the objectives of this Act…[54]

7.1.2 International Standards

This section describes international best practice for stakeholder engagement, as set forth in the IFC Performance Standards and the Equator Principles.

7.1.2.1 IFC Performance Standards

The IFC defines the objective of stakeholder engagement as being “the basis for building strong, constructive, and responsive relationships that are essential for the successful management of a project's environmental and social impacts.”[55] The IFC Performance Standards include specific guidance on conducting stakeholder engagement both during the planning phase and throughout the project lifecycle. Stakeholder engagement requirements are primarily contained in Performance Standard (PS) 1 (Assessment and Management of Environmental and Social Risks and Impacts) and covers the following key topics:

- Stakeholder Engagement;
- Disclosure of Relevant Project Information;
- Informed Consultation and Participation;
- External Communications;

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[54] The Government of Malawi, Environmental Management Act 1996, Part V, paragraphs 25 and 26. Available at https://www.malawilii.org/mw/legislation/act/1996/6 (Accessed March 2019).

[55] IFC Performance Standard 1: Environmental and Social Risks and Impacts, paragraph 25. Available at http://www.ifc.org/wps/wcm/connect/115482804a0255db96fbffd1a5d13d27/PS_English_2012_Full-Document.pdf?MOD=AJPERES (accessed March 2019)

- Grievance Mechanism for Affected Stakeholders; and
- On-going Reporting to Affected Stakeholders.

PS 5 (Land Acquisition and Involuntary Resettlement) is also applicable to the Project, given the planned land acquisition. PS 5 promotes the concept of negotiated settlements to avoid expropriation and the forcible removal of people or land use activities. It also includes requirements regarding community engagement to ensure that affected communities are informed and participate in decision-making processes related to land acquisition.[56]

7.1.2.2 Equator Principles

The most relevant principles in relation to stakeholder engagement are:

- Principle 2: Environmental and Social Assessment;
- Principle 5: Stakeholder Engagement;
- Principle 6: Grievance Mechanism; and
- Principle 10: Reporting and Transparency.

In addition, it should be noted that Principle 3 requires projects located in "Non-Designated" countries, which includes Malawi, to align with the IFC Performance Standards.

7.2 STAKEHOLDER IDENTIFICATION AND MAPPING

A stakeholder is defined in the IFC Performance Standards as:

> persons or groups who are directly or indirectly affected by a project, as well as those who may have interests in a project and/or the ability to influence its outcome, either positively or negatively. Stakeholders may include locally affected communities or individuals and their formal and informal representatives, national or local government authorities, politicians, religious leaders, civil society organizations and groups with special interests, the academic community, or other businesses.[57]

The purpose of the stakeholder identification process for the Project has therefore been to establish which individuals or groups, including vulnerable groups, may be directly or indirectly affected (positively or negatively) by the Project or have an interest in it.

Stakeholder identification has taken into account:

- The direct and indirect AoI of the Project, as described in Section 6.2.1, which are the geographical areas over which the Project may cause direct and indirect impacts (both positive and negative), respectively, over its lifetime, and therefore are the localities within which people and businesses could be affected; and

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[56] IFC Performance Standard 5: Land Acquisition and Involuntary Resettlement Paragraph 10. Available at http://www.ifc.org/wps/wcm/connect/115482804a0255db96fbffd1a5d13d27/PS_English_2012_Full-Document.pdf?MOD=AJPERES (accessed March 2019)

[57] IFC (2007) Stakeholder Engagement: A Good Practice Handbook for Companies Doing Business in Emerging Markets, page 20. Available at: https://www.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/sustainability-at-ifc/publications/publications_handbook_stakeholderengagement__wci__1319577185063 (Accessed March 2019)

- The nature of the impacts that could arise and therefore the types of government bodies, Non-Governmental Organisations (NGOs), academic and research institutions, and other bodies that may have an interest in these issues.

The aim of stakeholder mapping has been to understand stakeholder needs and expectations for engagement and consultation in order to tailor engagement to each type of stakeholder. Stakeholders have been categorized and mapped according to their interest, influence, and how they are likely to be affected by the Project.

A list of stakeholders identified to date based on the above methodology is provided in Table 7-1. This list is not exhaustive and will be updated as the Project progresses.

7.3 STAKEHOLDER ENGAGEMENT ACTIVITIES

This section overviews stakeholder engagement activities regarding the Project that have been carried out to date with a special focus on those activities undertaken that are relevant to the ESIA development. A chronological summary overview of meetings held and feedback from stakeholders, where relevant, is included in Appendix G.

7.3.1 Initial Stakeholder Engagement Activities

Initial engagement involved meetings between JCM representatives and Regional and District Lands Officers to gather information on the land acquisition and compensation process in Malawi, and in relation to the Project. In addition, meetings were held with community leaders and representatives of the land compensation beneficiaries. These early stage meetings were generally focused on developing working relationships between JCM and key local stakeholders who could facilitate positive ties with the community and guide JCM on local priorities and concerns *vis a vis* the Project. The local communities elected their own Project Committee early on in the process to represent them, especially with regard to the land acquisition process. The Project Committee is made up of approximately 16 community members and has been very active since its inception.

7.3.2 Grievance Mechanism

An effective grievance mechanism allows stakeholders to lodge complaints and/or concerns at no cost, without fear of retribution, and with the assurance of a timely response. JCM's Grievance Redress Framework serves as the foundation from which a Project-level Grievance Redress Committee was formed. The formal grievance mechanism and procedures are described in the SEP included as Appendix H. To summarize, the process includes:

- Identification of the grievance through reporting channels;
- Recording of the grievance;
- Assessment to determine priority and significance;
- Acknowledgement of receipt;
- Eligibility determination;
- Investigation culminating in corrective action when necessary;
- Communication on course of action and timeframe;
- Implementation of corrective action and resolution; and Close-out.

Table 7-1: Project Stakeholders.

Stakeholder Category	Stakeholder	Connection to the Project
National Regulatory Bodies - National bodies are of primary importance in terms of establishing policy, granting permits and other approvals for the Project and monitoring enforcing compliance.	Environmental Affairs Department (EAD)	The Project must comply with the Environmental and Social Impact Assessment (ESIA) requirements and to develop environmental management and monitoring plans. The Department is responsible for issuing the Environmental Certificate after an ESIA has been approved.
	Electricity Supply Corporation (ESCOM)	ESCOM is responsible for the procurement, transmission and distribution of electricity to consumers. If the affected communities are to benefit from the electricity by way of community investment, ESCOM may have to play a part in the modalities for household connections. Additionally, the Project can draw on ESCOM's experience in relation to land acquisition for electricity related projects.
	Ministry of Lands, Housing, and Urban Development/Department of Lands	The ministry, through the Department of Lands, is a key stakeholder in the Project due to the management of land issues in Malawi. The department is the final approving authority for land acquisition related matters. It represents the Ministry of Lands, Housing and Urban Development on all matters to do with compensation and resettlement. As such the department has the authority to issue a land lease / registration certificate to JCM. The Ministry also provides land and housing management services to the general public. It draws its mandate from various statutes and policy instruments such as the Land Act.
	Electricity Generation Company of Malawi (EGENCO)	EGENCO is currently the sole generator of electricity in Malawi. The contribution of the Project to the alleviation energy problems will greatly assist EGENCO.

Stakeholder Category	Stakeholder	Connection to the Project
	Malawi Energy Regulatory Authority (MERA)	MERA is the overall regulatory authority for energy in Malawi.
National Government Ministries	Ministry of Gender and Social Welfare	The Ministry of Gender and Social Welfare has an interest in the social welfare of the people throughout the country. Therefore, they will be interested in how the Project is managing impacts on vulnerable groups, including women.
	Ministry of Education, Science and Technology	The Ministry of Education, Science, and Technology would be interested in any access related constraints resulting from the Project as well as any skills training and education related community investment that the Project may support.
	Ministry of Local Government and Rural Development	The Ministry of Local Government and Rural Development provides a link between the central and local governments in Malawi and would thus be interested in ensuring district authorities and other local authorities effectivity participate in the development and authorization of the project according to their legal mandates.
	Finance, Economic Planning and Development Department	Formulates economic fiscal policy and manages financial material resources for the Government for Malawi in order to realize balanced and sustainable economic growth to reduce poverty.
	Natural Resources, Energy and Mining Department	The ministry oversees sustainable development, management and utilisation of energy, minerals and monitoring geo-hazards for socio economic development.
	District Commissioner (DC)	The DC is the overarching local authority for all the development projects in the district. The DC also has the authority to issue the project planning Permit (on behalf of the Department of Physical Planning).

Stakeholder Category	Stakeholder	Connection to the Project
		Additionally, the DC oversees the compensation process for all projects within the District, including payment of compensation and monitoring related activities. The DC's office works hand in hand with the Community Development Officer on matters related to social aspects including community mobilisation and sensitisation on such projects.
	Ministry of Irrigation and Water Development / Water Department	The Water Department is responsible for provision of water supply services including piped rural water supply schemes and boreholes. The Department must be engaged in relation to water use by the Project and any water-related CSR projects resulting from the Project. A water abstraction permit will be required from the Water Resources Authority if the Project requires a borehole or abstraction of surface water for construction and/or operational purposes.
	Ministry of Labour	The Ministry of Labour issues the Workplace Registration Certificate as mandated by the Occupational Safety Health and Welfare Act. It is also responsible for monitoring of workers' health and safety during construction and operation.
Community level– including the GV Pitala and in particular the following villages with PAPs whose customary land will be acquired by the Project: ▪ Ching'anipa ▪ Kalumo ▪ Nsamala	Project affected communities, including residents in surrounding villages and land users	Households and communities that will be directly or indirectly affected by the proposed Project activities. This includes people living in the affected land either by direct land take or by social and environmental impacts.
	Chiefs/Traditional authorities Group Village Heads/Village Heads	Local community leaders act as representatives of their local community. Meeting with Traditional Authorities will follow local practices and be held prior to any wider communication in order to respect the political and social structure.

Stakeholder Category	Stakeholder	Connection to the Project
▪ Kapesi ▪ Chisaka ▪ Chitseko		
Vulnerable groups	May include: ▪ Women headed households ▪ Children headed households ▪ Elderly, physically or mentally disabled ▪ Youth ▪ Low-income household	Vulnerable groups may be disproportionately affected by the proposed Project by virtue of socio-economic status or physical abilities and are therefore less resilient to change. A vulnerability assessment will be required for the Project to identify specific vulnerabilities in the Project Area.
Civil society groups	Community based organisations (CBOs) and cooperatives	Organisations that may be impacted by the Project or that the Project can work with on livelihood development activities. CBOs identified as stakeholders include two Village Savings and Loans groups, Youth Network, and Water Council Network. See Appendix G for more details.
Non-Governmental Organisation(NGO)/ Institutions/ Academic	Includes international, national and local NGOs covering biodiversity/ conservation, human rights, gender and child related issues	NGO and academic institutions are able to influence the success of projects through advocacy and negative media attention. The Project will identify and engage relevant NGOs and institutions to keep them informed about the Project. They may also act as a partner in implementing livelihood or community investment programmes. NGOs identified as stakeholders includes Total Land Care, Water for All, and the Golomoti AIDS Support Organization. See Appendix G for more details.
Commerce and Industry	Local businesses / potential suppliers and contractors	Will be interested in procurement opportunities in relation to the Project. They may also create cumulative impacts. As such the

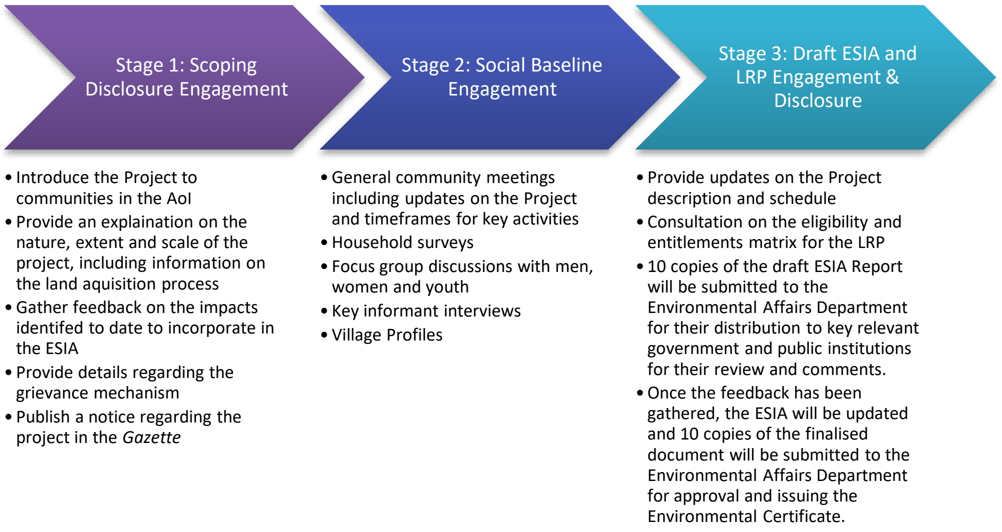
Stakeholder Category	Stakeholder	Connection to the Project
		Project is required to identify industries in the local area and aim to collaborate with them where appropriate.

As part of the general stakeholder engagement activities, and in advance of social baseline activities commencing (Stage 2 described below), an open community meeting was held on March 22, 2019 that was broadly attended by community members residing in the Project Area. During this meeting, JCM explained the purpose, process, and composition of a Project Grievance Redress Committee. Emphasis was placed on ensuring the committee had diverse membership representative of the community, including females, youth, and vulnerable groups. Community members in attendance then selected the representatives to form the committee. Ten total members (3 females and 7 males) were nominated to the committee, including a representative from JCM and community members from different villages, including some who could represent different perspectives in the communities (i.e., youth, religious, and disabled representatives). The committee members have received initial training from JCM on how to identify and record a grievance. Training will be reinforced before Project construction begins.

7.3.3 ESIA Stakeholder Engagement Process

In order to avoid stakeholder fatigue, there are three main stages of engagement that form the ESIA process. These include engaging on scoping and presenting the Project and gathering feedback from communities in the Project Area. A third stage of engagement will be undertaken on drafts of the ESIA and the Livelihood Restoration Plan (LRP), which will include consultation on the identified impacts and associated mitigation measures that have been proposed. This engagement process is presented in Figure 7-1.

Figure 7-1: ESIA Engagement.



- Introduce the Project to communities in the AoI
- Provide an explaination on the nature, extent and scale of the project, including information on the land aquisition process
- Gather feedback on the impacts identifed to date to incorporate in the ESIA
- Provide details regarding the grievance mechanism
- Publish a notice regarding the project in the *Gazette*

- General community meetings including updates on the Project and timeframes for key activities
- Household surveys
- Focus group discussions with men, women and youth
- Key informant interviews
- Village Profiles

- Provide updates on the Project description and schedule
- Consultation on the eligibility and entitlements matrix for the LRP
- 10 copies of the draft ESIA Report will be submitted to the Environmental Affairs Department for their distribution to key relevant government and public institutions for their review and comments.
- Once the feedback has been gathered, the ESIA will be updated and 10 copies of the finalised document will be submitted to the Environmental Affairs Department for approval and issuing the Environmental Certificate.

Source: ERM, 2019.

Stage 1 and 2 of the engagement process has been undertaken and details regarding these are provided below. At the time of writing the ESIA, Stage 3 was pending.

7.3.3.1 Stage 1: Scoping and Disclosure Engagement

ERM undertook a site visit in December 2018 and conducted meetings with stakeholders in Lilongwe and in the Project Area as part of its scoping exercise for the ESIA. In particular, ERM participated along with JCM in a community meeting that included GVH Pitala, seven village headmen, the Village Development Committee, and Project Committee representatives, as well as other community members. The team took advantage of this opportunity to explain the Project, listen to community expectations and concerns, and answer questions, which helped to inform the scoping results described in Section 6.2. See Appendix G for additional details.

In addition, as part of its December 2018 visit, ERM and JCM met with other key stakeholders, including those listed below.

- **Environmental Affairs Department (EAD):** Given that the EAD is the entity responsible for the ESIA process, the meeting focused on potential impacts and mitigations for the planned solar Project, requirements for the ESIA document, and how monitoring and inspections are conducted after the license is granted.
- **Ministry of Lands:** Given that the Ministry of Lands will facilitate the land acquisition process for the Project, the meeting focused on predominant land tenure regimes in Malawi and security thereof, the asset inventory process, market valuation approach, and other legislative requirements.
- **Electricity Supply Corporation of Malawi (ESCOM):** This meeting focused on technical aspects of the Project including the preliminary site layout, transmission, and physical interconnection requirements.

7.3.3.2 Stage 2: Social Baseline Engagement

Stage 2 was carried out between March and June 2019, including a site visit by ERM in June 2019. Activities included general community engagements, household surveys, social baseline participatory discussions, and meetings with district-level authorities, and generally built on dynamic and ongoing engagement between JCM and Project stakeholders. These activities are described in detail in Section 5.3.1, and the outputs are described throughout Section 5.3.

All meetings have been documented, including meeting registrations, photos, and discussion summaries to keep track of stakeholder feedback and concerns. Information gathered from stakeholder feedback has informed the baseline and impact assessment included in this ESIA and will also help to inform the organisation of future engagements and support monitoring and evaluation requirements, as detailed in the SEP.

8. ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

This chapter presents the Environmental and Social Management Plan (ESMP) for the construction and operation of the Project. The ESMP specifies the management and mitigation measures to which JCM is committed and shows how they will mobilise organisational capacity and resources to implement these measures. The objective is to make sure that there are appropriate mitigation measures in place and that the responsible individuals consistently follow them.

The ESMP briefly describes the other E&S management plans that will be developed and implemented for the Project by the EPC Contractor and JCM. It then presents the management procedures (i.e., mitigation measures) that will be implemented during construction and operation, organized by the potential impacts as described in Section 6.4 of the ESIA. Each management procedure includes a schedule for implementation, estimated budget, and institution and/or person responsible for implementation. The ESMP then presents an E&S Monitoring Plan, also organized by the potential impacts as described in Section 6.4 of the ESIA. The ESMP then describes how the ESMP will be implemented, including a description of the Project's E&S organization, roles and responsibilities, training and awareness, communication, documentation, and management of change. The ESMP concludes with a description of procedures for monitoring and review, including inspections, monitoring, audits, corrective actions, and reporting.

8.1 ESMP OBJECTIVES

The objectives of the ESMP are to:

- Ensure compliance with Malawian E&S laws and regulations and ESIA commitments, as well as alignment with international standards;
- Ensure that mitigation measures and commitments made by JCM and identified in the ESIA are taken into account during the construction and operation phases; and
- Establish an E&S monitoring program so that the ESMP can be updated and improved as the Project progresses in order to ensure continuous improvement.

8.2 MANAGEMENT PLANS

8.2.1 Contractor E&S Management Plans

JCM is currently constructing a solar power plant similar to the proposed Project at Salima in Malawi. The EPC contractor for the Salima project is SUMEC. JCM required SUMEC to develop a Construction Environmental and Social Management Plan (CESMP) for the Salima project. JCM reviewed the CESMP to ensure that it aligns with their corporate policies, complies with Malawian laws and regulations, complies with the project's ESIA commitments, and aligns with international standards. JCM has approved the CESMP and it is being implemented by SUMEC for the Salima project.

JCM intends to leverage its experience on the Salima project in regards to the E&S management of the proposed Project. To this end, JCM proposes to utilize the CESMP developed for the Salima project, with minor modifications. The CESMP for the Salima project has, and thus the CESMP for the proposed Project will have, procedures for:

- Soil management;

- Biodiversity management;
- Water management;
- Waste and wastewater management;
- Air quality management;
- Noise management;
- Visual management;
- Heritage resources management;
- Hazardous materials management;
- Traffic management;
- Security management;
- Community health, safety, and security;
- Human resources management; and
- Worker accommodation management.

The mitigation measures specified in the Salima CESMP capture and build upon the mitigation measures in the Salima ESMP described in the Salima ESIA, focusing on those that are the responsibility of the EPC Contractor.

JCM also required SUMEC to develop a Construction Health & Safety Management Plan (CHSMP) for the Salima project. JCM proposes to utilize the Salima CHSMP, with minor modifications, for the Project.

8.2.2 Other E&S Management Plans

Additional E&S management plans will be developed and implemented by JCM to support the implementation of this ESMP. These plans will focus on social management, as the CESMP and CHSMP to be developed by the EPC Contractor will focus on any environmental management procedures beyond those that are captured in this ESMP. The timing of the development of these plans may be staged, ensuring that the appropriate focus and level of detail is provided for construction and operational activities. The social management plans to be developed and implemented by JCM for this Project include:

- Livelihood Restoration Plan;
- STI/HIV Management Plan;
- Human Resources Policy (including a Labour and Employment Plan and Worker Grievance Mechanism);
- Gender Development Plan;
- Transportation Management Plan;
- Community Investment Plan; and
- Stakeholder Engagement Plan (including a Community Grievance Mechanism).

Each of these plans will be a modified version of the social management plans developed for the Salima project. The Golomoti plans will have the same objectives and cover the same set of activities as the Salima plans, but will be modified to meet the unique characteristics of the Golomoti Project. JCM will also seek to improve the plans for Golomoti based on lessons learned from the implementation of the Salima plans. The draft Stakeholder Engagement Plan has been completed and is included as Appendix E of this ESIA. The plan is considered a draft because it is a living document and will be updated as needed throughout the life of the Project.

8.3 MANAGEMENT PROCEDURES

The E&S management procedures presented in this section constitute mitigation measures to avoid, minimise, or compensate for the risks and impacts that have been identified in the ESIA. The management procedures for construction are presented in Table 8-1, and the management procedures for operations are presented in Table 8-2. Management procedures related to decommissioning are discussed in Section 8.3.2.

Table 8-1: Construction Environmental and Social Management Plan.

Ref	Potential Impact Managed/Enhanced	Objective	Mitigation / Avoidance/Enhancement Measures	Schedule for Implementation	Estimated Budget (USD)	Institutional Responsibility
Positive Impacts						
8.1	Employment ■ Employment opportunities and the need for the supply of goods and services has the potential to create jobs for local communities and improve income levels	Provide opportunities to local communities to enhance income levels and skills/ employability, and improve quality of life	1. A recruitment strategy will be established and implemented for staff required before and during construction to enable the community to access job opportunities. 2. Although recruits will require a basic level of skills prior to recruitment, training opportunities and internships will be provided to males and females in local communities in order to enhance their skills, increasing employability and career development opportunities at a later stage. 3. A Gender Development Plan will be developed and implemented to promote gender equality in job opportunities as well as to support the mitigation of gender-based violence and other gender-related issues within the workforce and externally (e.g., in Project-affected communities). 4. Goods and services required for construction and operation will be sourced in Dedza District as much as possible. If a good or service is not available in Dedza District, it will be sourced in Lilongwe and at a national level prior to sourcing outside of Malawi.	Before and during construction	USD 10,000 for review of recruitment performance (1-3) Part of EPC Contractor's bid (4)	JCM Project Manager (1-3) EPC Contractor (4) Quarterly Reports of EPC and JCM activities will be prepared by JCM's EHS Manager
Adverse Impacts						
9.1	Air Quality ■ Site preparation, construction activities, equipment and material, and worker transportation will generate fugitive dust emissions, which could act as a nuisance for nearby sensitive receptors	Minimise deterioration of ambient air quality from construction activities	1. Removal of vegetation and soil cover will be restricted to that which is necessary for the Project. 2. Land clearance will be sequential and the smallest possible area for working will be exposed where ground and earthworks are undertaken. 3. Stripping of topsoil will not be conducted earlier than required (i.e., the Project will maintain vegetation cover for as long as possible) in order to prevent the erosion (wind and water) of organic matter, clay, and silt. 4. A speed limit of 30 kph on unpaved surfaces will be enforced and national speed limits on public roads will not be exceeded. 5. Transported materials will be covered with tarpaulins to prevent fugitive dust. 6. Surface binding agents will be utilized on exposed open earthworks, when feasible. 7. Exposed ground and earthworks will be covered as much as possible with sheeting, shade cloth, or tarpaulin where wind generated dust occurs. 8. Stockpiles stored longer than six weeks will be vegetated or covered with sheeting, shade cloth, or tarpaulin to reduce soil loss from wind or storm water runoff. 9. Stockpiles will be located as far away from receptors as possible and will be covered with sheeting, shade cloth, or tarpaulin. 10. Wind breaks will be erected around key construction activities and, if possible, in the vicinity of potentially dusty works to minimize impacts to the nearby temporary residential accommodation and permanent residential receptors.	Regularly throughout construction	Part of EPC Contractor's bid (1-12) Part of CLO responsibilities (13)	EPC Contractor (1-12) JCM CLO (13) Quarterly Reports of EPC and JCM activities will be prepared by JCM's EHS Manager

Ref	Potential Impact Managed/Enhanced	Objective	Mitigation / Avoidance/Enhancement Measures	Schedule for Implementation	Estimated Budget (USD)	Institutional Responsibility
			11. Construction vehicles will be regularly maintained to minimise exhaust emissions. 12. Vehicles will be switched off when not in use, unless impractical for safety reasons (e.g., maintenance of air conditioning). 13. Complaints received from local community members through the Community Grievance Mechanism will be reported to the CLO.			
9.2	Noise ■ Site preparation, construction activities, equipment and material, and worker transportation will generate noise emissions, which could act as a nuisance for nearby sensitive receptors	Maintain noise levels within required limits of 55 dBA during the day time (07:00- 22:00) and 45 dBA during the night time (22.00 – 07.00)	1. Machines and equipment will be maintained in good working condition and inspected regularly. 2. Equipment and vehicles will be selected in accordance with best available techniques for noise reduction. 3. Vehicle movements within and around the site will be minimised as much as possible. 4. Local screening/site hoardings will be utilised to screen noise where appropriate. 5. Complaints received from local community members through the Community Grievance Mechanism will be reported to the CLO.	Regularly throughout construction phase	Part of EPC Contractor's bid (1-4) Part of CLO responsibilities (5)	EPC Contractor (1-4) JCM CLO (5) Quarterly Reports of EPC and JCM activities will be prepared by JCM's EHS Manager
9.3	Soil ■ Loss of arable soils and reduced soil quality	Avoid soil erosion and the consequent loss of soil quality and quantity	1. Mitigation measures 1-10 for air emissions (Ref. 9.1) are applicable to this impact. 2. Erosion control measures such as intercept drains and toe berms will be constructed where necessary. 3. Access roads will be well drained in order to limit soil erosion.	Regularly throughout construction phase	Part of EPC Contractor's bid (1-3)	EPC Contractor (1-3) Quarterly Reports of EPC activities will be prepared by JCM's EHS Manager
9.4	Groundwater ■ Some of the water to be utilized by the Project during construction is anticipated to be derived from groundwater, which may have an effect on other water users	Prevent the contamination of surface and groundwater and avoid loss of water availability to other water users	1. Water storage solutions (e.g., tanks) will be utilised for water abstracted from the Project borehole and/or brought in by bowsers during the wet season for use during the dry season. 2. Regular monitoring of affected village supplies will be conducted and Project abstraction will cease if the Project has a significant impact on the community boreholes.	Regularly throughout construction phase	Part of the Project's design costs (1) USD 15,000 for monitoring and assessment programme (2)	JCM (1-2) Quarterly Reports of JCM activities will be prepared by JCM's EHS Manager
9.5	Biodiversity ■ Loss of habitats and fauna disturbance ■ Risk of increased invasive alien plants	Minimise impacts on terrestrial flora, fauna, and avifauna during construction	*Loss of Habitats and Fauna Disturbance* 1. Provisions that prohibit staff and contractors from engaging in all forms of hunting and from clearing/utilising plant species in the Project Area will be included in the Worker Code of Conduct.	Prior to and regularly throughout construction phase	USD 1000 for Code of Conduct (1)	JCM (1) and JCM CLO (15) EPC Contractor (2-14)

Ref	Potential Impact Managed/Enhanced	Objective	Mitigation / Avoidance/Enhancement Measures	Schedule for Implementation	Estimated Budget (USD)	Institutional Responsibility
	■ Disruption of ecosystem services		2. Vegetation will be methodically cleared from the Project Site and excavations will be undertaken per designs to avoid unwarranted clearance of vegetation. 3. If feasible, clearance of the 2.9 ha of Secondary Mixed Deciduous Woodland will be removed gradually from one side such that any resident wildlife is provided an opportunity to exit the site. 4. Planning will be conducted in advance to determine the minimum feasible extent required. Predetermined areas will be clearly demarcated on the ground, fenced where appropriate, and enforcement measures will be taken to avoid footprint creep into surrounding areas. 5. Rehabilitation of disturbed areas (e.g., temporary access tracks and laydown areas) will be undertaken following construction. This will be done in such a way as to facilitate natural regeneration of vegetation. 6. Five or more seedlings of the same species will be planted in adjacent areas for each protected tree that is cut down. *Risk of Increased Invasive Alien Plants* 7. Invasive plant species will be removed from areas controlled by the Project. Manual removal will be favoured over mechanised or chemical control measures. 8. Invasive vegetative and/or seed bearing material that is removed through control measures will be contained in a cordoned off area, dried, and burnt on site to prevent the distribution of seeds. 9. Vehicles and construction equipment will be washed on a regular basis and kept clean to minimise the distribution of seeds and invasive plant material. 10. Source areas such as vehicle parking and construction camps will be kept clean of invasive plants to minimise the presence of seeds that can be dispersed unintentionally. 11. Disturbed areas will be rehabilitated at the earliest opportunity to minimise the establishment of invasive plant species. 12. Regular and ongoing monitoring of the presence of invasive plant species will be conducted within construction and rehabilitated sites and removal operations implemented according to the results. *Disruption of Ecosystem Services* 13. Rehabilitation of disturbed areas (e.g., temporary access tracks and laydown areas) will be undertaken following construction. This will be done in such a way as to facilitate natural regeneration of vegetation. 14. Piles of woody vegetation cleared for construction activities will be made available to communities to access it for use as wood fuel or other purposes. 15. Ongoing engagement will be maintained between the Project and local communities, with communities informed in advance of any vegetation clearing to allow pre-harvesting of resources such as wood fuel, mangoes, and building materials.		Part of EPC Contractor’s bid (2-14) Part of CLO responsibilities (15)	Quarterly Reports of EPC and JCM activities will be prepared by JCM’s EHS Manager

Ref	Potential Impact Managed/Enhanced	Objective	Mitigation / Avoidance/Enhancement Measures	Schedule for Implementation	Estimated Budget (USD)	Institutional Responsibility
9.6	Landscape and Visual ▪ Impact on the visual character of the landscape	Minimise the visual impact on surrounding sensitive receptors	1. Ongoing rehabilitation of cleared areas will be conducted to minimise visual scarring. Maintenance clearing will be kept to a minimum and will not extend beyond the Project Site boundary. 2. Excavated and cut and fill areas will be shaped and allowed to revegetate. 3. No debris or waste materials will be left at work sites. 4. Appropriate directional and intensity settings will be utilised for lighting.	Regularly throughout the construction phase	Part of EPC Contractor's bid (1-4)	EPC Contractor (1-4) Quarterly Reports of EPC activities will be prepared by JCM's EHS Manager
9.7	Land Acquisition and Displacement ▪ Economic displacement, in particular of subsistence farmers and land for livestock grazing	Avoid and minimise displacement as well as mitigate negative impacts and enhance positive impacts	1. A Livelihood Restoration Plan (LRP) will be developed, based on the one developed for the Salima project, that includes the following; a. Identification of affected land users; b. Census and asset inventory to assess compensation measures for those affected; c. Assessment of eligibility and entitlements for those affected; d. Identification of gender differentiated and sustainable livelihood improvement and/or restoration measures (e.g., financial literacy training, training on improved farming practices); e. Provisional implementation budgets; f. Roles and responsibilities, including details of an institutional structure/Livelihood Restoration Steering Committee; g. Monitoring and evaluation requirements; and h. Provisional implementation schedule. 2. An inclusive and participatory consultation process will be followed that ensures the participation of women, men, youth, elderly, disabled, and other groups in the decision making process regarding replacement land and livelihood restoration programmes.	August 2019	USD 60,000 for LRP development LRP implementation to be determined	JCM (1-2) Quarterly Reports of JCM activities will be prepared by JCM's EHS Manager
9.8	Walking Paths ▪ The presence of construction equipment and activities during construction may block pathways that provide access to communities and farmland	Minimise restrictions to existing pathways transecting the Project Site	1. Consultation will take place with communities to assess the possibility/need for an alternative walking path that could connect settlements to minimise impacts related to access restrictions without compromising the design of the facility.	Prior to and regularly throughout the construction phase	Part of CLO responsibilities	JCM CLO Quarterly Reports of JCM activities will be prepared by JCM's EHS Manager
9.9	Vector Borne and Communicable Diseases ▪ Construction equipment and activities have the	Avoid increasing the prevalence of vector borne and	1. Workforce training will be provided on communicable diseases, disease prevention, and treatment to raise awareness. 2. Workers will be provided with appropriate gender considerate sanitary facilities that are properly designed to prevent contamination.	Prior to and regularly throughout the	Part of EPC Contractor's bid (1-7)	EPC Contractor (1-7)

Ref	Potential Impact Managed/Enhanced	Objective	Mitigation / Avoidance/Enhancement Measures	Schedule for Implementation	Estimated Budget (USD)	Institutional Responsibility
	potential to create dust emissions and create breeding grounds for vector borne illnesses affecting communities living in villages adjacent to the Project Site ▪ The presence of the workforce during construction in combination with poor sanitary conditions has the potential to increase communicable diseases	communicable diseases	3. A waste handling system will be developed that is sufficient to avoid the creation of new vector breeding grounds. 4. Environmental controls will be established that reduce the presence of standing water on site during site preparation to avoid the creation of new breeding grounds. 5. Project areas, especially the camp, toilet, and eating facilities, will be kept clean and free from accumulation of wastes as well as supplied with clean potable water. This includes ensuring appropriate food preparation and monitoring measures are in place. 6. There will be a first aid area on site to avoid adding pressure on local health facilities. Arrangements will be made with nearby hospitals and clinics, however, so sick Project workers who cannot be fully treated at the Project first aid area can be referred for treatment. 7. Pre-employment screening measures will be developed and implemented to ensure that workers are fit for work, as well as to identify any pre-existing conditions. Individuals found to be suffering from communicable diseases will need to seek treatment prior to mobilisation to the Project Site. No one will be denied employment, however, on the basis of their health status as long as they are able to undertake the required duties (following treatment if relevant). 8. A worker Code of Conduct will be established that includes guidelines on worker-worker interactions, worker-community interactions, and development of personal relationships with members of local communities.	construction phase	USD 2000 for Code of Conduct (8)	JCM (8) Quarterly Reports of EPC and JCM activities will be prepared by JCM's EHS Manager
9.10	STI/HIV Transmission ▪ Increase in STI/HIV transmission and GBV due to worker-community interaction	Avoid Project-related increase in STI/HIV transmission and GBV	1. An STI/HIV Management Plan will be developed and implemented. The plan will include the following measures: a. STI and HIV prevention training to all employees, through workshops, posters, and informal information sessions; b. Medical examinations to determine level of health; workers should also be encouraged to determine their HIV status; c. Supply of condoms at the construction site; d. Development of a Code of Conduct and/or rules for worker-community interaction and onsite behaviour; and e. Support to workers and affected communities to access treatment for STIs, particularly HIV/AIDS, through existing health facilities or NGO campaigns or programmes. 2. A women's NGO that is addressing gender and GBV issues in Golomoti and in Project affected communities will be supported to raise awareness of such issues and to encourage prevention. 3. GBV and sexual abuse will be monitored through general stakeholder engagement and grievance management. 4. Work camp control protocols, while respecting freedom of movement, will be put in place to limit the interactions between non-local workers and the local community.	Prior to and regularly throughout the construction phase	USD 6,000 for STI/HIV Management Plan (1) USD 10,000 for support for NGO (2) Part of CLO responsibilities (3) Part of EPC Contractor's bid (4)	JCM (1-2) and JCM CLO (3) EPC Contractor (4) Quarterly Reports of JCM activities will be prepared by JCM's EHS Manager

Ref	Potential Impact Managed/Enhanced	Objective	Mitigation / Avoidance/Enhancement Measures	Schedule for Implementation	Estimated Budget (USD)	Institutional Responsibility
9.11	Community Safety and Security ▪ Security risk of petty crime, increased GBV, and perceptions that people in the communities are benefitting more than others creating tensions ▪ Worker-community interactions, including the presence of security, may pose a threat to the community	Avoid risks associated with safety and security	1. Security personnel will be trained in safeguarding the community in high tension situations such as any type of protest or community conflicts. This will include training on human rights concepts and include information on local resources that could assist in such situations such as the GVH and TA. 2. Security measures will be implemented to minimise safety risks and the possibility of theft in construction and storage areas. 3. Clear and visible signage will be established in construction areas to warn the community of any risks and hazards and other engagement/communication efforts will be employed to ensure community members are aware of safety risks, as needed. 4. Security personnel will not carry firearms and will comply with Malawian laws and regulations as well as the requirements of the Voluntary Principles on Security and Human Rights. Security procedures will include selection of personnel based on a careful background screening and monitoring of performance. 5. A community engagement programme will be established to provide information about safety hazards and raise awareness of how these are being managed. This includes visits to neighbouring communities and local schools. 6. Community awareness will be raised regarding the Project's Community Grievance Mechanism to address community concerns and issues in a timely manner to avoid issues escalating. This will include the use of the CLO, who will be present around the Project Site before and during construction.	Prior to and regularly throughout the construction phase	Part of EPC Contractor's bid (1-3) Part of CLO responsibilities (4-6)	EPC Contractor (1-3) JCM CLO (4-6) Quarterly Reports of EPC and JCM activities will be prepared by JCM's EHS Manager
9.12	Labour and Working Conditions ▪ The workforce may be subject to poor labour and working conditions	Prevent poor labour and working conditions	1. A Human Resources Policy will be developed, which will include a Labour and Employment Plan and Worker Grievance Mechanism. These will also be reflected in sub-contractor contracts. Key issues within Human Resource (HR) management and contracts will include: a. Provision of clear and understandable information regarding rights under national labour and employment law, and any applicable collective agreements, including those related to hours of work, wages, overtime, and compensation; b. Provision of reasonable working conditions and terms of employment; c. Provision of adequate accommodation (if relevant); d. Provision of employment, compensation/remuneration, and working conditions, including working hours, equal opportunity and fair treatment, and prohibition of discrimination; e. Non-discrimination in all aspects of labour recruitment, management, and exit; f. Provision of adequate welfare facilities on site; g. Implementation of a Worker Grievance Mechanism for Project workers (including sub-contractors); h. Adoption and implementation of a sexual harassment policy; and i. Freedom of association.	Policies and plans will be developed prior to construction (1-2) Other measures regularly throughout the construction phase (3-12)	USD 2000 for HR Policy (1) USD 7000 for Gender Development Plan (2) Part of CLO responsibilities (4) Part of EPC Contractor's bid (5-12)	JCM (1-3) and JCM CLO (4) EPC Contractor (5-12) Quarterly Reports of EPC and JCM activities will be prepared by JCM's EHS Manager

Ref	Potential Impact Managed/Enhanced	Objective	Mitigation / Avoidance/Enhancement Measures	Schedule for Implementation	Estimated Budget (USD)	Institutional Responsibility
			2. A Gender Development Plan will be prepared to promote gender equality in job opportunities and the elimination of gender-based violence, as well as to address other gender-related issues within the workforce and Project-affected communities. 3. Contractors will be supported in adhering to labour and working conditions in compliance with Malawian labour laws and in alignment with IFC PS 2 through awareness raising and information provision, as necessary. 4. A fair and transparent Worker Grievance Mechanism will be developed and implemented. It will be accessible to all workers, whether permanent or temporary, or directly or indirectly employed. The mechanism will be open to the EPC Contractor and subcontractor workers in the event that their grievance is not adequately resolved by their direct employer. 5. The contractor and supplier selection process will ensure that performance with regards to worker management, worker rights, and health and safety as outlined in Malawian law and international standards will be managed and reported. 6. Regular checks of contractors will be undertaken to ensure compliance with applicable labour laws. 7. A health and safety programme will be developed that includes risk assessments (e.g., working at heights, confined space, machine guarding), work permit systems, and a H&S management system, in line with industry best practice, including worker performance safety tracking (safety observations). Workers will receive induction and regular training regarding this system. 8. A hiring mechanism will be established to ensure no employee or job applicant is discriminated against on the basis gender, marital status, nationality, ethnicity, age, religion, or sexual orientation. 9. Workers (including contractors and subcontractors) will, as part of their induction, receive training on worker rights in compliance with Malawian legislation and in alignment with international standards. 10. Workers (including contractors and subcontractors) will have contracts that clearly state the terms and conditions of their employment and their legal rights. Contracts will be verbally explained to workers in their native language when necessary for them to understand their rights. Contracts must be in place prior to workers leaving their home location, if applicable. 11. Workers (including contractors and subcontractor) will have access to training on communicable diseases, STIs, and community interactions in general. This training will be developed in collaboration with local health institutions and local NGOs, if feasible.			
9.13	Cultural Heritage ▪ Removal of living heritage (e.g., sacred trees) and damage to archaeological sites by	Minimise impacts to cultural heritage	1. Additional, limited archaeological excavations will be conducted within the boundaries of the archaeological site identified in the Solar Plant Site. The purpose of these excavations will be to evaluate the integrity and significance of the site and to determine, in consultation with the MITC and Chief Antiquities Officer, if additional archaeological excavations are warranted. Investigations at the site will be done in consultation with the MITC and Chief	Prior to and regularly throughout the construction phase	USD 10,000 (1) Part of CLO's responsibilities (2)	JCM (1 & 3) and JCM CLO (2)

Ref	Potential Impact Managed/Enhanced	Objective	Mitigation / Avoidance/Enhancement Measures	Schedule for Implementation	Estimated Budget (USD)	Institutional Responsibility
	ground-disturbing activities		Antiquities Officer and with required government-issued permits and approvals. 2. Additional stakeholder engagement will be conducted with the local community to develop a plan to transfer the cultural significance/value of the baobab tree living heritage site to another location, if feasible, or otherwise compensate for the loss of this resource. 3. A Chance Find Procedure (CFP) will be developed and implemented. The CFP will set forth the procedures to implement in the event that archaeological resources are encountered during ground disturbing activities. Workers will be trained in identifying chance finds and implementing the CFP.		USD 1000 (3)	
9.14	Unplanned Events - Spills leading to soil and groundwater contamination - Traffic accidents	Minimise the impact of unplanned spills and reduce the risk of traffic accidents impacting community health and safety	1. A Hazardous Spill Response Plan will be developed and spill clean-up and response capability adequate for addressing spills for all phases of the Project will be maintained. Spills will be immediately contained and cleaned up. Contaminated areas will be remediated. 2. A Waste Management Plan will be developed and implemented. 3. Refuelling of equipment and vehicles will be carried out in a designated area (the AST) on hard standing ground to prevent seepage of any spills into the ground. Collection systems will be installed in these areas to manage any spills. Fuels will be collected and either reused or removed by a local contractor. Drip trays will be used when refuelling and servicing vehicles or equipment where there is no hard standing surface. 4. Hazardous material storage will be on hard standing and impermeable surfaces and the storage facility will be bunded. The storage and handling of hazardous materials and fuels will be restricted to bunded areas of sufficient capacity to contain a release. 5. A Traffic Management Plan, driving codes of conduct, and enhanced driver safety awareness will be developed and implemented. 6. Traffic routes will be planned to limit road use by the Project during high traffic periods (including pedestrian traffic) and in sensitive areas such as near schools in order to reduce interaction with public road use. 7. Local road conditions will be assessed and road maintenance discussed during Project construction to minimise traffic risks associated with roads deteriorated from Project activities. 8. Collaboration with relevant local and regional governments will take place to ensure the roads used by Project vehicles are well maintained, and that potential problems or hazards are communicated to the relevant authority in a timely manner. 9. Engagement with local communities and authorities will take place to inform them about plans and procedures. 10. Awareness campaigns will be implemented to address traffic and road safety in communities along the transportation corridor. 11. Driver training will be provided to promote safe and responsible driving behaviour. The training will include contractors and subcontractors.	Plans will be developed prior to construction (1-2 & 5) Other measures regularly throughout the construction phase (3-4 & 6-11)	Part of EPC Contractor's bid (1-4 & 11) USD 7000 for Traffic Management Plan (5) Part of the Project's design costs (6-8) Part of CLO responsibilities (9-10)	EPC Contractor (1-4 & 11) JCM (5-8) and JCM CLO (9-10) Quarterly Reports of EPC and JCM activities will be prepared by JCM's EHS Manager

Table 8-2: Operational Environmental and Social Management Plan.

Ref	Potential Impact Managed/Enhanced	Objective	Mitigation/Enhancement Measures	Schedule for Implementation	Estimated Budget (USD)	Institutional Responsibility
Positive Impacts						
8.1	Economy ■ Generation of electricity	Not applicable				
Adverse Impacts						
9.4	Groundwater ■ Some of the water to be utilized by the Project during operation is anticipated to be derived from groundwater, which may have an effect on other waters users	Prevent the contamination of surface and groundwater and avoid loss of water availability to other water users	1. Regular monitoring of affected village supplies will be conducted and Project abstraction will cease if the Project has a significant impact on the community boreholes. 2. Water storage solutions (e.g., tanks) will be utilized for water pumped during the wet season for use during the dry season.	Regularly throughout operations	Ongoing monitoring costs to be confirmed	JCM Project Manager
9.6	Landscape and Visual ■ Impact from solar reflection	Minimise the visual impact on surrounding sensitive receptors	1. Rehabilitation of disturbed areas (e.g., temporary access tracks and laydown areas) will be undertaken following construction. This will be done in such a way as to facilitate natural regeneration of vegetation. 2. Ongoing engagement will be maintained between the Project and local communities with regards to potential solar reflection impacts.	Regularly throughout operations	No additional costs required	JCM Project Manager
9.8	Walking Paths ■ The presence of a fenced solar site may block pathways that provide access to communities and farmland	Minimise restrictions to existing pathways transecting the Project Site	1. Consultation will take place with communities to assess the possibility/need for an alternative walking path that could connect settlements to minimise impacts related to access restrictions without compromising the design of the facility.	Regularly throughout operations	Part of JCM's operational costs	JCM Project Manager and CLO
9.11	Community Safety and Security ■ Safety hazards may arise from trespassers into the solar plant and those that illegally try to connect to the transmission line	Avoid incidents related to trespassers and opportunists attempting to steal panels or illegally connect to the transmission line	1. The solar farm will be fenced and have security personnel present at all times to avoid trespassers entering the site. 2. Security personnel will not carry firearms and will comply with Malawian laws and regulations as well as the requirements of the Voluntary Principles on Security and Human Rights. Security procedures will include selection of personnel based on a careful background screening and monitoring of performance. 3. Clear and visible signage will be established in hazardous areas to warn the community of any risks and hazards and engagement/communication efforts will be employed to ensure community members are aware of safety risks, as needed.	Regularly throughout operations	Part of JCM's operational costs	JCM Project Manager (1-3) and CLO (3)

Ref	Potential Impact Managed/Enhanced	Objective	Mitigation/Enhancement Measures	Schedule for Implementation	Estimated Budget (USD)	Institutional Responsibility
9.12	Labour and Working Conditions ■ The workforce may be subject to poor labour and working conditions	Prevent poor labour and working conditions	1. The Human Resources Policy, Labour and Employment Plan, and Worker Grievance Mechanism developed for construction will continue to be implemented. 2. The Gender Development Plan developed for construction will continue to be implemented during operation. 3. Contractors will be supported in adhering to labour and working conditions in compliance with Malawian labour laws and in alignment with IFC PS 2 through awareness raising and information provision, as necessary. 4. The Worker Grievance Mechanism developed for construction will continue to be implemented.	Regularly throughout operations	Part of JCM's operational costs	JCM Project Manager
9.14	Unplanned Events ■ Spills leading to soil and groundwater contamination	Minimise the impact of unplanned spills	1. The Hazardous Spill Response Plan developed for construction will continue to be implemented and spill clean-up and response capability adequate for addressing spills for all phases of the Project will be maintained. Spills will be immediately contained and cleaned up. Contaminated areas will be remediated. 2. The Waste Management Plan developed for construction will continue to be implemented. 3. Hazardous material storage will be on hard standing and impermeable surfaces and the storage facility will be bunded. The storage and handling of hazardous materials and fuels will be restricted to bunded areas of sufficient capacity to contain a release.	Regularly throughout operations	Part of JCM's operational costs	JCM Project Manager

8.3.2 Decommissioning

A detailed decommissioning and rehabilitation plan will be developed prior to decommissioning the solar plant and associated infrastructure. This plan will include management of socio-economic aspects such as employment loss, removal, re-use and recycling of materials, and vegetative rehabilitation to prevent erosion.

The decommissioning activities will be similar to construction activities and therefore recommendations outlined to manage construction phase impacts will be adhered to during decommissioning. Management actions will focus on the rehabilitation of disturbed areas and the removal of infrastructure.

It is important to note that JCM and ESCOM may agree to trigger a clause in the PPA that would extend the term beyond 20 years. It is therefore possible the plant will operate beyond the 20 year term of the current PPA. Land leases for the Project are expected to be for 50 years.

8.4 MONITORING PLAN

JCM will undertake environmental and social monitoring during the construction and operation phases. The monitoring commitments are presented in Table 8-3 and Table 8-4.

Table 8-3: Construction Environmental and Social Monitoring Plan.

Ref	Potential Impact Managed/Enhanced	Objective	Monitoring Indicator	Monitoring Frequency	Estimated Budget (USD)	Institutional Responsibility
Positive Impacts						
8.1	Employment and the Economy ▪ Employment opportunities and the need for the supply of goods and services has the potential to create jobs for local communities and improve income levels	Provide opportunities to local communities to enhance income levels and skills/employability, and improve quality of life	1. Number of males and females employed from Project affected communities 2. Number of males and females employed from Dedza District 3. Review of economic trends through baseline monitoring (community level and district level – in Dedza) 4. Number/type/location of suppliers of goods and services	Quarterly reporting by JCM	USD 10,000 for review of recruitment performance (1-3) Part of EPC Contractor's bid (4)	JCM Project Manager (1-3) EPC Contractor (4) Quarterly Reports of EPC and JCM activities will be prepared by JCM's EHS Manager District Commissioner will review JCM's Quarterly Reports
Adverse Impacts						
9.1	Air Pollution ▪ Site preparation, construction activities, equipment and material, and worker transportation will generate fugitive dust emissions, which could act as a nuisance for nearby sensitive receptors	Minimise deterioration of ambient air quality from construction activities	1. Weekly visual inspection logs 2. Audit reports 3. Grievances logged	Weekly visual inspection Quarterly audit reporting by JCM	Part of EPC Contractor's bid (1) Part of EHS Manager (2) and CLO (3) responsibilities	EPC Contractor (1) JCM EHS Manager (2) and CLO (3) Quarterly Reports of EPC and JCM activities will be prepared by JCM's EHS Manager District Environmental Officer will review JCM's Quarterly Reports
9.2	Noise Pollution ▪ Site preparation, construction activities, equipment and material, and worker transportation will generate noise emissions, which could act as a nuisance for nearby sensitive receptors	Maintain noise levels within required limits of 55 dBA during the day time (07:00-22:00) and 45 dBA during the night time (22.00 – 07.00)	1. Equipment/vehicle inspection logs 2. Equipment/vehicle manuals 3. Audit reports 4. Grievances logged	Weekly visual inspection Quarterly audit reporting by JCM	Part of EPC Contractor's bid (1-2) Part of EHS Manager (3) and CLO (4) responsibilities	EPC Contractor (1-2) JCM EHS Manager (3) and CLO (4) Quarterly Reports of EPC and JCM activities will be prepared by JCM's EHS Manager District Environmental Officer will review JCM's Quarterly Reports
9.3	Soil ▪ Loss of arable soils and reduced soil quality	Avoid soil erosion and the consequent loss of soil quality and quantity	1. Weekly visual inspection logs 2. Audit reports 3. Grievances logged	Weekly visual inspection	Part of EPC Contractor's bid (1)	EPC Contractor (1) JCM EHS Manager (2) and CLO (3)

Ref	Potential Impact Managed/Enhanced	Objective	Monitoring Indicator	Monitoring Frequency	Estimated Budget (USD)	Institutional Responsibility
				Quarterly audit reporting by JCM	Part of EHS Manager (2) and CLO (3) responsibilities	Quarterly Reports of EPC and JCM activities will be prepared by JCM's EHS Manager District Environmental Officer will review JCM's Quarterly Reports
9.4	Groundwater ■ Some of the water to be utilized by the project during construction is anticipated to be derived from groundwater, which may have an effect on other water users	Prevent the contamination of surface and groundwater and avoid loss of water availability to other water users	1. Monitoring reports 2. Evidence of water storage solutions 3. Grievances logged	Quarterly reporting by JCM	USD 15,000 for monitoring and assessment programme (1-2) Part of CLO responsibilities (3)	JCM Project Manager (1-2) and CLO (3) Quarterly Reports of JCM activities will be prepared by JCM's EHS Manager EAD will review JCM's Quarterly Reports
9.5	Biodiversity ■ Loss of habitats and fauna disturbance ■ Loss of threatened flora ■ Risks of Increased Invasive plant species ■ Disruption of ecosystem services	Minimise impacts on terrestrial flora, fauna, and avifauna	1. Weekly visual inspection logs (including photographic evidence) 2. Audit reports 3. Grievances logged	Quarterly audit reporting by JCM	Part of EPC Contractor's bid (1) Part of EHS Manager (2) and CLO (3) responsibilities	EPC Contractor (1) JCM EHS Manager (2) and CLO (3) Quarterly Reports of EPC and JCM activities will be prepared by JCM's EHS Manager District Environmental Officer will review JCM's Quarterly Reports
9.6	Landscape and Visual ■ Impact on the visual character of the landscape	Minimise the visual impact on surrounding sensitive receptors	1. Weekly visual inspection logs (including photographic evidence) 2. Audit reports 3. Grievances logged	Quarterly audit reporting by JCM	Part of EPC Contractor's bid (1) Part of EHS Manager (2) and CLO (3) responsibilities	EPC Contractor (1) JCM EHS Manager (2) and CLO (3) Quarterly Reports of EPC and JCM activities will be prepared by JCM's EHS Manager District Environmental Officer will review JCM's Quarterly Reports
9.7	Land Acquisition and Displacement	Avoid and minimise displacement as well as a mitigate negative	1. Monitoring Plan within the Livelihood Restoration Plan (LRP)	Quarterly reporting by JCM	USD 60,000 for LRP development; LRP	JCM is responsible for the development and implementation of the LRP.

Ref	Potential Impact Managed/Enhanced	Objective	Monitoring Indicator	Monitoring Frequency	Estimated Budget (USD)	Institutional Responsibility
	■ Economic displacement, in particular of subsistence farmers and land for livestock grazing	impacts and enhance positive impacts			implementation to be determined	Quarterly Reports of JCM activities will be prepared by JCM's EHS Manager District Commissioner will review JCM's Quarterly Reports
9.8	Access Restrictions ■ The presence of construction equipment and activities during construction may block pathways that provide access to communities and farmland	Minimise restrictions to existing pathways transecting the Project Site	1. Meeting minutes with affected communities to determine and avoid access restrictions 2. Grievances logged	Quarterly reporting by JCM	Part of CLO responsibilities (1-2)	JCM CLO (1-2) Quarterly Reports of JCM activities will be prepared by JCM's EHS Manager District Lands Officer will review JCM's Quarterly Reports
9.9	Vector Borne and Communicable Diseases ■ Construction equipment and activities have the potential to create dust emissions and create breeding grounds for vector borne illnesses affecting communities living in villages adjacent to the Project Site ■ The presence of the workforce during construction in combination with poor sanitary conditions has the potential to increase communicable diseases	Avoid increasing the prevalence of vector borne and communicable diseases	1. Incident Records 2. Worker Code of Conduct 3. Grievances logged	Quarterly reporting by JCM	Part of EPC Contractor's bid (1-2) USD 2000 to develop Code of Conduct (3) Part of CLO responsibilities (4)	EPC Contractor (1-2) JCM (3) and JCM CLO (4) Quarterly Reports of EPC and JCM activities will be prepared by JCM's EHS Manager District Health Officer with support from the officers from the Ministry of Gender will review JCM's Quarterly Reports
9.10	STI/HIV Transmission ■ Increase in STI/HIV transmission and GBV due to worker-community interaction	Avoid Project-related increase in STI/HIV transmission and GBV	1. Health worker outreach reports and number of people targeted by providers 2. Number of condoms distributed 3. Assessment of NGOs addressing GBV and other gender issues 4. Impact monitoring of selected NGO 5. Grievances logged	Quarterly reporting by JCM	USD 6000 for STI/HIV Management Plan (1-3) USD 10,000 for support for NGO (4-5) Part of CLO responsibilities (6)	JCM (1-6) Quarterly Reports of JCM activities will be prepared by JCM's EHS Manager District Health Officer with support from the officers from the Ministry of Gender will review JCM's Quarterly Reports

Ref	Potential Impact Managed/Enhanced	Objective	Monitoring Indicator	Monitoring Frequency	Estimated Budget (USD)	Institutional Responsibility
9.11	Community Safety and Security - Security risk of petty crime, increased GBV, and perceptions that people in the communities are benefitting more than others creating tensions - Worker-community interactions, including the presence of security, may pose a threat to the community	Avoid risks associated with safety and security	1. Incident records 2. Meeting minutes from community engagement, including registers, photos and communication materials 3. Grievances logged	Quarterly reporting by JCM	Part of EPC Contractor's bid (1) Part of CLO responsibilities (2-3)	EPC Contractor (1) JCM CLO (2-3) Quarterly Reports of EPC and JCM activities will be prepared by JCM's EHS Manager District Health Officer with support from the officers from the Ministry of Gender will review JCM's Quarterly Reports
9.12	Labour and Working Conditions - The workforce may be subject to poor labour and working conditions	Prevent poor labour and working conditions	1. Incident records 2. Health and safety training records 3. STI training records 4. Recruitment statistics 5. EPC/contractor contracts 6. Gender Development Plan 7. Worker grievances logged	Quarterly reporting by JCM	Part of EPC Contractor's bid (1-4) USD 2000 for HR Policy (5) USD 7000 for Gender Development Plan (6) Part of CLO responsibilities (7)	EPC Contractor (1-4) JCM (5-6) and JCM CLO (7) Quarterly Reports of EPC and JCM activities will be prepared by JCM's EHS Manager District Commissioner will review JCM's Quarterly Reports
9.13	Cultural Heritage - Removal of living heritage (e.g., sacred trees) and damage to archaeological sites by ground-disturbing activities	Minimise impacts to cultural heritage	1. Chance find records 2. Audit reports	Quarterly reporting by JCM	Part of Project's design costs (1) Part of EHS Manager responsibilities (2)	JCM (1) and JCM EHS Manager (2)
9.14	Unplanned Events - Spills leading to soil and groundwater contamination - Traffic accidents	Minimise the impact of unplanned spills and reduce the risk of traffic accidents impacting community health and safety	1. Weekly visual inspection logs (including photographic evidence) including of hazardous material and waste containment and clean up kits 2. Incident records 3. Waste Management Plan 4. Hazardous Spill Response Plan 5. Driving training records 6. Audit reports 7. Grievances logged	Quarterly reporting by JCM	USD 7000 for Transportation Management Plan Part of EPC Contractor's bid (1-5) Part of EHS Manager (6) and CLO (7) responsibilities	EPC Contractor (1-5) JCM EHS Manager (6) and CLO (7) Quarterly Reports of EPC and JCM activities will be prepared by JCM's EHS Manager EAD and District Commissioner will review JCM's Quarterly Reports

Table 8-4: Operational Environmental and Social Monitoring Plan.

Ref	Potential Impact Managed/Enhanced	Objective	Monitoring Indicator	Monitoring Frequency	Estimated Budget (USD)	Institutional Responsibility
Positive Impacts						
8.1	Economy ■ Generation of electricity	Not applicable				
Adverse Impacts						
9.4	Groundwater ■ Some of the water supply to be utilized by the Project during operation is anticipated to be derived from groundwater, which may have an effect on other waters users	Prevent the contamination of surface and groundwater and avoid loss of water availability to other water users	1. Monitoring reports 2. Evidence of water storage solutions 3. Grievances logged	Bi-annual Audit Reports by JCM	Ongoing monitoring costs to be confirmed	JCM Project Manager (1-3) EAD will review JCM's Bi-annual Audit Reports
9.6	Landscape and Visual ■ Impact from solar reflection	Minimise the visual impact on surrounding sensitive receptors	1. Audit reports 2. Grievances logged	Bi-annual Audit Reports by JCM	Part of JCM's operational costs	JCM Project Manager (1) and CLO (2) EAD will review JCM's Bi-annual Audit Reports
9.8	Access Restrictions ■ The presence of a fenced solar site may block pathways that provide access to communities and farmland	Minimise restrictions to existing pathways transecting the Project Site	1. Meeting minutes with affected communities to determine and avoid access restrictions 2. Grievances logged	Bi-annual Audit Reports by JCM	Part of JCM's operational costs	JCM Project Manager (1) and CLO (2) District Commissioner will review JCM's Bi-annual Audit Reports
9.11	Community Safety and Security ■ Safety hazards may arise from trespassers into the solar plant and those that illegally try to connect to the transmission line.	Avoid incidents related to trespassers and opportunists attempting to steal panels or illegally connect to the transmission line	1. Incident records 2. Signage in hazardous locations 3. Community engagement records, including registers, photos, and communication materials 4. Grievances logged	Bi-annual Audit Reports by JCM	Part of JCM's operational costs	JCM Project Manager (1-2) and CLO (3-4) District Commissioner will review JCM's Bi-annual Audit Report
9.12	Labour and Working Conditions ■ The workforce may be subject to poor labour and working conditions	Prevent poor labour and working conditions	1. Incident records 2. Health and safety training records 3. Worker grievances logged	Bi-annual Audit Reports by JCM	Part of JCM's operational costs	JCM Project Manager (1-2) and CLO (3) District Commissioner will review JCM's Bi-annual Audit Reports
9.14	Unplanned Events	Minimise the impact of unplanned spills	1. Annual review of plans 2. Incident records	Bi-annual Audit Reports by JCM	Part of JCM's operational costs	JCM Project Manager (1-2)

Ref	Potential Impact Managed/Enhanced	Objective	Monitoring Indicator	Monitoring Frequency	Estimated Budget (USD)	Institutional Responsibility
	■ Spills leading to soil and groundwater contamination					EAD will review JCM's Bi-annual Audit Reports

8.5 IMPLEMENTATION

The Project is committed to providing resources and establishing the systems and components essential for the implementation and control of the ESMP. These include appropriate human resources with specialised skills, training programmes, communication procedures, documentation control, and a management of change procedure.

8.5.1 Organisation

JCM is ultimately responsible for the management and supervision of Project activities and will have principal responsibility for implementing this ESMP and its mitigation measures. During construction, the Project will delegate some responsibility to the EPC Contractor. JCM will be responsible for operation but may engage contractors for certain operational aspects and in these cases, contractors would be delegated some responsibility for environmental and social performance. As a contractual requirement, the contractors will be required to demonstrate compliance of their activities with the ESMP. This includes providing resources to ensure compliance of subcontractors and a process for emergency stop-work orders in response to monitoring triggers. JCM will manage its contractors to ensure that this ESMP is implemented and monitored effectively through contractual mechanisms and regular direct oversight.

8.5.2 Roles and Responsibilities

The roles and responsibilities of the team responsible for implementing this ESMP are listed in Table 8-5. Supervision of contractor activities will be the responsibility of the Project Manager. The Project's Construction Manager and EHS Manager will be placed locally at the Project Site to supervise contractors and subcontractors during construction, while the Project's Operations Manager and EHS Manager will supervise personnel and contractors during operational activities. The CLO will be responsible for engagement with stakeholders, including local communities, to obtain and maintain the Project's social license to operate, which is crucial for the success of the Project.

Table 8-5: ESMP Implementation Roles and Responsibilities.

Position	Responsibility
Project Manager	Responsible for technical aspects of the Project, including contractor and subcontractor supervision during construction.
EHS Manager	Responsible for ensuring that the Project, including contractors and subcontractors, complies with applicable Malawian environment, social, health and safety, and labour laws and regulations, as well as ESIA commitments, including implementation of the mitigation measures set forth in the ESMP. Also responsible for ensuring that the Project aligns with applicable international standards.
Community Liaison Officer (CLO)	Responsible for engaging with local communities, government regulators, and other stakeholders on behalf of the Project. Also responsible for implementing EHS awareness and education programmes with communities.
EPC Contractor	Responsible for subcontractor technical and EHS performance and compliance.

8.5.3 Training and Awareness

The Project will identify, plan, monitor, and record training needs for personnel whose work may have a significant adverse impact on the environment or social conditions. The Project recognises that it is important that all employees are aware of the Project's environmental and social commitments, potential impacts of their activities, and roles and responsibilities in complying with this ESMP.

Key staff will be appropriately trained in key areas of EHS management and operational control with core skills and competencies being validated on an on-going basis. The identification of training and awareness requirements and expediting of identified training/awareness events will be the responsibility of the EHS Manager. This will be achieved through a formal training process. Employee training will include, as applicable to each employee's responsibilities, awareness and competency with respect to:

- E&S impacts that could potentially arise from their activities;
- Legal requirements for E&S performance;
- Necessity of complying with ESIA and ESMP commitments in order to avoid or reduce E&S impacts;
- Activity-specific training on waste management practices, documentation systems, and community interactions; and
- Roles and responsibilities to achieve compliance, including management of change and emergency response.

The EHS Manager is responsible for coordinating training, maintaining employee training records, and ensuring that training needs are monitored and reviewed on a regular basis. The EHS Manager will also periodically verify that staff are performing competently through discussion and observation.

Employees responsible for performing site inspections will receive additional training, drawing on external resources as necessary. Training will be coordinated by the EHS Manager prior to commissioning of the facilities. Upon completion of training and once deemed competent by management, staff will be ready to train other people.

JCM will also require that contractors and subcontractors institute training programmes for their personnel. Each contractor and subcontractor is responsible for providing EHS awareness training for personnel working on the Project Site. Contractors and subcontractors are also responsible for identification of any additional training requirements to maintain required competency levels.

8.5.4 Communication

The Project will maintain a formal procedure for communications with regulatory authorities and local communities. The EHS Manager will be responsible for communication of EHS issues with regulatory authorities, as required. The Project Manager will be kept informed of such communications and pertinent information arising from these communications will be communicated to contractors and subcontractors through the EHS Manager.

The CLO will be responsible for disseminating information and coordinating communications with local communities and other stakeholders through the course of the Project. The Project will implement a Community Grievance Mechanism whereby community members can raise any issues of concern. Grievances may be verbal or written and are usually either specific claims for damages/injury or complaints or suggestions about the way that the Project is being implemented. When a grievance has been brought to the attention of the Project team, it will be logged and evaluated. The person or group filing the grievance is required to present grounds for making a complaint or claiming loss so that a proper and informed evaluation can be made.

When a complaint or claim is considered to be valid, steps will be taken to address the issue or reach agreement on compensation for the loss. In all cases, the decision made and the reason for the decision will be communicated to relevant stakeholders and recorded. When there remains disagreement on the outcome, an arbitration procedure may be required to be overseen by a third party (e.g., government official). Local community stakeholders will be informed on how to access and utilize the Community Grievance Mechanism.

8.5.5 Documentation

The Project will control EHS documentation, including management plans, associated procedures, checklists, forms, and reports through a formal procedure. All records will be kept on site and will be backed up at offsite locations (including secure cloud storage facilities). Records will be kept in both hard copy and electronic formats. All records will be archived for the life of the Project.

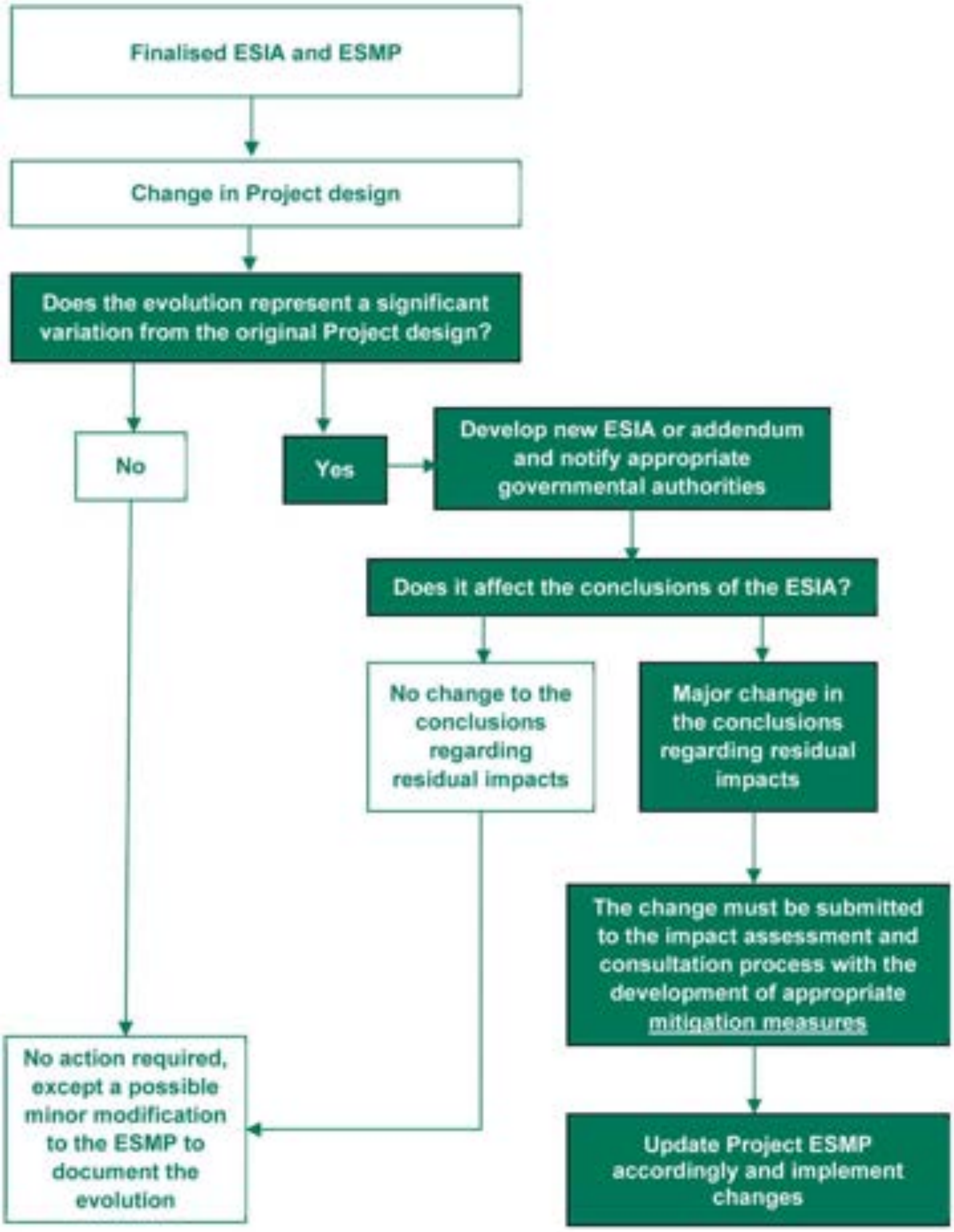
The EHS Manager will be responsible for maintaining a master list of applicable EHS documents and making sure that this list is communicated to appropriate parties. The EHS Manager will be responsible for providing notice to the appropriate parties of changes or revisions to documents, for issuing revised copies, and for checking that the information is appropriately communicated within the parties’ organisations.

Contractors and subcontractors will be required to develop a system for maintaining and controlling their own EHS documentation and to describe these systems in their respective EHS plans.

8.5.6 Management of Change

Gaps and uncertainties inevitably remain in terms of information regarding the proposed Project and the ESIA process at the time of writing this report. As a result, JCM will implement a clear and transparent Management of Change Procedure in order to take gaps and uncertainties into account as they arise. Uncertainties remaining about the timetable and logistics for the Project must be addressed in a structured and transparent manner. The decision tree that JCM proposes to follow in order to manage these uncertainties is depicted in Figure 8-1.

Figure 8-1: Management of Change Decision Tree.



Source: ERM

8.6 MONITORING AND REVIEW

The Project's monitoring and review program will include inspections, monitoring, audits, corrective actions, and reporting. The objective of the program is to assess the effectiveness of the implementation of the ESMP.

8.6.1 Inspections

Internal EHS inspections will be conducted weekly on an ad hoc basis and formally at least once every six months. During construction, inspections will be conducted by the EPC Contractor and JCM, as specified in Table 8-3. The results of inspections will be reported to the EHS Manager, who will recommend actions to the Project Manager to address non-compliances and improve performance. During operations, inspections will be carried out by the Project Manager and designated staff as specified in Table 8-4.

The Project will also facilitate any external inspections by governmental regulators. The results of these inspections will be reported to the EHS Manager and the Project Manager. The EHS Manager will be responsible for responding to any observations during these external inspections, and the Project Manager will be responsible for ensuring that contractors and subcontractors implement any required corrective actions.

8.6.2 Monitoring

Monitoring will be conducted to ensure compliance with ESIA and ESMP commitments, including the mitigation measures listed in Table 8-1 and Table 8-2. Monitoring parameters are listed in Table 8-3 and Table 8-4. The results of monitoring will be documented in Quarterly Reports or as otherwise specified in Table 8-3 and Table 8-4.

In addition, lenders may require monitoring of the Project's compliance with the E&S requirements specified in loan agreements and general alignment with lender E&S standards.

8.6.3 Audits

Beyond the routine inspection and monitoring activities, audits will be carried out internally by the Project to ensure compliance with regulatory requirements. Audits will also cover contractor self-reported monitoring and inspection activities. Audits will be performed by qualified staff, and the results will be reported to the EHS Manager and Project Manager.

Audit will include an assessment of compliance with ESIA and ESMP requirements, and will minimally include:

- Completeness of EHS documentation, including planning documents and inspection records;
- Compliance with monitoring requirements;
- Efficacy of activities to address non-conformances with monitoring requirements; and
- Training activities and record keeping.

There will also be a cycle of audits into specific areas or activities of the Project. The frequency of audits will be risk-based and will vary with the stage of the Project, and will depend on the results of previous audits.

8.6.4 Corrective Actions

The Project will implement a formal non-compliance and corrective action tracking procedure for investigating the causes of, and identifying corrective actions to, accidents or E&S non-compliances. This will ensure coordinated action between JCM and its contractors and subcontractors. The EHS Manager will be responsible for keeping records of corrective actions and for overseeing the modification of E&S procedures and/or training programs to avoid repetition of non-compliances. The Project Manager will be responsible for ensuring that contractors and subcontractors implement corrective actions.

8.6.5 Reporting

If required, the Project will provide appropriate documentation of EHS related activities, including internal inspection records, training records, and reports, to governmental authorities. Contractors and subcontractors will be required to provide EHS performance reporting to the Project on a regular basis through weekly and monthly reports. These will be used as inputs to the above. Quarterly and annual monitoring reports will be provided to government authorities as requested.

9. CONCLUSION AND RECOMMENDATIONS

This report presents the results of an Environmental and Social Impact Assessment (ESIA) of the Golomoti Solar Project. Environmental Resources Management (ERM) conducted the ESIA and prepared this ESIA Report as part of a larger Feasibility Study being conducted by Power Engineers. Power Engineers is conducting the Feasibility Study under a grant from the United States Trade and Development Agency (USTDA). This ESIA Report is designed to comply with Malawian laws and regulations, specifically the Environmental Management Act of 1996 and the Environmental Affairs Department (EAD) Guidelines for Environmental Impact Assessment (www.sdnp.org.mw/enviro/eia). It is also designed to align with international lender standards, specifically the International Finance Corporation (IFC) Performance Standards on Environmental and Social Sustainability (2012). This is because: 1) the ESIA is being funded by the USTDA; and 2) the Project proponent is committed to aligning with the IFC Performance Standards in its Environmental and Social (E&S) Policy. Baseline studies for the ESIA were conducted by Geoconsult Limited (Geoconsult) and Water Waste and Environment Consultants (WWEC), both based in Lilongwe, under subcontract to Power Engineers and ERM, respectively.

The Project proponent is Golomoti JCM Solar Corporation Limited (JCM). Project sponsors include JCM Power, InfraCo Africa, and the Project's development partner is Matswani Capital (PTY). JCM Power is an independent power producer (IPP) dedicated to accelerating social, economic, and environmental sustainability in growth markets through the development, construction, and operation of renewable energy facilities and high voltage direct current (HVDC) transmission lines. InfraCo Africa seeks to alleviate poverty by mobilising private sector expertise and finance to develop infrastructure projects in sub-Saharan Africa.

9.1 IMPACT SUMMARY

The potential impacts assessed in this ESIA Report were determined based on the results of a scoping exercise, which is described in Section 6.2.

Positive impacts are expected through the generation of electricity and job creation. The generation of 20 MW of power will lead to a 7.4% increase in the generation capacity of Malawi, representing a significant benefit to the macro economy of the country. The employment of approximately 200 people is anticipated for the construction phase, and approximately 20 people for the operation phase.

The only potential impact assessed to be major was economic displacement. Potential impacts assessed to be moderate are dust emissions, noise emissions, soil erosion, groundwater abstraction, disruption of ecosystem services, landscape and visual changes, increase in vector borne and communicable diseases, increase in STI/HIV transmission, poor labour and working conditions, damage to archaeological resources, and loss of baobab tree.

Unplanned events identified as a result of scoping are spills and improper disposal of waste to soils and groundwater, as well as traffic accidents. The impact significance (pre-mitigation) of spills was assessed to be major for both construction and operation, and the impact significance of traffic accidents was assessed to be major for construction.

9.2 CONCLUSION

Positive impacts are expected through the generation of electricity and job creation. The generation of 20 MW of power will lead to a 7.4% increase in the generation capacity of Malawi, representing a significant benefit to the macro economy of the country. The employment of approximately 200 people is anticipated for the construction phase, and approximately 20 people for the operation phase. Enhancement measures have been included in the ESMP (Section 8) to maximise the positive impacts. Regarding potential negative impacts, management and mitigation measures have been included in the ESMP to reduce the impacts identified by the ESIA process. There are no residual impacts of major significance.

Economic displacement is the only residual impact of moderate significance. Land Acquisition will be undertaken in close coordination with the Ministry of Lands. No physical displacement is anticipated. A Livelihood Restoration Plan (LRP) is being developed in parallel with the ESIA. The plan will evaluate the extent and scale of displacement impacts and address engagement related to land acquisition, eligibility and entitlements for affected persons, and implementation, monitoring, and evaluation requirements.

Unplanned events identified during scoping include spills and improper disposal of waste to soils and groundwater, as well as traffic accidents. Preventive measures have been included in the ESMP to reduce their likelihood and impact. With these measures in place, the likelihood and risk of unplanned events would be significantly reduced.

9.3 RECOMMENDATIONS

JCM is committed to working with the local community and authorities during the construction and operation of the Project and will maintain open dialogue as part of their ongoing stakeholder engagement activities. JCM is also committed to implementing the management procedures (i.e., enhancement, management, mitigation, and preventive measures) detailed in Table 8-1 (construction) and Table 8-2 (operation) of the ESMP, as well as the monitoring procedures detailed in Table 8-3 (construction) and Table 8-4 (operation) of the ESMP. As a result, it is recommended the Project be approved and proceed as planned.

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APPENDIX A ENVIRONMENTAL AFFAIRS DEPARTMENT TERMS OF REFERENCE

December 14, 2018

Telephone: 01 771 111
Telefax No.: 01 773 379
Our Reference No.: EAD 99/07/05
Your Reference No..

Communications should be addressed to:
The Director of Environmental Affairs

ENVIRONMENTAL AFFAIRS DEPARTMENT
LINGADZI HOUSE
CITY CENTRE
PRIVATE BAG 394
LILONGWE 3
MALAWI

14th December, 2018

The Country Director
JCM Matswani Solar Corporation Limited
P.O. Box 378
LILONGWE

Dear Sir,

RE: PROJECT BRIEF FOR PROPOSED INSTALLATION OF GOLOMOTI SOLAR POWER PROJECT IN DEDZA

Reference is made to your project brief which was submitted to the Department on above captioned subject.

Considering the nature and size of the proposed project, I wish to inform you that you are required to conduct an Environmental and Social Impact Assessment (ESIA) before implementation of the proposed activities on the site. Find attached Terms of Reference for conducting the ESIA.

Should you require any further information or clarification on the foregoing, please do not hesitate to contact us.

Yours faithfully,

Shamiso Najira
FOR: DIRECTOR OF ENVIRONMENTAL AFFAIRS

Attd: Terms of Reference for ESIA

Terms of Reference for Environmental and Social Impact Assessment for the Golomoti Solar Power Project in Dedza

1. Provide a full description of the nature/components of the proposed Golomoti Solar Power Project with respect to the name and addresses of the proponent, aim and objectives of the proposed project; the spatial location of the site for the project with aid of appropriate maps. In addition, describe the estimated cost of the project, source of funding, the size of land for the project, the number of people to work on the area (provide a breakdown in terms of locals and non-locals, male and female).
2. Describe potential social and economic impacts of the proposed Golomoti Solar Power Project.
3. Describe main activities to be undertaken in implementation of the proposed Golomoti Solar Power Project in Dedza.
4. Provide a concise description of the project area focusing on relevant physical, biological and socio-economic resources and conditions, including any changes anticipated during construction and operations of Golomoti Solar Power project.
5. State reasons for selecting Golomoti for the Solar Power Project and not other areas.
6. Predict potential environmental impacts associated with the proposed Golomoti Solar Power Project at and around the site, focusing on both the positive and negative impacts. The impacts should include:
    a) Project location (loss of gardens by local people, loss of flora , risks of soil erosion)
    b) Construction and installation of infrastructure (risks of accidents, soil erosion ,influx of people etc)
    c) Operations of solar power Project (risks of sewage discharge, generation of solid wastes, increase in surface run off discharge etc)
7. Prescribe measures to eliminate, reduce or mitigate the negative effects identified 6 above and measures to enhance the positive effects.
8. Propose an Environmental and Social Management Plan by which all of the measures prescribed in 7 above, will be carried out. In the Environmental and Social Management Plan, suggest budget for the recommended mitigation measures, specifications of who will be responsible for these measures and the schedule when these measures will take place during both construction and operational phases of Golomoti Solar Power Project in Dedza.

9. Propose an Environmental and Social Monitoring Plan by which all mitigation measures recommended in Environmental and Social Management Plan will be monitored. The plan should include the activities, the frequency of monitoring, the key monitoring indicators, and identification of authorities responsible for monitoring the exercises.

10. Provide an account of all statutory and regulatory licences and approvals to be obtained for the proposed Solar Project to ensure that implementation of the project follows sound environmental management practices and are in compliance with relevant existing legislation. Reference should at least be made to the National Environmental Policy, Environment Management Act, Malawi National Energy Policy, Energy Regulations Act, Electricity Act, Occupational Safety, Health and Welfare Act, Physical Planning Act (2016), National Water Policy, Water Works Act, Public Health Act, and other relevant policies and pieces of legislation.

11. Undertake stakeholder consultations to ensure that key interested stakeholders are involved in the environmental impact assessment process. Incorporate their views in the report and indicate a record of consultations in the appendices part of the report.

12. Recommended composition of ESIA team. A team of qualified experts should include the following:
    a) **A Senior Urban Planner and ESIA Expert with Masters Degree** – Team Leader, over 15 years experiences in Environmental and Social Impact Assessment for large scale projects
    b) **A Senior Socio – Economist and ESIA Expert** with Masters Degree with over 10 years experiences in socio-economic appraisal of projects
    c) **Structural Engineer with minimum of Bachelor of Science degree** with over 5 years experiences in related assignment

13. **Format and structure of the report:**
    The format of the report shall as much as possible follow the recommended structure within the Guidelines for Environmental Impact Assessment in Malawi (1997) as outlined on pages 33 – 36 and 53 – 59 available at Environmental Affairs Department in Lilongwe. All maps and figures in the report shall be presented in colour to portray the themes clearly and should be drawn to a suitable and readable scale.

14. **Deliverables:**
    The consultant shall produce and submit 20 Draft Environmental and Social Impact Assessment Reports to Environmental Affairs Department.

APPENDIX B HYDROLOGY AND FLOOD RISK ASSESSMENT (GEOCONSULT)

April 2019

GEOCONSULT

GOLOMOTI SOLAR PV

HYDROLOGY AND FLOOD RISK ASSESSMENT

POWER ENGINEERS

Contents

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List of Abbreviations

Q_t	Peak Discharge (m^3/s)
C_t	Runoff Coefficient
T_C	Time of concentration (hours)
I_t	Rainfall Intensity (mm/h)
A	Catchment Area (km^2)
L	Length of river run (km)
S	Gradient of river (%)
WBH	Water Borehole

1. Site Investigations

1.1 Scope

The scope of the project is to identify flood risks associated with the following components:

- Rainfall
- Groundwater flow
- Water stagnation
- 1:2, 1:5, 1:10 1:25 and 1:100 year flood lines
- Properties of aquifers on site

1.2 Site Location

The site is located below the Bangwe escarpments in the Golomoti township. The site borders the main M5 road, and an access road perpendicular to the M5 leading to an ESCOM substation indicated in figure 1 below. The site is currently being used for subsistence farming and currently does not house any residential buildings.

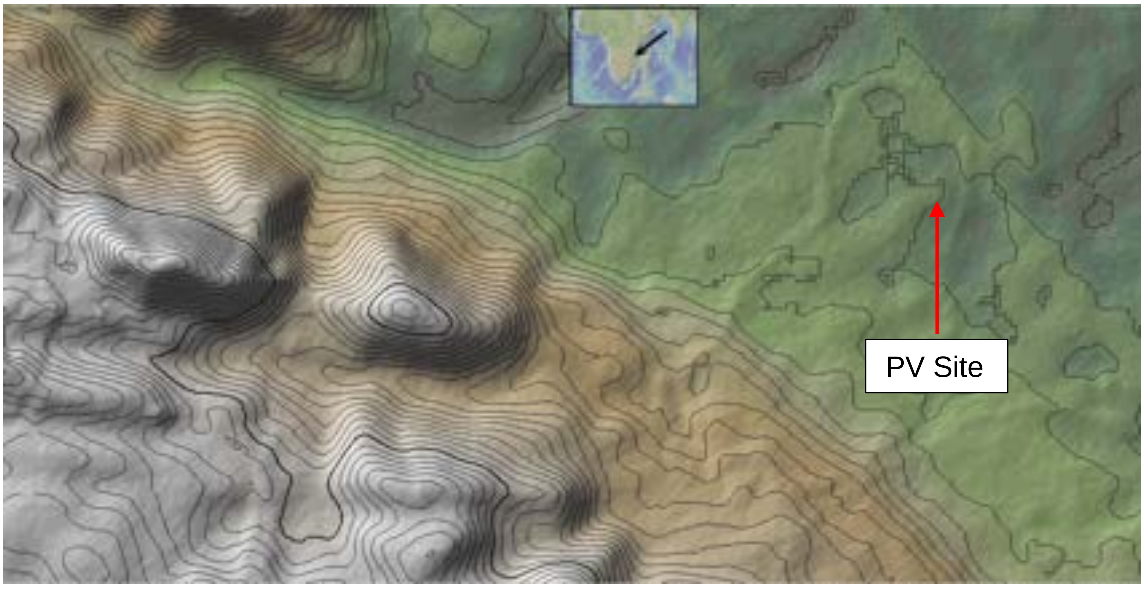
The two roads are significant as they not only allow for access to a large section of the site, but they act as barriers to free flowing water, this is a substantial feature for any floodplain modelling.

Site boundary, regional location and coordinates are shown in figure 1 below.

Coordinates UTM 36L
672468.00 m E , 8403648.00 m S

Figure 1: Site Boundary Indicated in Red

1.3 Regional Topography



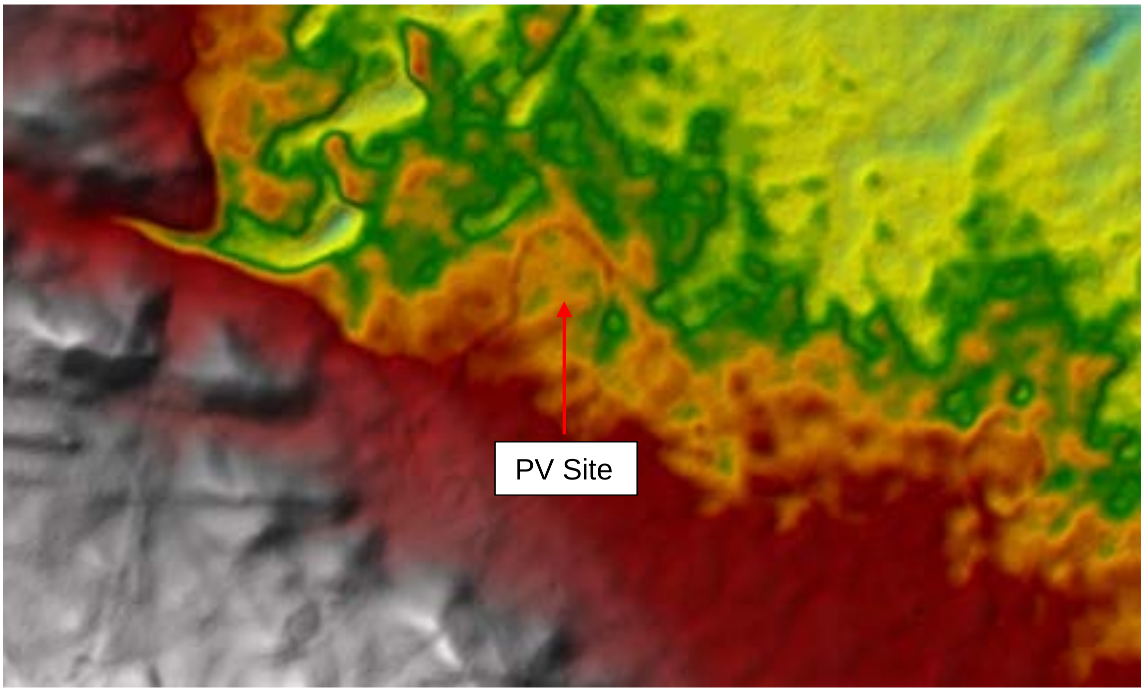


Figure 2: Topographic Mapping

The catchment area has a varied range in topography, starting in the Bangwe forrest reserve / escarpments and finally finishing in the flat planes of the Golomoti. Due to the Livulezi river in to the North east of the site and the current topographical make-up of the mountain range's discharge points, the majority of water flowing down the escarpment is diverted north of the site into the river.

Any excess water build up is channelled through the two culverts located on the main road, shown in figure 15 in the appendix that discharge to a stream further downhill.

2. Site Data Processing

2.1 Catchment Hydrology

The size of the catchment area was calculated based off two different topographic software models. Two different models were needed to achieve a greater understanding of the ground elevation and slope on the flat flood plains. Due to the access road leading to the substation, the adjacent catchment is broken up and forms part of the site's catchment which was measured at 3.5km^2.

Figure 3: Catchment Area

One assumption of the data is that the flood producing rainfall falls uniformly across the catchment area, and the duration of the rainfall is equal to the time of concentration. Time of concentration is defined as the time it takes for rainfall that lands at the furthermost point of the catchment to contribute to the outlet. Peak flow will occur when the entire watershed is contributing to the catchment outlet. In this case the 'Discharge point labelled in figure 3

The rational method was adopted to calculate the selected return period flood discharges, this method in particular was chosen due to the catchment being less than 20km^2 and the availability of data and parameters required for calculations. The return period floods that were determined included 2, 10, 25, 50, 100 year discharges.

2.2 Rainfall Zone Identification

Rainfall intensity data was taken from a study into the rainfall patterns across Malawi, the data breaks up intensity in mm/h with varying return periods across the country.

The rainfall intensity zone used for the flood risk assessment was Central Lakeshore Plains and Escarpments. The table of intensity and return periods is given in figure 13, section 5.1 in the Appendix.

2.3 Calculated Data

In order to accurately model the potential flood lines, the peak discharge and the time of concentration must first be calculated for 2, 10, 25, 50 and 100 year floods.

Rainfall intensity from figure 13 can only be taken once the time of concentration is known. T_C is calculated using equation1 below:

Equation 1: Time of concentration

$$T_c = \frac{1.286\ L}{A^{0.223}\ S^{0.263}} = \mathbf{5.26h}$$

Where:

L = 3.1 km

A = 3.5 km^2

S = 0.12

With T_C known, the below rainfall intensity data is taken from figure 13 for a duration of 6 hours.

Table 1: Return period against rainfall intensity

Return Period (Years)	Rainfall Intensity (mm/h for 6h)
2	15.2
10	24.7
25	29.6
50	33.2
100	36.9

With the rainfall intensity known, peak discharge can be calculated using equation 2 below:

Equation 2: Peak discharge

$$Q_t = 0.278\ C_t\ I_t\ A$$

Where:

Ct = 0.3

Substituting the rainfall intensity into equation 2 the following peak discharge flow for the given return periods are calculated and given in table 2.

Table 2: Return period against peak discharge

Return Period (Years)	Peak Discharge m^3/s
2	4.4
10	7.2
25	8.6
50	9.7
100	10.8

3. Flood Modelling

In order to model the flood lines for the various peak discharges the program HEC-RAS was used. HEC-RAS was developed by the US Army Corps of Engineers to model river hydraulics through a network of open channels, floodplains and alluvial fans. Inputting topographic and terrain modelling obtained through GMRT global elevation data, HEC-RAS modelled the sections across the design site that would pose a risk due to elevated water levels. The discharge of the culverts was taken into consideration when modelling the flow, and effective discharge was accounted for. As well as the design flood levels being shown, a 2 year flood model with no culvert discharge was calculated in figure 9 to show the importance of maintaining functioning culverts.

Standing water was observed along the roadside as depicted in figure 14, the standing water at this location is a typical occurrence during the rains. This is located in front of culvert 1 and drains downstream when it overflows. This does not pose any flood risk to the site and acts as a temporary reservoir before evaporating or discharging downstream.

Maximum water level depth was calculated at 0.8m in 1:100 year in the section displayed in figure 10, this water level is equal for both areas of standing water on site. With the culverts in functioning order these are the only major sections within the site boundary to have standing water for all return periods.

Table 3: Return period against max water table

Return Period (Years)	Calculated max water depth (m)
1:2	0.5
1:10	0.68
1:25	0.75
1:50	0.79
1:100	0.84

Figure 4: 2 Year Flood

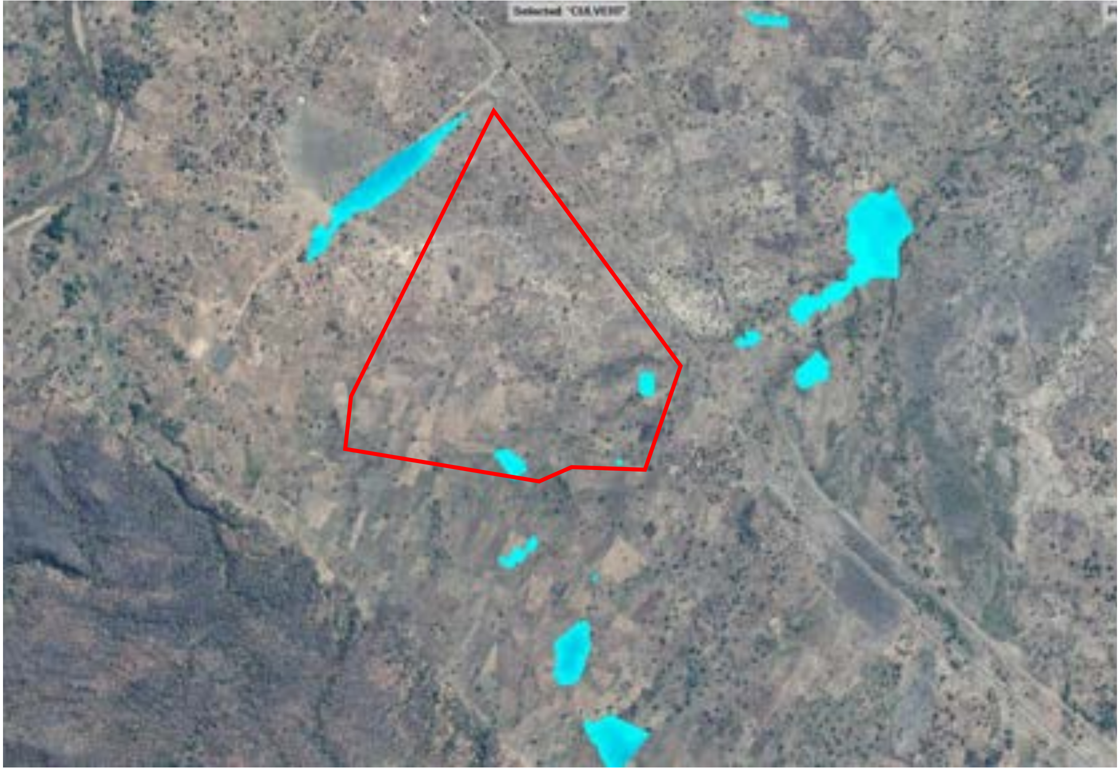


Figure 5: 10 Year Flood

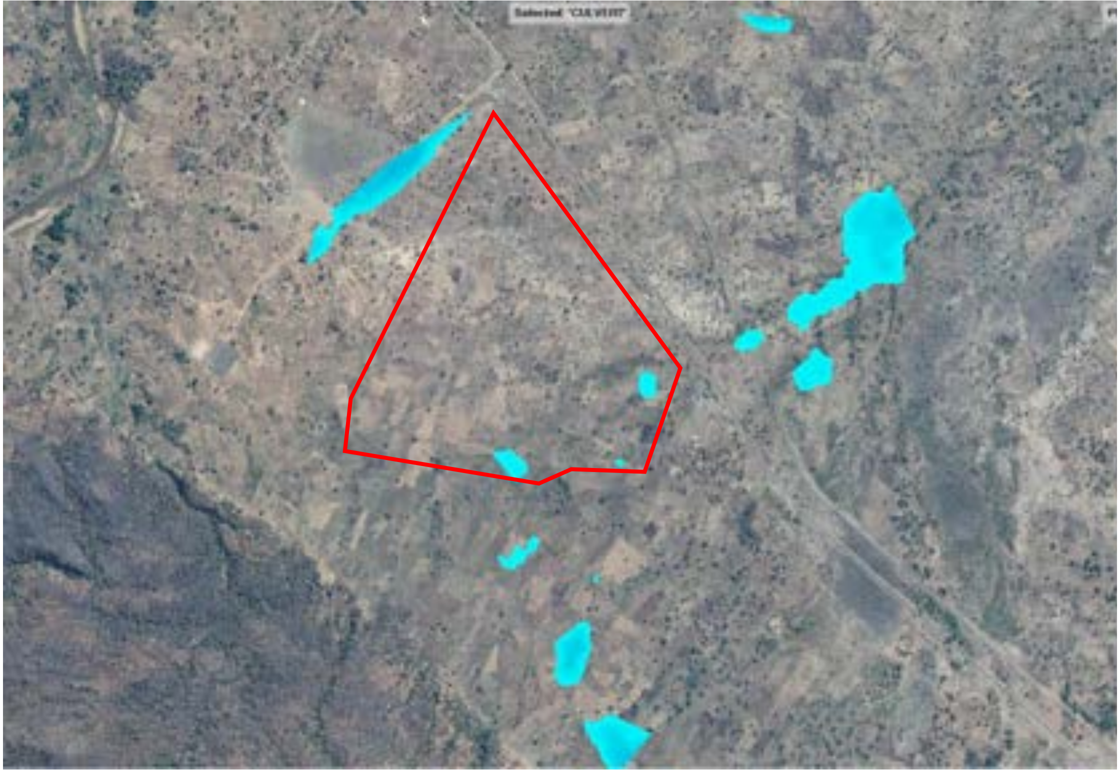


Figure 6: 25 Year Flood

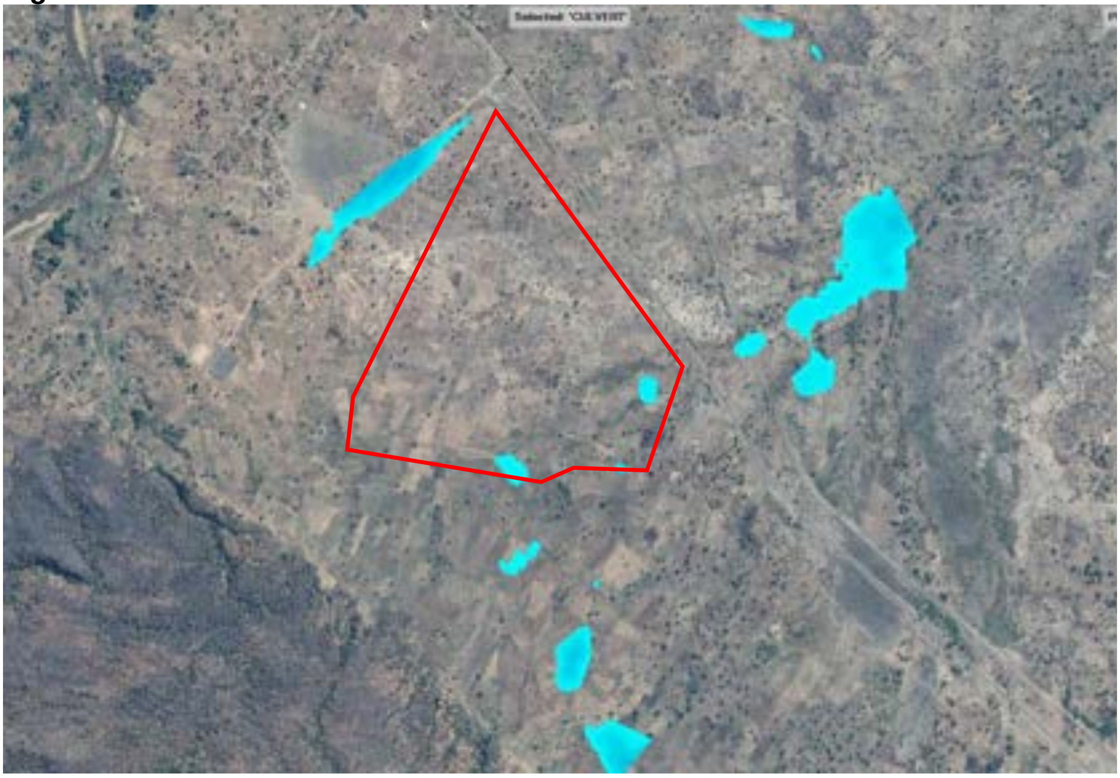


Figure 7: 50 Year Flood

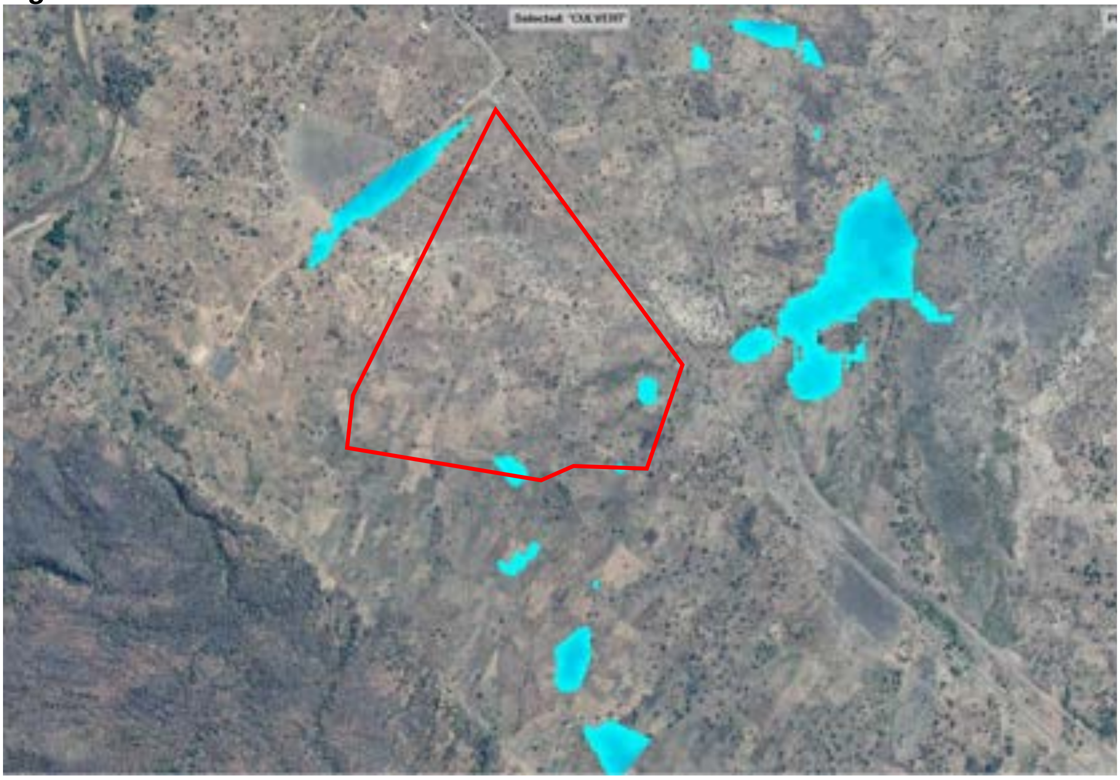


Figure 8: 100 Year Flood

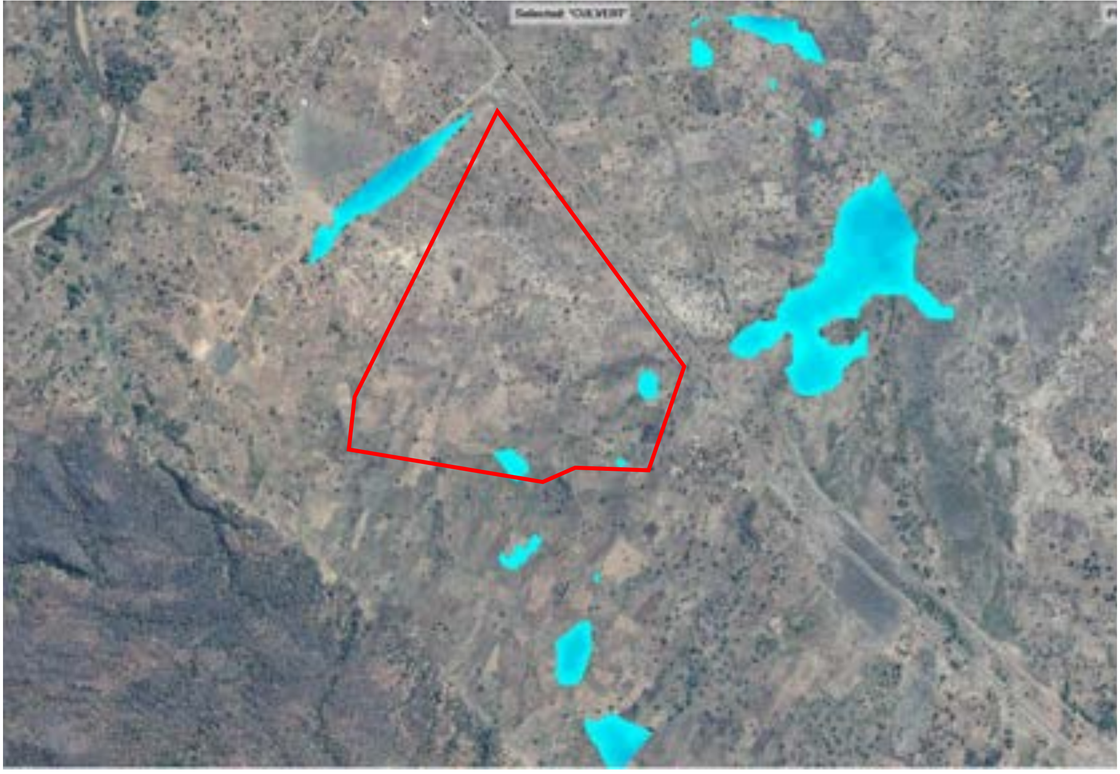


Figure 9: 2 Year Flood No Culverts

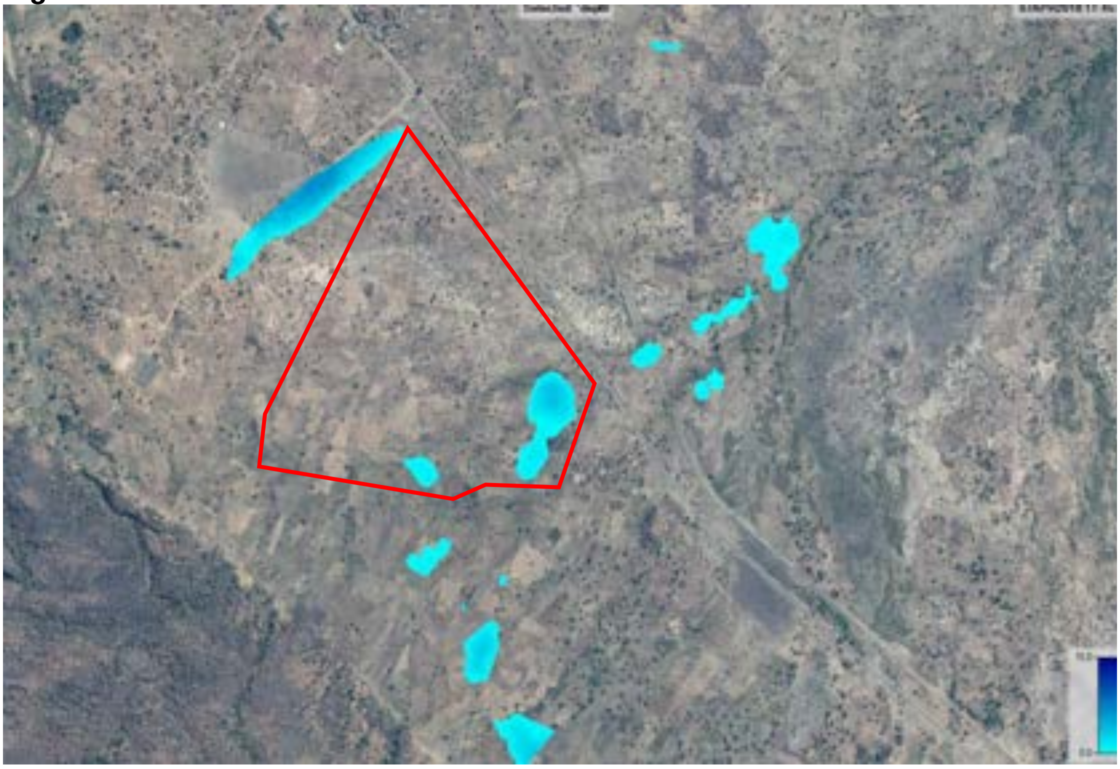
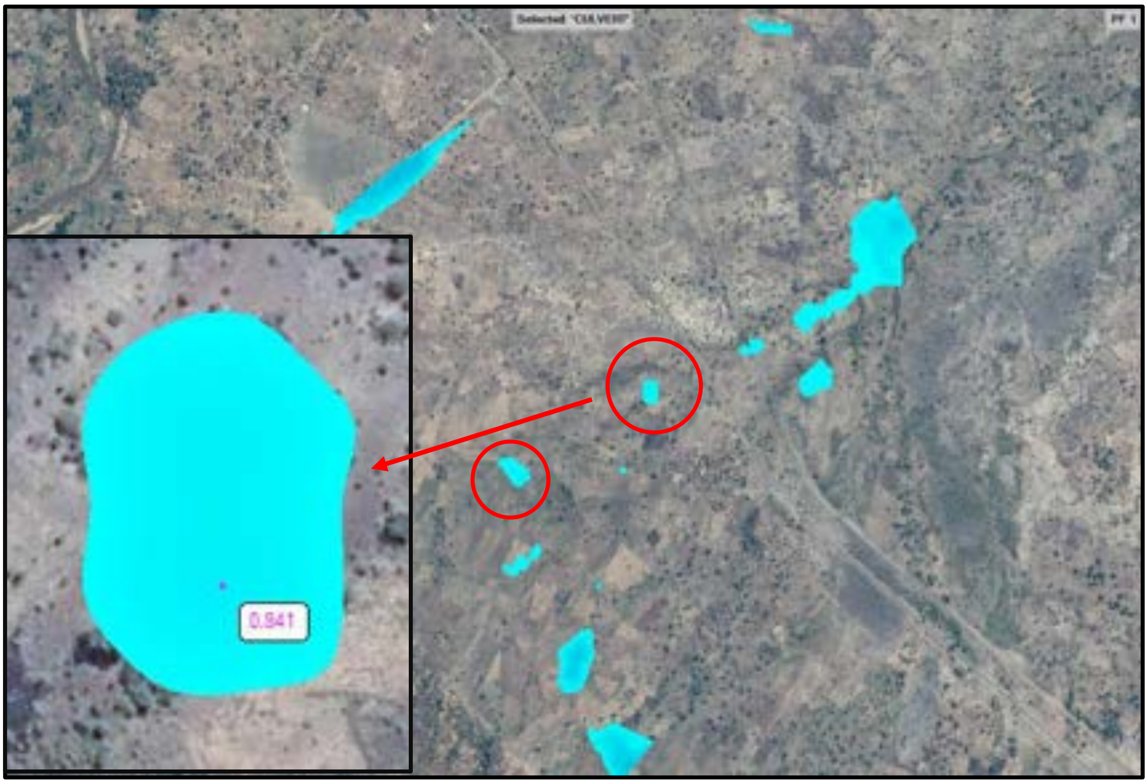


Figure 10: Max flood water depth



4. Ground Water Study

4.1 Livulezi River

The Livulezi River runs 1.2km North West of the site, figure 11 shows the river during peak rains. The river is perennial and is a sustainable source of water for all construction and site requirements.

Upstream Livulezi River

Downstream Livulezi River

Figure 11: Livulezi River

4.2 Installed Water Boreholes

On the northern border of the site boundary there are three water boreholes as shown in figure 12. WBH1 is a community installed well and services the few adjacent settlements.

WBH2 located 500m North West of WBH1, this is a government installed borehole which services a larger group of 40+ households.

WBH3 is the only borehole with an electric pump within the area, and supplies a 12,000 litre tank as well as some community taps. This borehole is primarily run and used for the ESCOM substation, the ESCOM staff who live nearby and the immediate community around the substation.

According to reports the boreholes were sunk to 50m and have never run dry. Information from government regarding the flow and yield was not possible to obtain so local knowledge was used.

Coordinates for the boreholes are given below to supplement figure 12 and the photographs in figure 16

WBH1	671979.75 m E , 8403234.00 m S
WBH2	671523.96 m E , 8403416.48 m S
WBH3	671480.72 m E , 8402954.45 m S

Figure 12: Current Water Borehole Locations

4.3 Aquifer hydrology

The provincial area around the site is classified as alluvium / weathered aquifer area as per figure 20. A more localised map is given below in figure 13, this classifies the area as a weathered aquifer with the potential yield of 0.25 – 1 l/s.

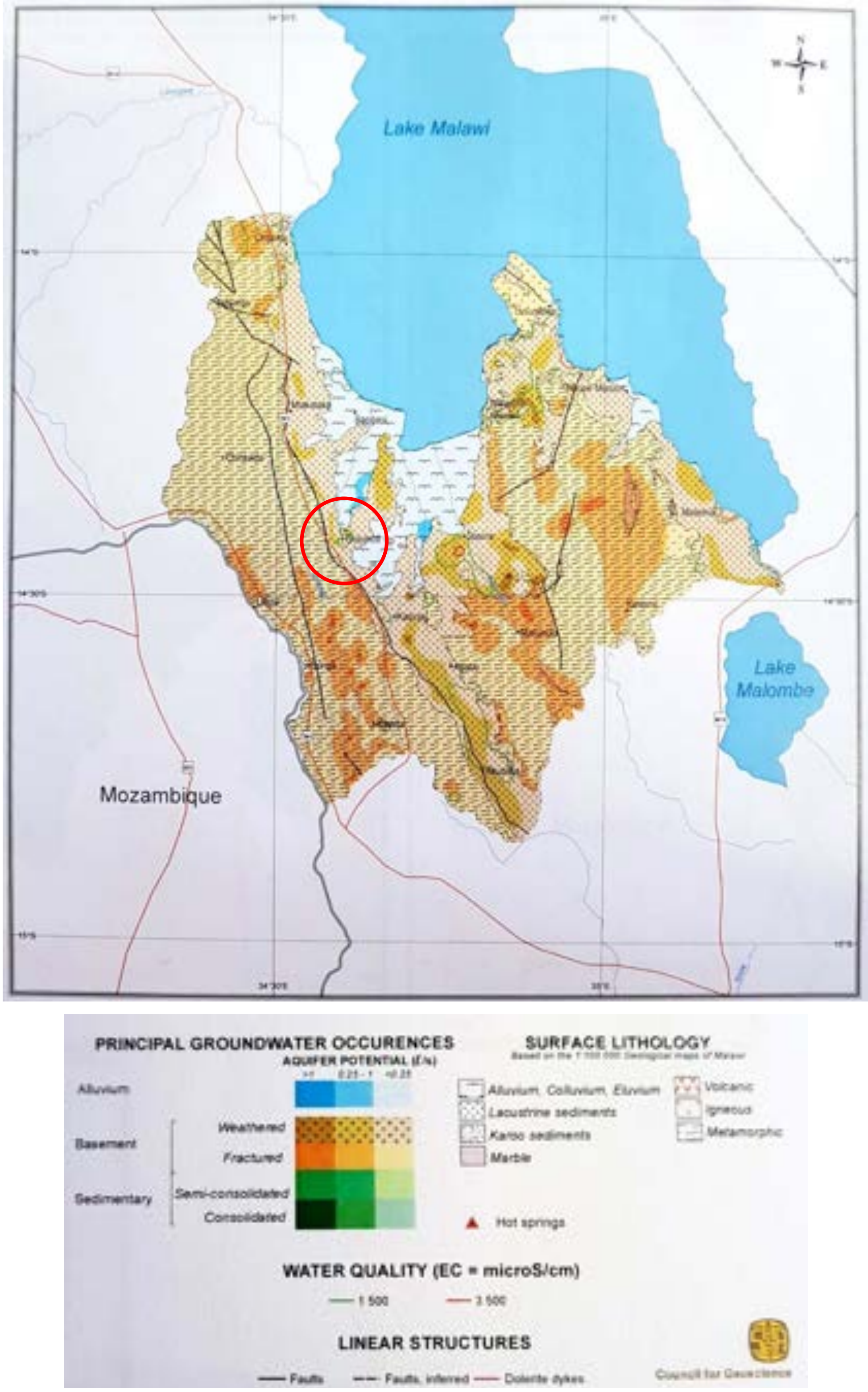


Figure 13: Aquifer Classification – Site Area Indicated in Red

Source: National Water Development Programme, Atlas for the Hydrogeological and Water Quality Map, Malawi (2015)

4.4 Water quality

A Chemical composition for weathered aquifers across the provincial area is given below in figure 14.

Maps shown in the appendix section 6.4 show low levels of sulphates, nitrates, chlorides, fluoride, calcium, magnesium, sodium, iron and medium levels of acidity.

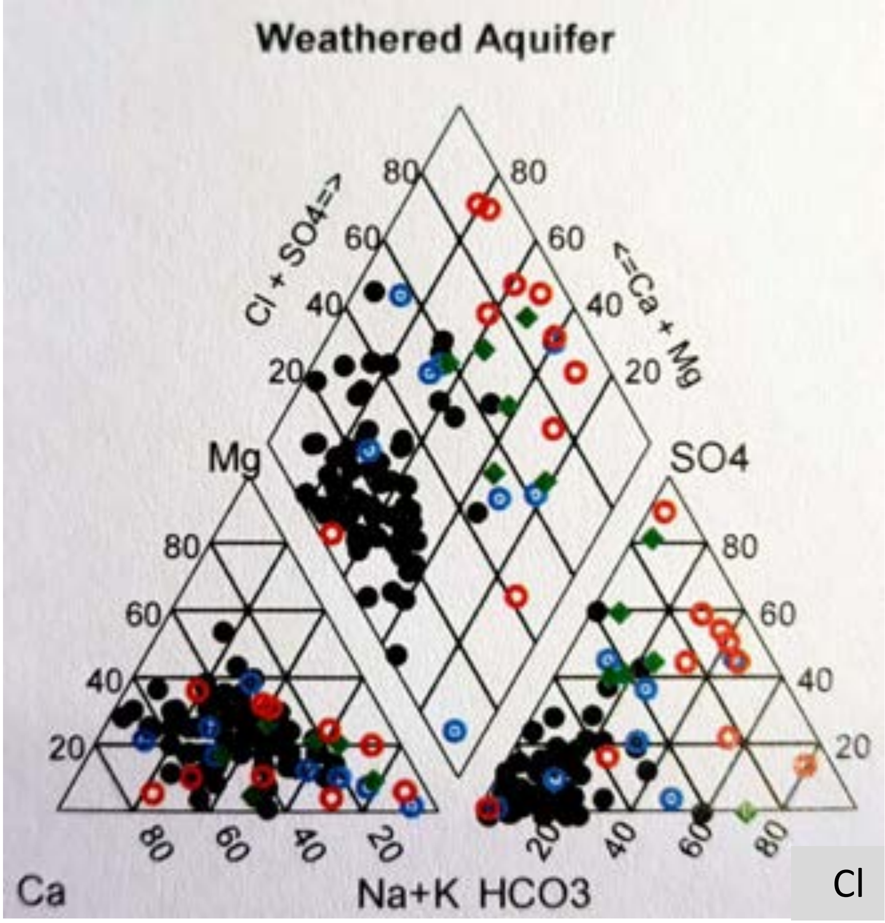


Figure 14: Chemical Composition for Weathered Aquifers

Source: National Water Development Programme, Atlas for the Hydrogeological and Water Quality Map, Malawi (2015)

A more detailed chemical study of the Bua catchment area was carried out by the British Geological Survey, in their “Ground Water Quality: Malawi (2004)” study it states generally low salinity values for groundwaters from weathered basement in the Bua catchment of western Malawi. Total dissolved solids were quoted in the range 200–740 mg/l. Low-conductivity groundwaters in basement aquifers from the Livulezi (central) and Dowa West (south-central) areas with electrical conductance were usually <750 µS/cm but extremes up to 4000 µS/ cm were recorded

4.5 Flow rate

As shown in figure 13 the flow rates for the area are given in the range of 0.25 - 1 l/s. the installed pump at WBH3 was a 0.75 Hp Franklin Electric water pump, from the control box it is understood it is likely a 4" 3200 Series Pump. The below chart shows it has an average yield of 9m^3/h.

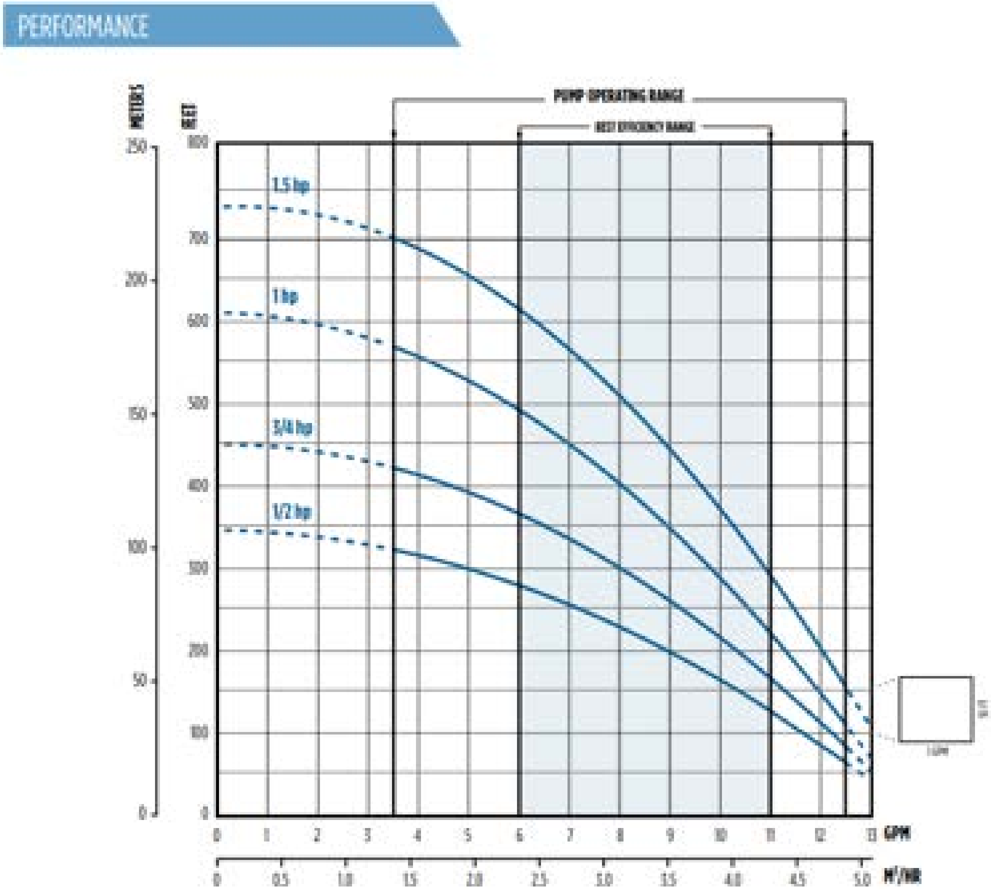


Figure 15: Franklin Electric 4" 3200 Water Pump Performance Chart

5. Conclusion and Recommendations

5.1 Flood Risk

From the hydrological modelling, field assessments and data collection it can be taken that there is little flood risk across the site. The two potential sections that show standing water due to excessive rainfall are due to uneven topography. During the first phase of land clearing it would be recommended to level these two areas to avoid pooling with the installation of French drains across the site to allow any further standing water to flow to the catchment outlet at the culverts.

Typically, flood modelling across similar regions in Malawi will factor in future change in land use. However the majority of the catchment area is protected land under Bangwe Forrest reserve, and the current land designation has a high runoff coefficient C_t, making the current land model the worst case scenario with the future solar PV land designation taken into account.

5.2 Ground Water Analysis and Availability

Ground water from local aquifers is available, should a borehole be installed. Currently 2 manual and 1 electric boreholes are installed within a 0.1 km^2 vicinity with no evidence of low water levels, even during the dry season. The closest river is the Livulezi River at 1.6km distance, which is perennial and is easily accessible from the main road adjacent to the site.

A borehole could be installed on the southern section of the site to provide water for site activities, where water for construction could be obtained from the Livulezi River from the site.

Chemical analysis tests from nearby boreholes surrounding the area show to have a composition that comprises of low levels of sulphates, nitrates, chlorides, fluoride, calcium, magnesium, sodium, iron and medium levels of acidity, providing chemically sound water for construction and panel washing.

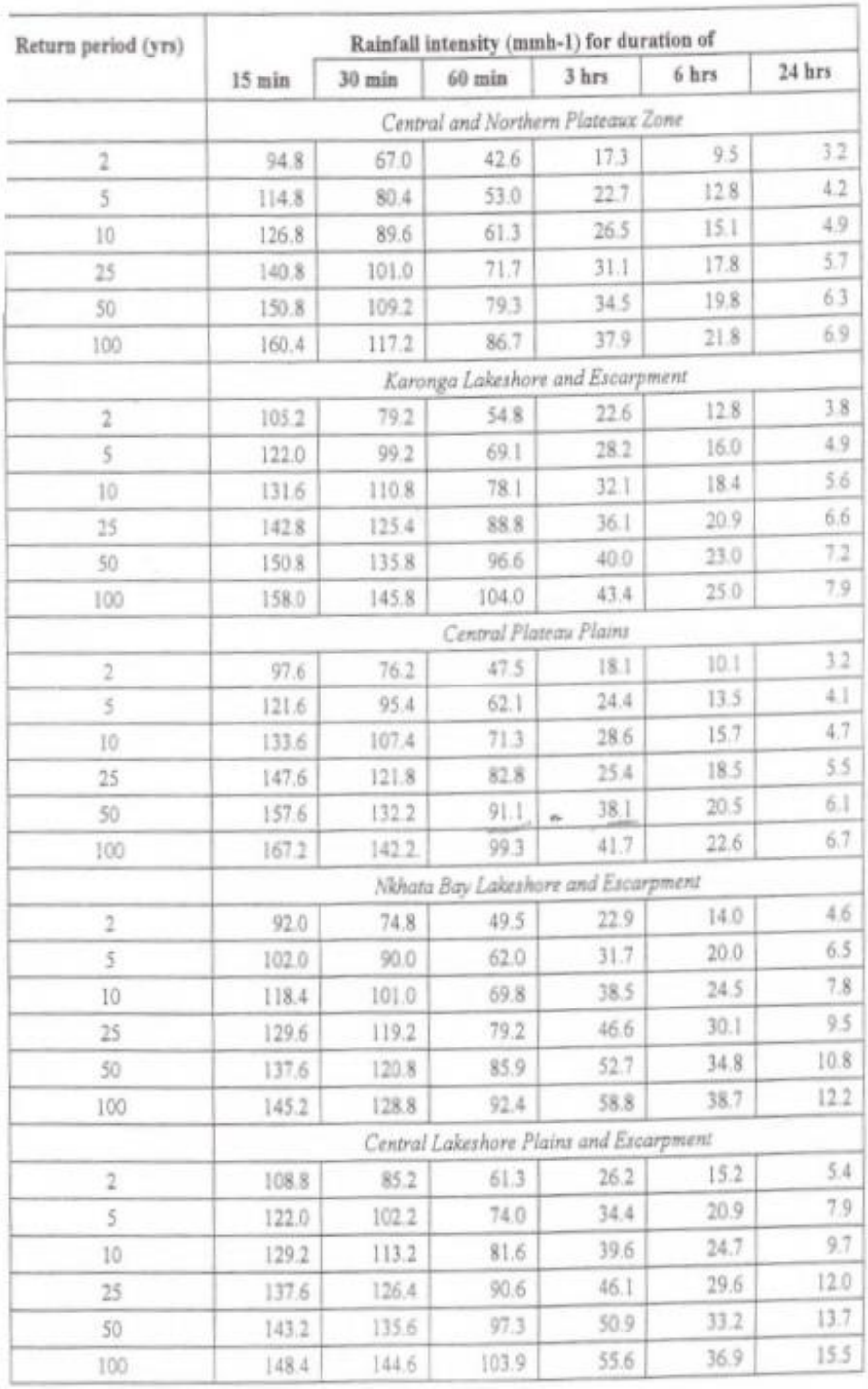
The current yields are indicated between 0.25 – 1l/s from figure 13 in the aquifer map, however the minimum yield required for a hand pump is 0.25l/s, the presence of two hand pumps and one electric pump within close proximity is evidence of a decent yield with a large reserve.

With the current flow rates indicated by the installed electric pump a typical water bowser of 10,000l would take approximately one hour to fill, it is recommended that if a tank is not installed and bowsers are to be filled directly from a pumped borehole that the borehole be installed south of the site to limit the possible disturbance to current community wells reserves.

During the dry season where there is no runoff from farm land across the catchment into the river it would be recommended to look into the viability of drawing water directly from the Livulezi river as the levels of suspended solids would be at their lowest during this time.

6. Appendix

6.1 Rainfall Intensity Chart for Malawi



Return period (yrs)	Rainfall intensity (mmh-1) for duration of					
	15 min	30 min	60 min	3 hrs	6 hrs	24 hrs
	Central and Northern Plateaux Zone					
2	94.8	67.0	42.6	17.3	9.5	3.2
5	114.8	80.4	53.0	22.7	12.8	4.2
10	126.8	89.6	61.3	26.5	15.1	4.9
25	140.8	101.0	71.7	31.1	17.8	5.7
50	150.8	109.2	79.3	34.5	19.8	6.3
100	160.4	117.2	86.7	37.9	21.8	6.9
	Karonga Lakeshore and Escarpment					
2	105.2	79.2	54.8	22.6	12.8	3.8
5	122.0	99.2	69.1	28.2	16.0	4.9
10	131.6	110.8	78.1	32.1	18.4	5.6
25	142.8	125.4	88.8	36.1	20.9	6.6
50	150.8	135.8	96.6	40.0	23.0	7.2
100	158.0	145.8	104.0	43.4	25.0	7.9
	Central Plateau Plains					
2	97.6	76.2	47.5	18.1	10.1	3.2
5	121.6	95.4	62.1	24.4	13.5	4.1
10	133.6	107.4	71.3	28.6	15.7	4.7
25	147.6	121.8	82.8	25.4	18.5	5.5
50	157.6	132.2	91.1	38.1	20.5	6.1
100	167.2	142.2	99.3	41.7	22.6	6.7
	Nkhata Bay Lakeshore and Escarpment					
2	92.0	74.8	49.5	22.9	14.0	4.6
5	102.0	90.0	62.0	31.7	20.0	6.5
10	118.4	101.0	69.8	38.5	24.5	7.8
25	129.6	119.2	79.2	46.6	30.1	9.5
50	137.6	120.8	85.9	52.7	34.8	10.8
100	145.2	128.8	92.4	58.8	38.7	12.2
	Central Lakeshore Plains and Escarpment					
2	108.8	85.2	61.3	26.2	15.2	5.4
5	122.0	102.2	74.0	34.4	20.9	7.9
10	129.2	113.2	81.6	39.6	24.7	9.7
25	137.6	126.4	90.6	46.1	29.6	12.0
50	143.2	135.6	97.3	50.9	33.2	13.7
100	148.4	144.6	103.9	55.6	36.9	15.5

Figure 16: Rainfall Intensity-Duration Values for Different Return Periods. (PEMConsult, 1999)

6.2 Culverts Along M5

Culvert 1: 673255.68 m E , 8402690.36 m S

Culvert 2: 673160.26 m E , 8402829.22 m S

Culvert 1: Downstream

Culvert 2: Downstream

Figure 17: Culverts Located on the M5 Road

Figure 18: Standing Water 15m Upstream from Culvert 1

6.3 Installed Water Boreholes

WBH1
671979.75 m E , 8403234.00 m S

WBH2
671523.96 m E , 8403416.48 m S

WBH3
671480.72 m E , 8402954.45 m S

Figure 19: Current Installed Water Boreholes

6.4 Aquifer Charts

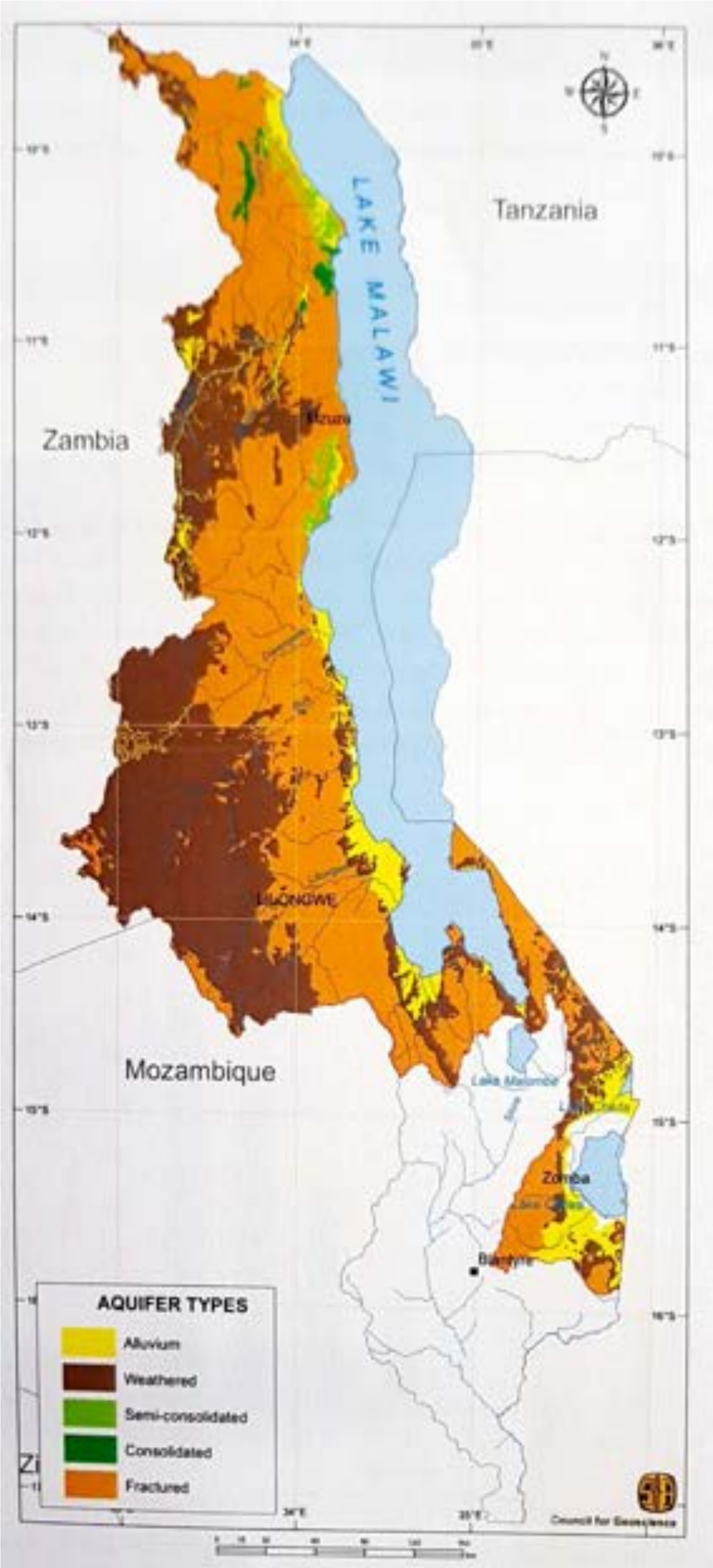


Figure 20: Aquifer Types Across Malawi

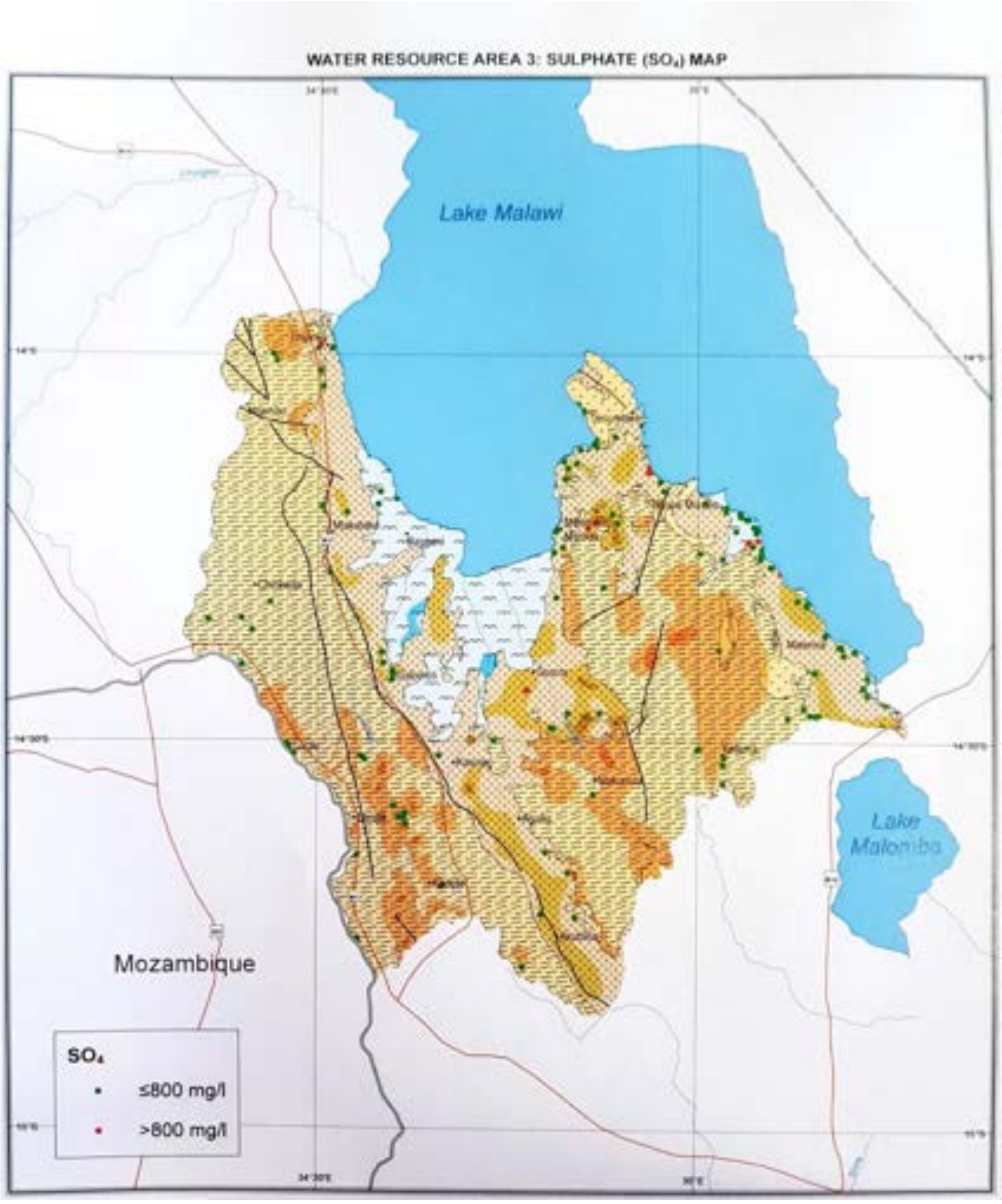


Figure 21: Sulphate Map

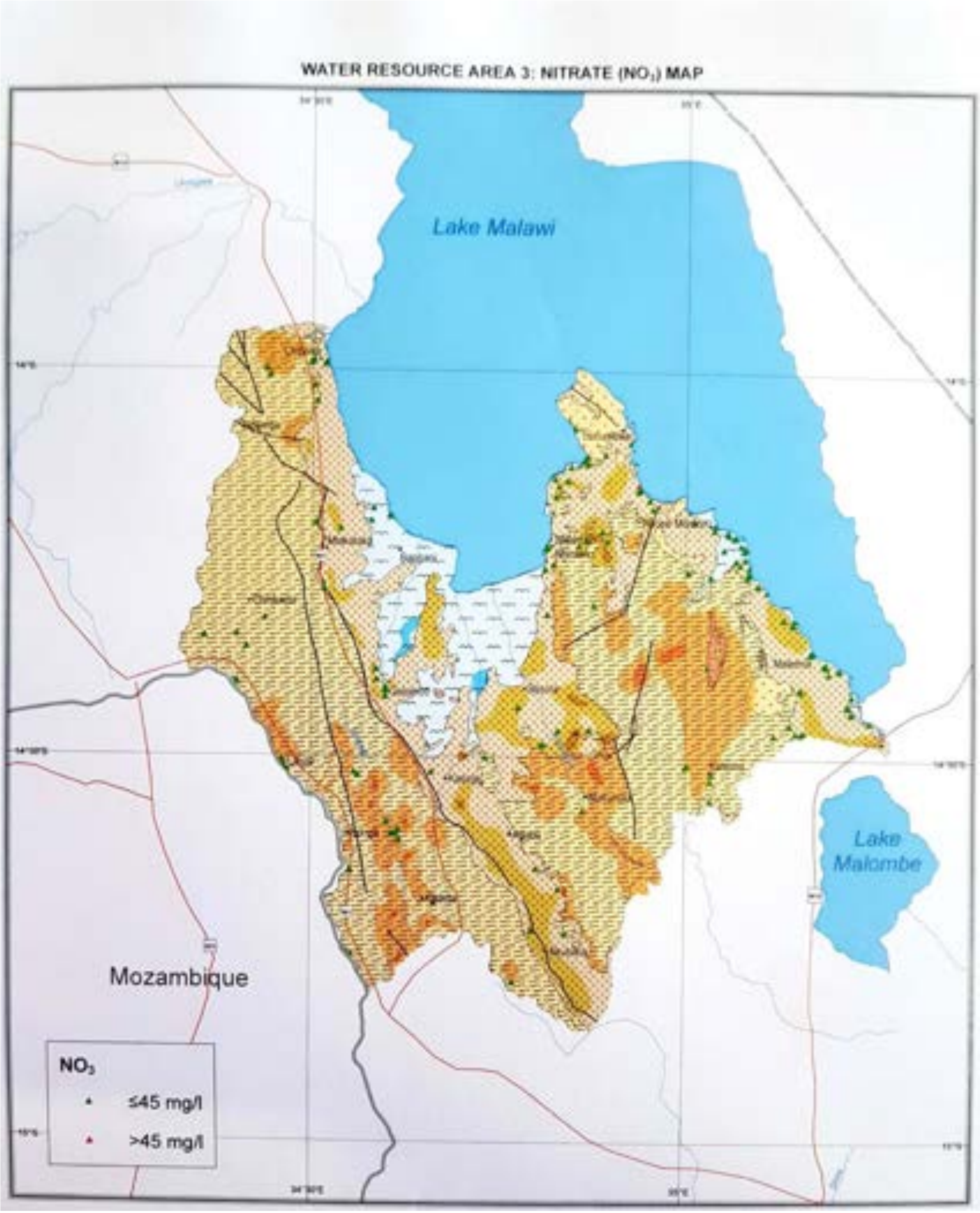


Figure 22: Map of Nitrate Levels

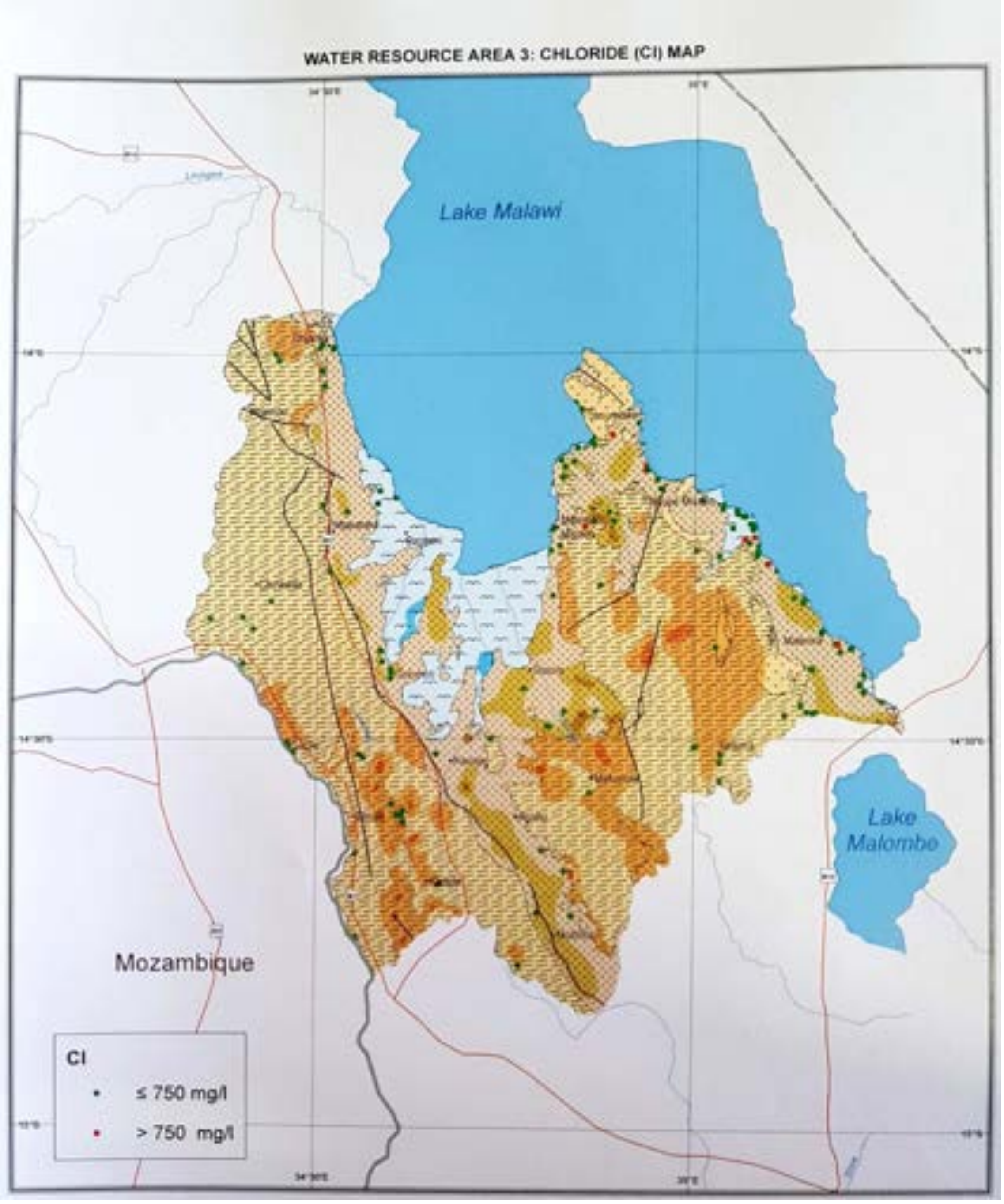


Figure 23: Map of Chloride Levels

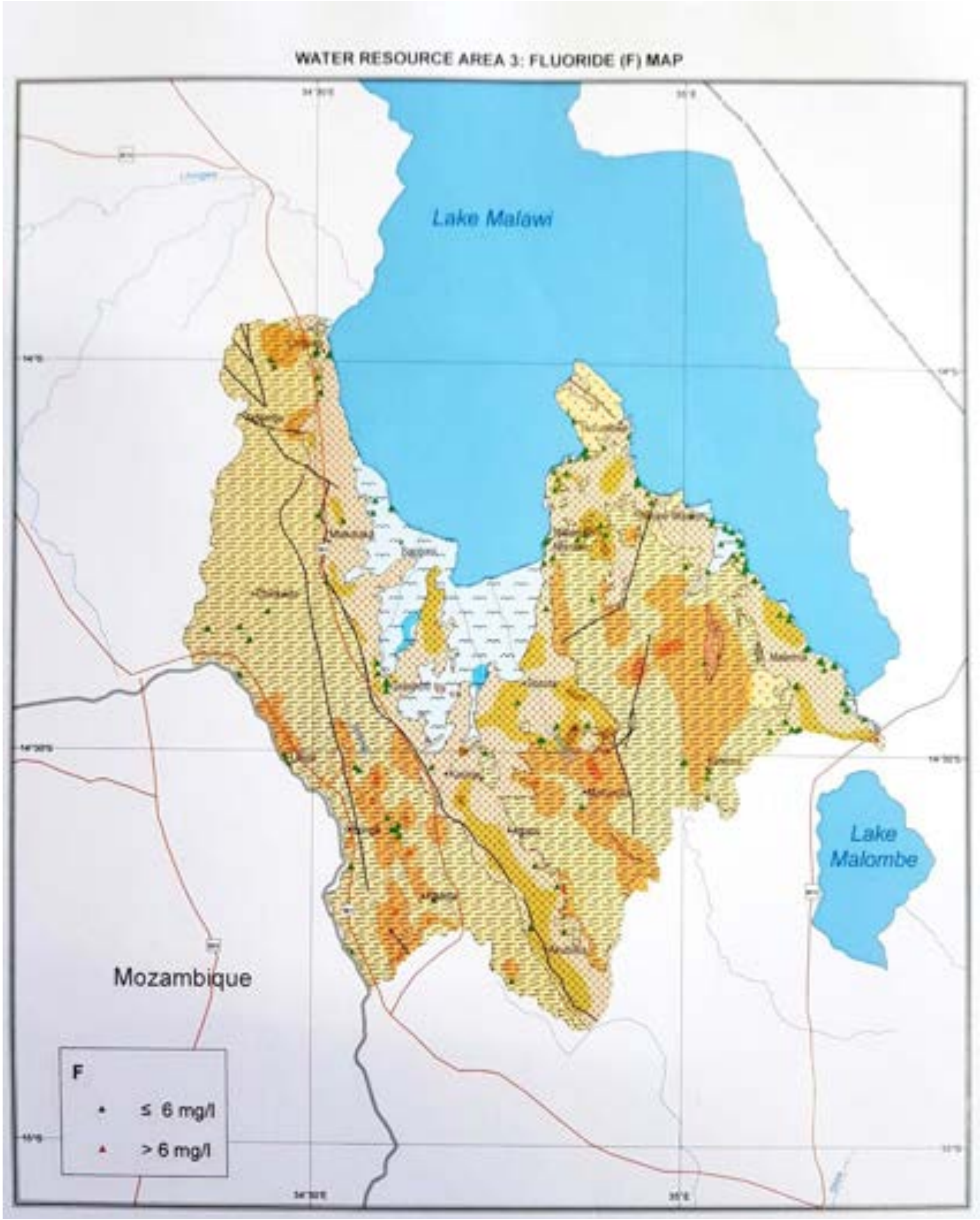


Figure 24: Map of Flouride Levels

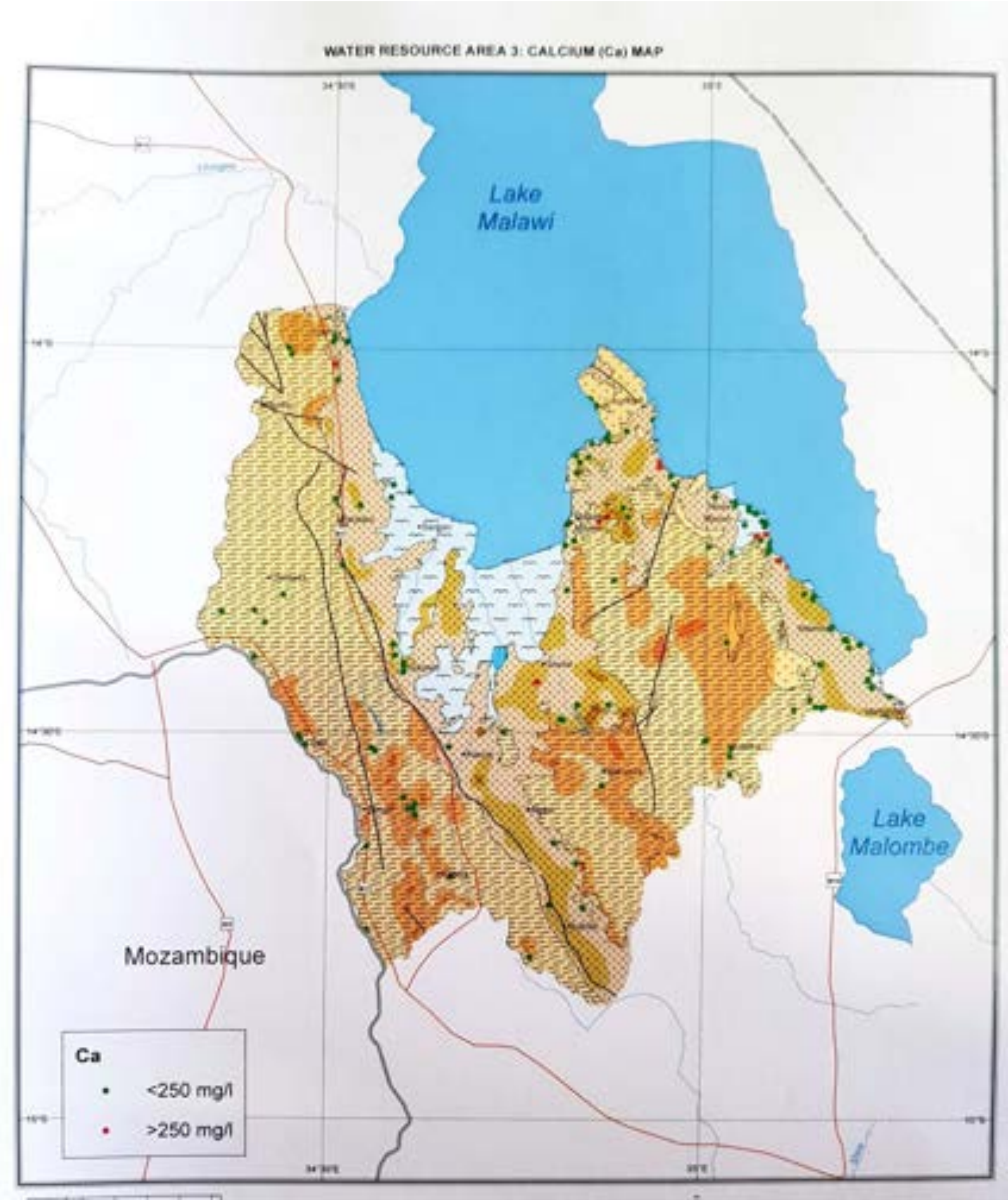


Figure 25: Map of Calcium Levels

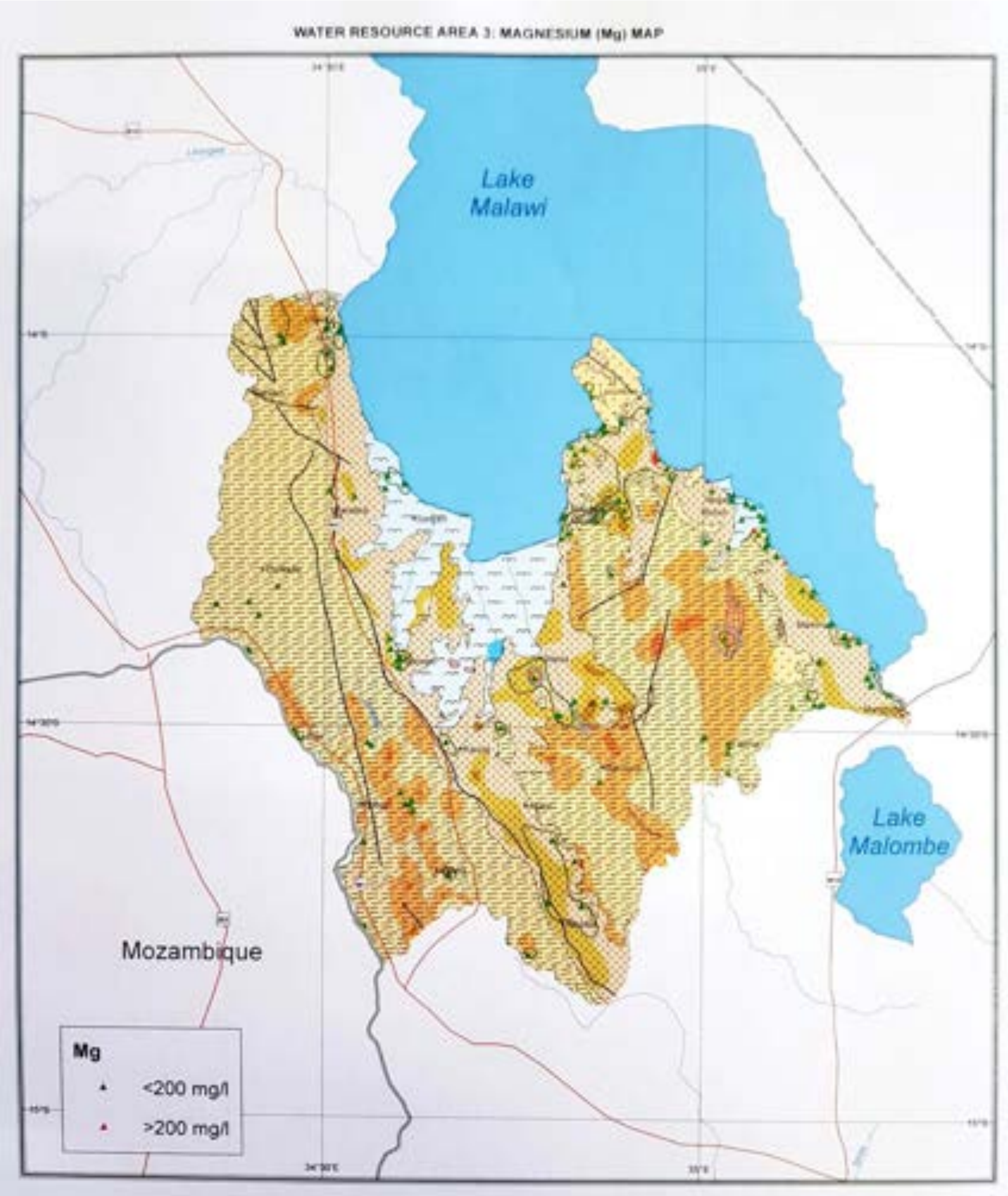


Figure 26: Map of Magnesium Levels

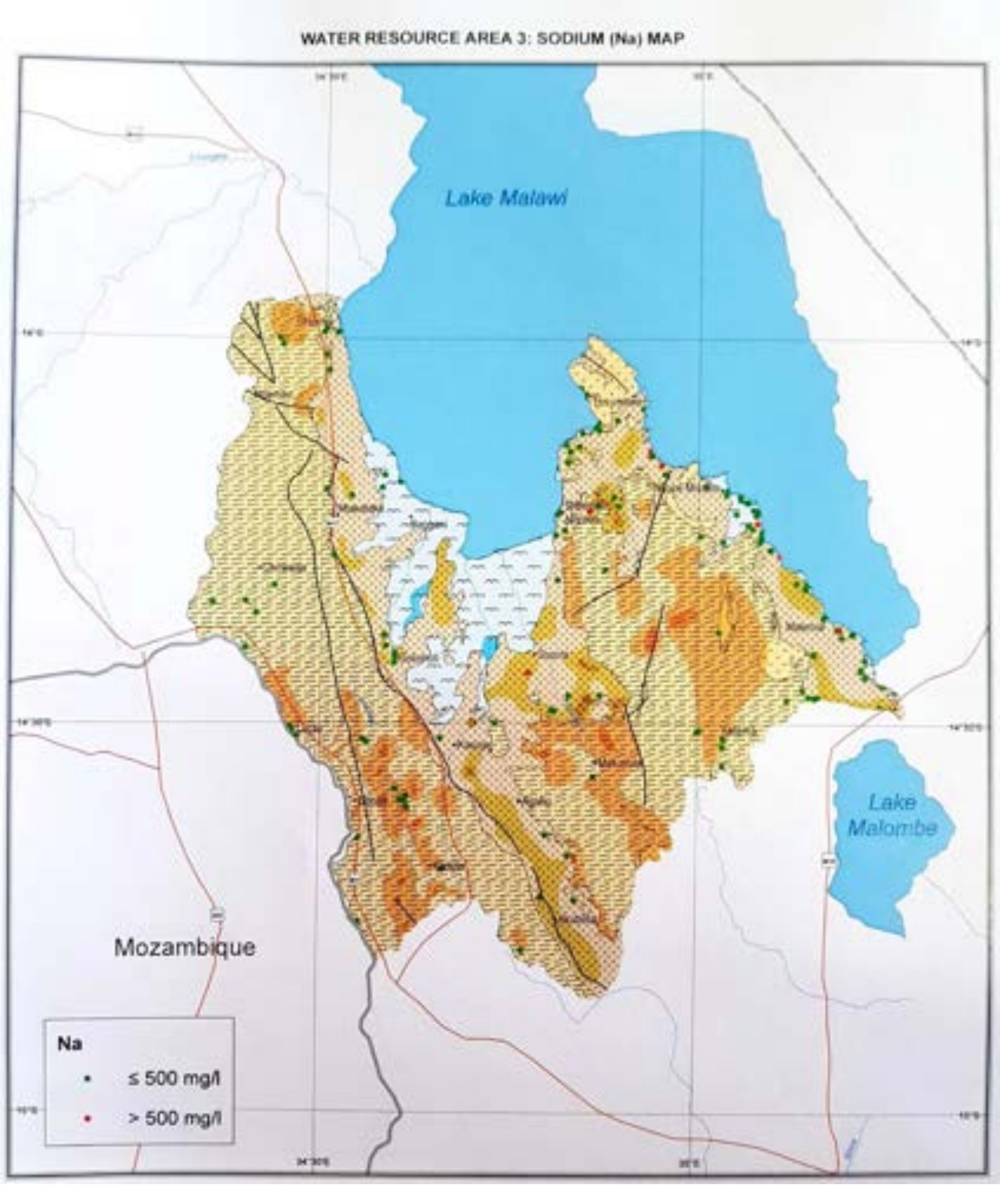


Figure 27: Map of Sodium Levels

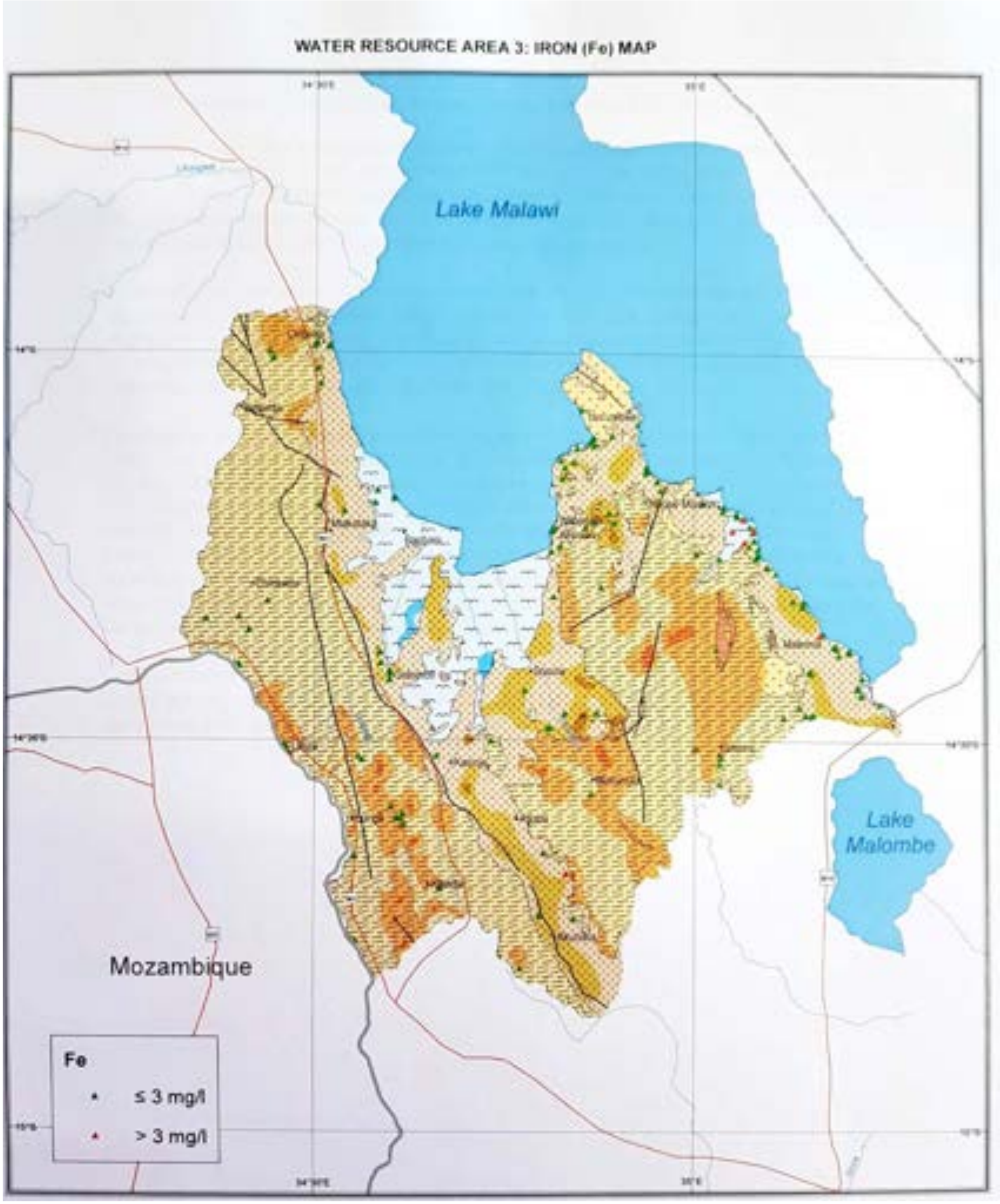


Figure 28: Map of Iron Levels

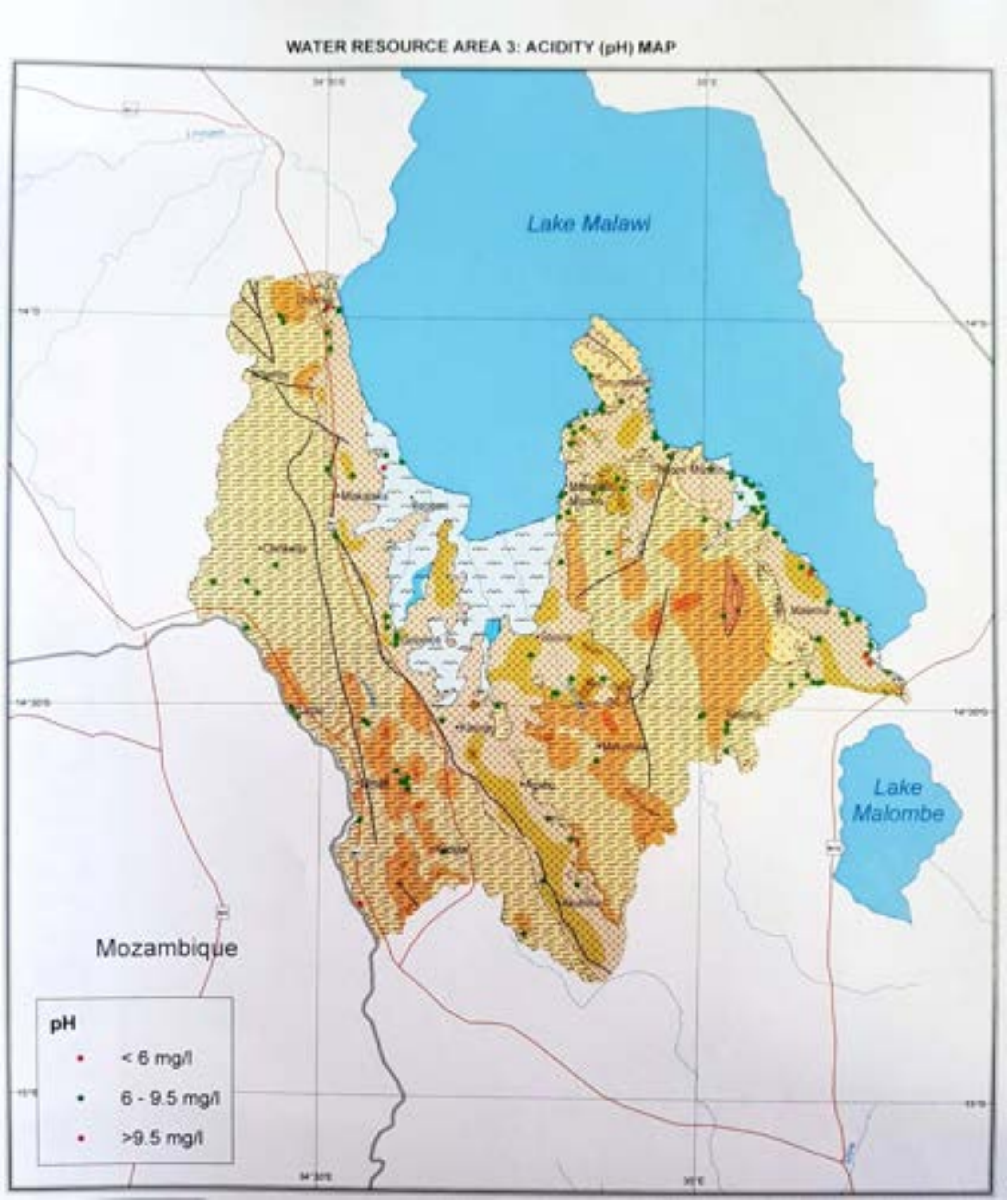


Figure 29: Map of Acidity Levels

APPENDIX C GEOTECHNICAL STUDY (GEOCONSULT)

July 2019

GEOCONSULT

GOLOMOTI SOLAR PV

GEOTECHNICAL SURVEY REPORT

POWER ENGINEERS

Contents

List of Figures

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List of Abbreviations

TP	Trial Pit
PI	Plasticity Index
LL	Liquid Limits
CBR	California Bearing Ratio
C	Cohesion (kPa)
φ	Fiction Angle
Qp	Pile tip / Base resistance
Qs	Pile skin friction resistance
Qul	Ultimate Pile Load
Qallow	Allowable Pile Capacity

1. Site Investigations

1.1 Scope

The aim of the report is to evaluate suitability of subsoil conditions along the project site to support a solar array as well as small structures in the areas adjacent to the substation.

Material's mechanical and physical properties are to be investigated to ensure adequate design and mitigation, if required, is implimented.

1.2 Site Location

The site is located below the Bangwe escarpments in the Golomoti township. The site borders the main M5 road, and an access road perpendicular to the M5 leading to an ESCOM substation indicated in figure 1 below. The site is currently being used for subsistence farming and currently does not house any residential buildings.

Site boundary, regional location and coordinates are shown in figure 1 below.

Coordinates UTM 36L
672468.00 m E , 8403648.00 m S

Figure 1: Site Boundary Indicated in Red

1.3 Site Testing and Overview

Site testing consisted of excavated trial pits to 3-4m depths, where conditions allowed. Soil samples were taken at each change of soil strata to establish soil plasticity, gradation and chemical analysis. A Dynamic Cone Penetrometer (DCP) test was conducted at 1.0m and to establish insitu soil strength. Samples were collected at 1.0m and at 2.0m to conduct triaxial tests to determine cohesion values and friction angles to for use in bearing capacity calculations.

1.4 Trial Pit Coordinates

Table 1: Trial Pit Coordinates

TP	Easting	Southing	TP	Easting	Southing
TP1	672 496	8 403 452	**TP11**	672 996	8 402 377
TP2	672 496	8 403 306	**TP12**	672 650	8 402 797
TP3	672 315	8 403 152	**TP13**	672 640	8 402 638
TP4	672 616	8 403 213	**TP14**	672 645	8 402 499
TP5	672 768	8 403 075	**TP15**	672 384	8 402 794
TP6	672 663	8 402 947	**TP16**	672 342	8 402 660
TP7	672 863	8 402 795	**TP17**	672 016	8 402 655
TP8	673 025	8 402 675	**TP18**	671 938	8 402 608
TP9	673 013	8 402 587	**TP19**	671 989	8 402 554
TP10	673 006	8 402 499	**TP20**	671 990	8 402 438

Figure 2: Trial Pit Locations

2. Site Test Results

2.1 Soil Plasticity – Atterberg Limits

Due to the size and change in soil structure across the site, trial pit analysis will be classified within three different zones:

Zone 1: TP 1 – 9

Zone 2: TP 10 – 16

Zone 3: TP 17 – 20

Zone 1

Trial pits 1 – 9 are located almost parallel and along the road reserve. This is the lowest lying area along the site and has sections that are prone to small areas of standing water.

PI levels in this zone average low 20s are classified as medium plasticity. Based on the plasticity index and the liquid limit trial pits found in Zone 1 are classified as CL and CI in the chart presented in figure 3. This classification is used for *clay of low plasticity* and *clay of intermediate plasticity.*

Zone 2

Trial pits 10-16 have relatively uniform PI values across the section down to a depth of 4m. The soil classification falls on the boundary of CI and CL due to the high LL values averaging 35-40 and the medium PI levels of average 20.

Zone 3

Trial pits 17-20 located closer to the substation and the OHL connections to the substation. The initial 1.0m of material shows to have slightly plastic values, slightly plastic soils are those with PI levels greater than 0 but less than 7, typically in the range of 3-7. This classifies the soil as CL-ML, an inorganic silt of low plasticity. These are typically cohesionless. After the initial 1.0m of material the soil the material moves into the CL range of soils (*clay of low plasticity*)

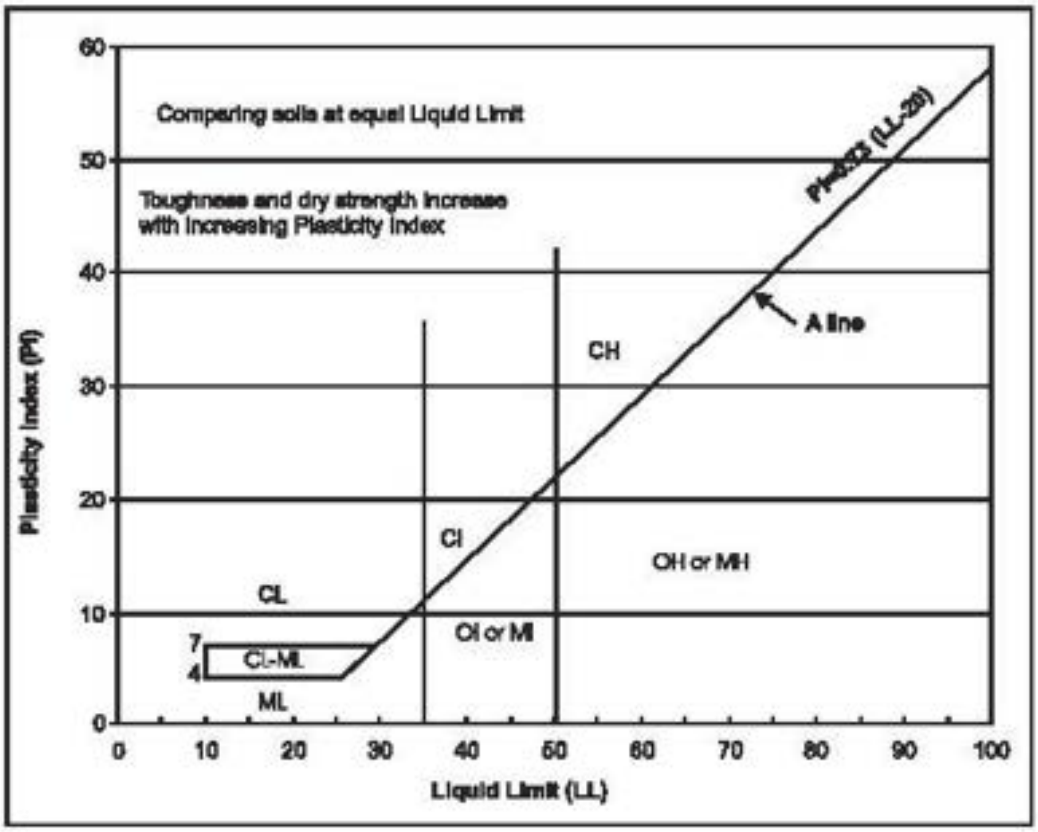


Figure 3: Plasticity Chart

Table 2: Atterburg Limits

Depth	TP1		TP2		TP3		TP4		TP5	
	PI	LL	PI	LL	PI	LL	PI	LL	PI	LL
1.0	11	21.6	22	9.4	23	12.0	13	6.1	26	12.9
2.0	21	34.3	19	8.5	13	6.9	25	12.9	26	12.9
3.0	29	42.5	19	8.5	13	6.9	20	9.4	19	10.2
4.0	21	38.6	16	7.7	21	7.7	20	9.4	19	12.0

Depth	TP6		TP7		TP8		TP9		TP10	
	PI	LL	PI	LL	PI	LL	PI	LL	PI	LL
1.0	23	11.2	22	40.8	21	39.6	21	39.6	11	31.4
2.0	23	11.1	12	32.3	20	38.7	27	42.6	11	31.4
3.0	23	11.1	11	32.3	15	38.6	21	39.0	16	36.5
4.0	24	12.0	11	32.3	15	38.6	21	39.0	19	37.0

Depth	TP11		TP12		TP13		TP14		TP15	
	PI	LL	PI	LL	PI	LL	PI	LL	PI	LL
1.0	23	38.0	15	37.7	9	27.5	16	41.5	14	28.9
2.0	12	33.0	17	37.9	15	30.1	19	44.0	21	37.4
3.0	-	-	13	28.4	19	43.8	19	44.0	17	36.9
4.0	-	-	13	28.4	19	43.8			17	36.9

Depth	TP16		TP17		TP18		TP19		TP20	
	PI	LL	PI	LL	PI	LL	PI	LL	PI	LL
1.0	11	31.1	SP	SP	SP	SP	SP	SP	13	37.5
2.0	16	33.5	12	34	14	34.6	18	36.3	14	36.8
3.0	16	33.5	10	24	16	33.1	17	35.4	20	31.7
4.0	17	36.4	10	24	16	33.1	17	35.4	20	31.7

2.2 Gradation

Gradation values as show the material on site to be predominantly silt and clay based. Sections of gravel are present in various layers however mostly surrounded by a silty clay.

2.3 DCP – Dynamic Cone Penetrometer

DCP testing was carried out at 1.0m depths to further test the subsoil's insitu strength. The test results have been correlated to CBR for an easier understanding of strength characteristics. Table 3 below shows the insitu CBR strength results per location. They are classified using the below criteria.

CBR	Strength Value
0 - 10	Poor
10 - 20	Average
20 - 30	Good
30+	Very Good

$$CBR = \frac{292}{DPI^{1.12}}$$

Table 3: DCP Insitu Strength

Trial Pit	Remarks	Trial Pit	Remarks
T01	Poor	T11	Very good
T02	Poor	T12	Very good
T03	Good	T13	Very good
T04	Good	T14	Very good
T05	Good	T15	Poor
T06	Very good	T16	Very good
T07	Very good	T17	Average
T08	Very good	T18	Average
T09	Very good	T19	Average
T10	Good	T20	Good

2.4 Triaxial Testing

Depending on the soil type Mohr or Lambe values were used.

Table 4:Triaxial Test Results

Depth	**TP1**		**TP2**		**TP3**		**TP4**		**TP5**	
	C	φ	C	φ	C	φ	C	φ	C	φ
1.0	14	24	70	10	75	27	23	27	63	33
2.0	-	-	13	35	48	17	74	38	16	33

Depth	**TP6**		**TP7**		**TP8**		**TP9**		**TP10**	
	C	φ	C	φ	C	φ	C	φ	C	φ
1.0	-	-	39	22	68	18	55	35	54	15
2.0	60	19	19	28	-	-	32	11	-	-

Depth	**TP11**		**TP12**		**TP13**		**TP14**		**TP15**	
	C	φ	C	φ	C	φ	C	φ	C	φ
1.0	43	12	-	-	85	26	82	35	11	20
2.0	26	18	48	28	-	-	27	10	23	30

Depth	**TP16**		**TP17**		**TP18**		**TP19**		**TP20**	
	C	φ	C	φ	C	φ	C	φ	C	φ
1.0	-	-	36	25	15	27	13	26	38	39
2.0	39	11	50	30	50	36	13	31	33	18

2.5 Pile Bearing Capacity

Bearing capacities were calculated for a 0.3m pile of 4.0m length.

The following constants were used throughout the calculations:

- Adhesion coefficient: α 0.9
- Friction resistance: fsi 4.5
- Pile Diameter: D 0.3m
- Pile Length: L 4.0m

Table 5 shows the calculate values for:

- Q_p *– Pile tip / Base resistance (Load carried by the pile point)*
- Q_s *– Pile skin friction resistance (Load carried by the pile shaft)*
- Q_{ult} *– Ultimate Pile Load*
- Q_{allow} *– Allowable Pile Capacity (calculated for SF of **2.5**)*

Table 5: Piled Bearing Capacity Results

Bearing Capacity Values (Ton)					
	TP1	**TP2**	**TP3**	**TP4**	**TP5**
Q_p	0.7	10.3	6.52	85.6	111.6
Q_s	16.9	16.9	16.9	16.9	16.9
Q_{ult}	17.7	27.2	23.5	102.6	128.0
Q_{allow}	7.1	10.9	9.4	41.0	51.4

Bearing Capacity Values (Ton)					
	TP6	**TP7**	**TP8**	**TP9**	**TP10**
Q_p	3.8	4.1	3.8	4.6	1.5
Q_s	16.9	16.9	16.9	16.9	16.9
Q_{ult}	20.7	21.0	20.8	21.57	18.5
Q_{allow}	8.3	8.4	8.3	8.6	7.4

Bearing Capacity Values (Ton)					
	TP11	**TP12**	**TP13**	**TP14**	**TP15**
Q_p	1.5	6.8	6.1	3.05	1.6
Q_s	16.9	16.9	16.9	16.9	16.9
Q_{ult}	18.4	23.7	22.9	20.0	18.5
Q_{allow}	7.4	9.5	9.1	8.0	7.4

Bearing Capacity Values (Ton)					
	TP16	**TP17**	**TP18**	**TP19**	**TP20**
Q_p	0.36	6.1	5.3	6.0	7.5
Q_s	19.9	16.9	16.9	16.9	16.9
Q_{ult}	17.3	23.0	22.2	23.0	24.5
Q_{allow}	6.9	9.2	8.9	9.2	9.8

2.6 Shallow Foundations

Bearing capacity for the trial pits closer to the substation TP17-20 was calculated for shallow footings. Values based on Terzaghi (1943). Figures are for footing dimensions of 3x3m, for strip and rectangular footing widths of 3.0m

Ultimate bearing capacity values are given for a safety factor of 3.

Bearing Capacity Shallow Foundations								
Foundation Type	**TP17**		**TP18**		**TP19**		**TP20**	
	q_{ult} (ton/m2)	**q_a (kPa)**	**q_{ult} (ton/m2)**	**q_a (kPa)**	**q_{ult} (ton/m2)**	**q_a (kPa)**	**q_{ult} (ton/m2)**	**q_a (kPa)**
Strip Foundation	174	581	142	475	93	312	165	552
Rectangular	204	682	163	544	96	321	189	633
Square	204	682	163	544	96	321	189	633

Table 6: Bearing Capacity for Shallow Foundations

2.7 Chemical Analysis

Two samples per pit were tested to determine the Sulphate, Chloride and Oxide Reduction Potential (ORP). Results of the tests are shown in table 7.

Trial Pit	**Depth (m)**	**pH**	**Sulphate SO_4^{2-} (mg/l)**	**Chloride (Cl) mg/l**	**ORP mV**
01	0.2 - 1.0	6.7	8.8	17.7	2.6
	3.0 - 4.0	6.8	14.3	19.5	9.4
02	0.2 - 1.0	7.7	15.4	23.4	12.3
	3.3 - 4.0	6.9	5.3	15.9	1.9
03	0.6 - 2.5	7.3	423	28.4	7.6
	2.5 - 4.1	7.2	353	25.0	5.1
04	0.2 - 1.0	7.3	101.3	39.0	13.4
	2.0 - 4.0	7.6	385.6	25.0	3.2
05	0.1 - 1.5	6.8	12.1	17.7	15.0
	3.0 - 4.0	7.1	17.8	19.5	16.3
06	0.5 - 2.0	6.9	6.8	14.2	7.1
	2.0 - 4.0	7.0	2.6	15.9	10.1
07	0.2 - 1.0	7.6	289	21.3	17.3
	1.0 - 2.5	7.3	291	35.5	8.2
08	0.8 - 2.5	7.1	15.7	33.7	15.7
	2.5 - 4.0	7.2	9.1	26.6	19.4
09	0.1 - 1.0	7.5	50.9	17.3	17.8
	2.5 - 4.0	7.6	42.0	17.3	18.2
10	0.1 - 2.0	7.6	13.5	15.9	12.0
	3.0 - 4.0	7.1	12.0	15.9	7.8
11	0.1 - 2.0	7.0	3.8	33.7	7.7
	2.0 - 4.2	6.9	2.1	65.6	5.6
12	0.1 - 1.5	7.2	9.2	15.9	8.6
	3.0 - 3.8	6.9	18.7	19.5	13.2
13	0.1 - 1.0	7.9	3.8	19.7	17.3
	2.0 - 4.0	7.5	10.0	37.2	60.0
14	0.1 - 1.0	7.3	21.1	12.4	8.9
	2.0 - 3.8	7.1	22.1	14.4	2.7
15	0.1 - 0.6	7.2	38.9	23.0	12.6
	2.5 - 4.3	7.4	73.1	15.9	20.2
16	0.3 - 1.0	7.3	12.2	15.9	13.3
	3.0 - 4.0	7.1	16.2	24.8	8.3
17	0.1 - 0.6	7.1	9.3	15.9	5.6
	2.5 - 4.1	7.2	25.5	17.7	14.7
18	0.2 - 0.5	7.1	379.6	21.3	4.7
	2.0 - 4.0	7.0	344.0	28.4	1.7
19	0.1 - 0.5	6.7	8.9	24.8	5.7
	2.0 - 4.1	6.7	10.0	17.7	4.9
20	0.1 - 1.0	6.8	10.9	39.0	128.5
	2.0 - 4.2	6.8	21.5	21.3	14.1

Table 7: Chemical Analysis

2.8 Summary

Site investigations and laboratory test results have shown the site to have predominantly silty clayey soils within the initial 1-2m with sections of harder material at 2-4m. Laterite gravel and weathered rock was found at 2-3 meter depths in several of the trial pits.

Plasticity levels predominantly classify the soil conditions as clay of low plasticity, with the areas adjacent to the substation demonstrating non plastic tendencies within the initial 1.0m layer. For shallow foundations and any structures that would need to be built to house inverters or transformers, these soil conditions are desirable. Shallow foundations around zone 3 show bearing capacity values of 500kPa + with the exception of TP19 at 321kPa, this however is still regarded as an adequate design value.

Piling was considered for the panels due to the high load spread over a comparatively small surface area. Piling will require less structural concrete works as a wide footing would be required to combat overturning moments. Piles of diameter 0.3m and 4m lengths were used for design calculations. Piles with an allowable bearing capacity of less than 8 tons are TP01, TP10, TP11, TP15 and TP16.

Chemical analysis shows neutral pH values, chloride levels are within levels that will not pose corrosion risk to the concrete. Sulphide levels are elevated above acceptable levels in TP04, TP07 and TP18 of an average of 300 mg/l. It is recommended the surrounding area be tested to establish the extent of the elevated sulphate levels. Oxide reduction is seen to be elevated in TP2 and TP13, further testing as per with the sulphate is recommended prior to introducing mitigating measures.

3. Appendix

3.1 Soil Profiles

GEOCONSULT

+265 0888 846 543
sabelli@geoconsult.cc

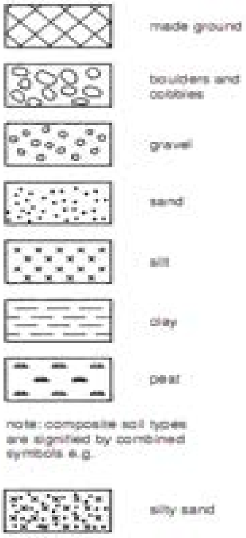
LAB REF: GC499 / 05MAY19 / 15:30		SAMPLE No. GSPV / TP01 / 27APR19		
SAMPLED BY: GEOCONSULT		DATE: 27 - 04 - 2019	TIME: 11:05	
LOCATION: 36L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
TP 01	0 672 496	8 403 452	543 (m)	0.000-4.000
TYPE OF MATERIAL:				
TESTED BY: S.THANGATO		DATE: 27 - 04 - 2019	TIME: 11:05	
CHECKED BY: G. KACHIWALA		DATE: 27 - 06 - 2019	TIME: 17:00	
APPROVED BY: M. MICHELLE		DATE: 27 - 06 - 2019	TIME: 10:00	
PROJECT: GOLOMOTI SOLAR PV		**CLIENT:** JCM		

TRIAL PIT SOIL PROFILE STANDARD: BS 1377

	0 200	MOIST LIGHT BROWN TOP SOIL
	400 600 800 1000	MOIST DARK BROWN SANDY SILTY CLAY
	1200 1400 1600 1800 2000	MOIST BROWN YELLOWISH SANDY SILTY CLAY
	2200 2400 2600 2800 3000	MOIST BROWN YELLOWISH GRAVELLY SANDY SILTY CLAY
	3200 3400 3600 3800 4000	VERY MOIST BROWN GRAVELLY SANDY SILTY CLAY CONTAINS SPOTS OF DECOMPOSED ROCK

WATER LEVEL: 3.2M

LEGEND



PHOTOGRAPHIC REPORT

REMARKS: SAMPLED FROM TP 01 @ GOLOMOTI SOLAR PV

GEOCONSULT	LAB REF: GC499 / 05MAY19 / 15:30		SAMPLE No. GSPV / TP02 / 27APR19		
	SAMPLED BY: GEOCONSULT		DATE: 27 - 04 - 2019	TIME: 08:10	
	LOCATION: 36L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
	TP 02	0 672 496	8 403 306	543 (m)	0.000-4.000
	TYPE OF MATERIAL:				
	TESTED BY: S.THANGATO		DATE: 27 - 04 - 2019	TIME: 08:10	
+265 0888 846 543	CHECKED BY: G. KACHIWALA		DATE: 27 - 06 - 2019	TIME: 17:00	
sabelli@geoconsult.cc	APPROVED BY: M. MICHELLE		DATE: 27 - 06 - 2019	TIME: 10:00	
PROJECT: GOLOMOTI SOLAR PV			**CLIENT:** JCM		

TRIAL PIT SOIL PROFILE STANDARD: BS 1377

▨	0 200	MOIST LIGHT BROWN TOP SOIL
▤	400 600 800 1000	MOIST DARK BROWN SANDY SILTY CLAY
▤	1200 1400 1600 1800 2000 2200 2400 2600 2800 3000 3200	MOIST BROWN YELLOWISH SANDY SILTY CLAY
▤	3400 3600 3800 4000	VERY MOIST BROWN YELLOWISH GRAVELLY SANDY SILTY CLAY

ATER LEVEL: 3.4M

LEGEND

▨	made ground
○	boulders and cobbles
∘	gravel
⁘	sand
×	silt
☰	clay
▬	peat

note: composite soil types are signified by combined symbols e.g.

⁘	silty sand

PHOTOGRAPHIC REPORT

REMARKS: SAMPLED FROM TP 02 @ GOLOMOTI SOLAR PV

GEOCONSULT	LAB REF: GC499 / 05MAY19 / 15:30		SAMPLE No. GSPV / TP03 / 27APR19		
	SAMPLED BY: GEOCONSULT		DATE: 27 - 04 - 2019	TIME: 08:10	
	LOCATION: 36L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
	TP 03	0 672 315	8 403 152	546 (m)	0.000-4.200
	TYPE OF MATERIAL:				
	TESTED BY: S.THANGATO		DATE: 27 - 04 - 2019	TIME: 08:10	
+265 0888 846 543	CHECKED BY: G. KACHIWALA		DATE: 27 - 06 - 2019	TIME: 17:00	
sabelli@geoconsult.cc	APPROVED BY: M. MICHELLE		DATE: 27 - 06 - 2019	TIME: 10:00	

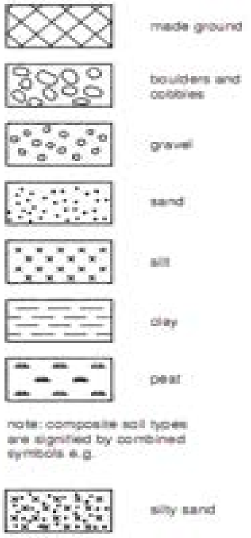
PROJECT: GOLOMOTI SOLAR PV

CLIENT: JCM

TRIAL PIT SOIL PROFILE STANDARD: BS 1377

▨	0 200	DRY LIGHT BROWN TOP SOIL
▨	400 600 800 1000	MOIST STIFF DARK GREY SANDY SILTY CLAY
▨	1200 1400 1600 1800 2000 2200 2400 2600 2800 3000 3200 3400	MOIST STIFF LIGHT BROWN SANDY SILTY CLAY
▨	3800 4000 4200	MOIST BROWN REDDISH SANDY SILTY CLAYEY LATERITE GRAVEL

LEGEND



PHOTOGRAPHIC REPORT

REMARKS: SAMPLED FROM TP 03 @ GOLOMOTI SOLAR PV

LAB REF: GC499 / 05MAY19 / 15:30			SAMPLE No. GSPV / TP04 / 27APR19		
SAMPLED BY: GEOCONSULT			DATE: 27 - 04 - 2019	TIME: 11:33	
LOCATION: 36L UTM	EASTING		NORTHING	ELEVATION	DEPTH (m)
TP 04	0 672 616		8 403 213	546 (m)	0.000-4.000
TYPE OF MATERIAL:					
TESTED BY: S.THANGATO			DATE: 27 - 04 - 2019	TIME: 11:33	
CHECKED BY: G. KACHIWALA			DATE: 27 - 06 - 2019	TIME: 17:00	
APPROVED BY: M. MICHELLE			DATE: 27 - 06 - 2019	TIME: 10:00	

GEOCONSULT

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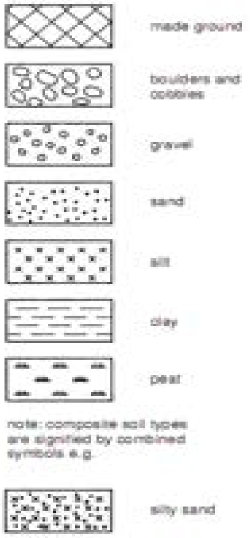
PROJECT: GOLOMOTI SOLAR PV

CLIENT: JCM

TRIAL PIT SOIL PROFILE   STANDARD: BS 1377

▨	0 200	MOIST LIGHT BROWN TOP SOIL
▨	400 600 800 1000	MOIST LIGHT BROWN SANDY SILTY CLAY
▨	1200 1400 1600 1800 2000	MOIST BROWNISH GREY SANDY SILTY CLAY
▨	2200 2400 2600 2800 3000 3200 3400 3800 4000	MOIST BROWN REDDISH LATERITE GRAVELLY SANDY SILTY CLAY

LEGEND



PHOTOGRAPHIC REPORT

REMARKS: SAMPLED FROM TP 04 @ GOLOMOTI SOLAR PV

GEOCONSULT

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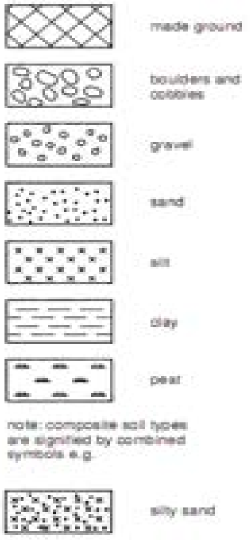
LAB REF: GC499 / 05MAY19 / 15:30		SAMPLE No. GSPV / TP05 / 30APR19		
SAMPLED BY: GEOCONSULT		DATE: 30 - 04 - 2019	TIME: 08:30	
LOCATION: 36L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
TP 05	0 672 768	8 403 213	545 (m)	0.000-4.000
TYPE OF MATERIAL:				
TESTED BY: S.THANGATO		DATE: 30 - 04 - 2019	TIME: 08:30	
CHECKED BY: G. KACHIWALA		DATE: 27 - 06 - 2019	TIME: 17:00	
APPROVED BY: M. MICHELLE		DATE: 27 - 06 - 2019	TIME: 10:00	
PROJECT: GOLOMOTI SOLAR PV		**CLIENT:** JCM		

TRIAL PIT SOIL PROFILE STANDARD: BS 1377

▨	0 200	MOIST LIGHT BROWN TOP SOIL
▨	400 600 800 1000 1200 1400	MOIST LIGHT BROWN SANDY SILTY CLAY
▨	1600 1800 2000 2200 2400 2600 2800 3000	MOIST LIGHT BROWN REDDISH GRAVELLY SANDY SILTY CLAY
▨	3200 3400 3800 4000	MOIST STIFF REDDISH BROWN LATERITE GRAVELLY SANDY SILTY CLAY

LEGEND



PHOTOGRAPHIC REPORT

REMARKS: SAMPLED FROM TP 05 @ GOLOMOTI SOLAR PV

GEOCONSULT	LAB REF: GC499 / 05MAY19 / 15:30		SAMPLE No. GSPV / TP06 / 30APR19		
	SAMPLED BY: GEOCONSULT		DATE: 30 - 04 - 2019	TIME: 10:11	
	LOCATION: 36L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
	TP 06	0 672 663	8 403 947	544 (m)	0.000-4.000
	TYPE OF MATERIAL:				
	TESTED BY: S.THANGATO		DATE: 30 - 04 - 2019	TIME: 10:11	
+265 0888 846 543	CHECKED BY: G. KACHIWALA		DATE: 27 - 06 - 2019	TIME: 17:00	
sabelli@geoconsult.cc	APPROVED BY: M. MICHELLE		DATE: 27 - 06 - 2019	TIME: 10:00	
PROJECT: GOLOMOTI SOLAR PV			**CLIENT:** JCM		

TRIAL PIT SOIL PROFILE STANDARD: BS 1377

▨	0 200	MOIST LIGHT BROWN TOP SOIL
▨	400 600 800 1000	MOIST LIGHT GREY SANDY SILTY CLAY
▨	1200 1400 1600 1800 2000 2200 2400 2600 2800 3000	MOIST LIGHT BROWN SANDY SILTY CLAY
▨	3200 3400 3800 4000	MOIST BROWN REDDISH SANDY SILTY CLAYEY LATERITE GRAVEL

PHOTOGRAPHIC REPORT

LEGEND

▨	made ground
▨	boulders and cobbles
▨	gravel
▨	sand
▨	silt
▨	clay
▨	peat

note: composite soil types are signified by combined symbols e.g.

▨	silty sand

REMARKS: SAMPLED FROM TP 06 @ GOLOMOTI SOLAR PV

GEOCONSULT	LAB REF: GC499 / 05MAY19 / 15:30		SAMPLE No. GSPV / TP07 / 30APR19		
	SAMPLED BY: GEOCONSULT		DATE: 30 - 04 - 2019	TIME: 13:57	
	LOCATION: 36L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
	TP 07	0 672 863	8 402 795	544 (m)	0.000-4.000
	TYPE OF MATERIAL:				
	TESTED BY: S.THANGATO		DATE: 30 - 04 - 2019	TIME: 13:57	
+265 0888 846 543	CHECKED BY: G. KACHIWALA		DATE: 27 - 06 - 2019	TIME: 17:00	
sabelli@geoconsult.cc	APPROVED BY: M. MICHELLE		DATE: 27 - 06 - 2019	TIME: 10:00	

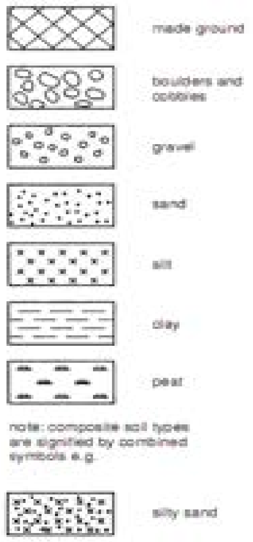
PROJECT: GOLOMOTI SOLAR PV

CLIENT: JCM

TRIAL PIT SOIL PROFILE STANDARD: BS 1377

▨	0 200	DRY LIGHT BROWN TOP SOIL
▨	400 600 800 1000	MOIST REDDISH GREY SANDY SILTY CLAY
▨	1200 1400 1600 1800 2000 2200 2400	MOIST STIFF BROWN GRAVELLY SANDY SILTY CLAY
▨	2600 2800 3000 3200 3400 3800 4000	MOIST BROWN REDDISH SANDY SILTY CLAYEY LATERITE GRAVEL

LEGEND

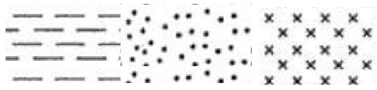
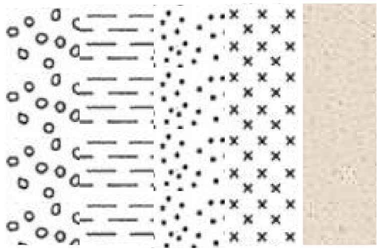
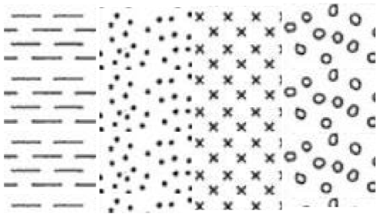


PHOTOGRAPHIC REPORT

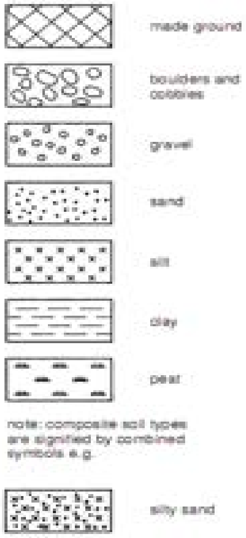
REMARKS: SAMPLED FROM TP 07 @ GOLOMOTI SOLAR PV

GEOCONSULT	LAB REF: GC499 / 05MAY19 / 15:30		SAMPLE No. GSPV / TP08 / 30APR19		
	SAMPLED BY: GEOCONSULT		DATE: 30 - 04 - 2019	TIME: 15:10	
	LOCATION: 36L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
	TP 08	0 673 025	8 402 675	540 (m)	0.000-4.000
	TYPE OF MATERIAL:				
	TESTED BY: S.THANGATO		DATE: 30 - 04 - 2019	TIME: 15:10	
+265 0888 846 543	CHECKED BY: G. KACHIWALA		DATE: 27 - 06 - 2019	TIME: 17:00	
sabelli@geoconsult.cc	APPROVED BY: M. MICHELLE		DATE: 27 - 06 - 2019	TIME: 10:00	
PROJECT: GOLOMOTI SOLAR PV			**CLIENT:** JCM		

TRIAL PIT SOIL PROFILE STANDARD: BS 1377

	0 200	DRY TOP SOIL
	400 600 800	MOIST DARK BROWN SANDY SILTY CLAY
	1000 1200 1400 1600 1800 2000 2200 2400	MOIST BROWN GRAVELLY SANDY SILTY CLAY WITH SPOTS OF HARD DECOMPOSED ROCK
	2600 2800 3000 3200 3400 3800 4000	MOIST BROWN REDDISH SANDY SILTY CLAYEY LATERITE GRAVEL

LEGEND



PHOTOGRAPHIC REPORT

REMARKS: SAMPLED FROM TP 08 @ GOLOMOTI SOLAR PV

GEOCONSULT	LAB REF: GC499 / 05MAY19 / 15:30		SAMPLE No. GSPV / TP09 / 01MAY19		
	SAMPLED BY: GEOCONSULT		DATE: 01 - 05 - 2019	TIME: 15:10	
	LOCATION: 36L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
	TP 09	0 673 013	8 402 587	542 (m)	0.000-4.000
	TYPE OF MATERIAL:				
	TESTED BY: S.THANGATO		DATE: 01 - 05 - 2019	TIME: 15:10	
+265 0888 846 543	CHECKED BY: G. KACHIWALA		DATE: 27 - 06 - 2019	TIME: 17:00	
sabelli@geoconsult.cc	APPROVED BY: M. MICHELLE		DATE: 27 - 06 - 2019	TIME: 10:00	

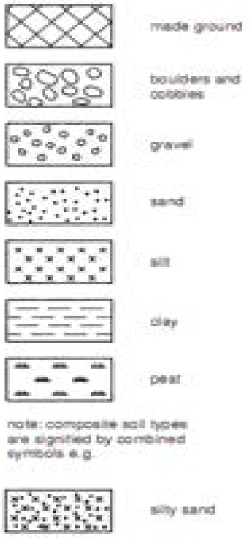
PROJECT: GOLOMOTI SOLAR PV

CLIENT: JCM

TRIAL PIT SOIL PROFILE   STANDARD: BS 1377

▨	0 200	DRY TOP SOIL
▨	400 600 800 1000	MOIST DARK GREY SANDY SILTY CLAY
▨	1200 1400 1600 1800 2000 2200 2400	MOIST BROWN STIFF GRAVELLY SANDY SILTY CLAY CONTAINS SPOTS OF WHITISH DECOMPOES ROCK
▨	2600 2800 3000 3200 3400 3800 4000	MOIST BROWN REDDISH LATERITE GRAVELLY GRAVLLEY SANDY SILTY CLAY

LEGEND



PHOTOGRAPHIC REPORT

REMARKS: SAMPLED FROM TP 09 @ GOLOMOTI SOLAR PV

GEOCONSULT	LAB REF: GC499 / 05MAY19 / 15:30		SAMPLE No. GSPV / TP010 / 01MAY19		
	SAMPLED BY: GEOCONSULT		DATE: 01 - 05 - 2019	TIME: 15:10	
	LOCATION: 36L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
	TP 10	0 673 006	8 402 499	548 (m)	0.000-4.000
	TYPE OF MATERIAL:				
	TESTED BY: S.THANGATO		DATE: 01 - 05 - 2019	TIME: 15:10	
+265 0888 846 543	CHECKED BY: G. KACHIWALA		DATE: 27 - 06 - 2019	TIME: 17:00	
sabelli@geoconsult.cc	APPROVED BY: M. MICHELLE		DATE: 27 - 06 - 2019	TIME: 10:00	

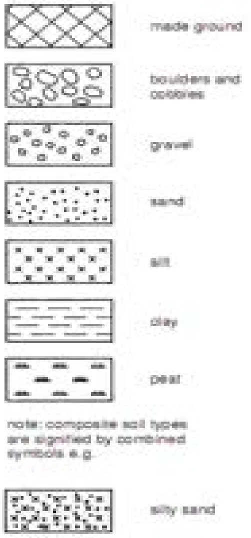
PROJECT: GOLOMOTI SOLAR PV

CLIENT: JCM

TRIAL PIT SOIL PROFILE STANDARD: BS 1377

▨	0 200	DRY TOP SOIL
▨	400 600 800 1000 1200 1400 1600 1800 2000	MOIST DARK BROWN SANDY SILTY CLAY
▨	2200 2400 2600 2800 3000	MOIST DARK BROWN STIFF SANDY SILTY CLAY
▨	3200 3400 3800 4000	MOIST BROWN GRAVELLY SANDY SILTY CLAY

LEGEND

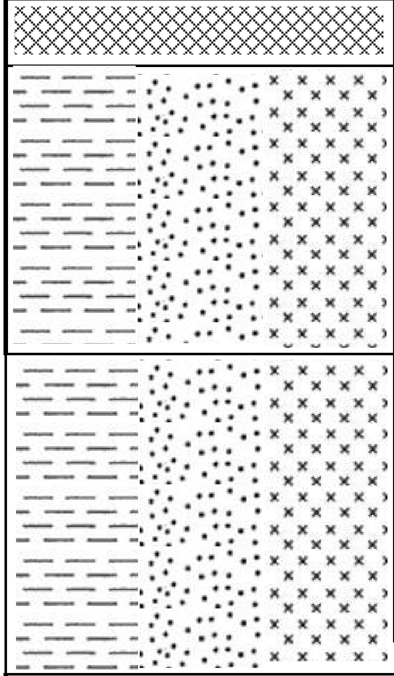


PHOTOGRAPHIC REPORT

REMARKS: SAMPLED FROM TP 10 @ GOLOMOTI SOLAR PV

GEOCONSULT	LAB REF: GC499 / 05MAY19 / 15:30		SAMPLE No. GSPV / TP011 / 01MAY19			
	SAMPLED BY: GEOCONSULT		DATE: 01 - 05 - 2019	TIME: 11:30		
	LOCATION: 36L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)	
	TP 11	0 672 996	8 402 377	546 (m)	0.000-4.200	
	TYPE OF MATERIAL:					
	TESTED BY: S.THANGATO		DATE: 01 - 05 - 2019	TIME: 11:30		
+265 0888 846 543	CHECKED BY: G. KACHIWALA		DATE: 27 - 06 - 2019	TIME: 17:00		
sabelli@geoconsult.cc	APPROVED BY: M. MICHELLE		DATE: 27 - 06 - 2019	TIME: 10:00		
PROJECT: GOLOMOTI SOLAR PV			**CLIENT:** JCM			

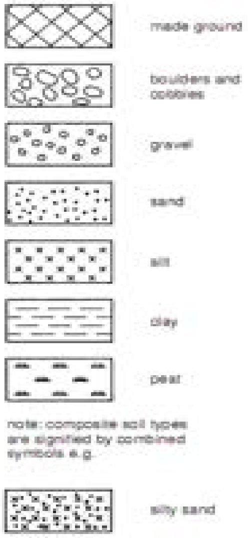
TRIAL PIT SOIL PROFILE STANDARD: BS 1377



0 200	DRY TOP SOIL
400 600 800 1000 1200 1400 1600 1800 2000	MOIST DARK BROWN SANDY SILTY CLAY
2200 2400 2600 2800 3000 3200 3400 3800 4000 4200	MOIST BROWN SANDY SILTY CLAY

PHOTOGRAPHIC REPORT

LEGEND



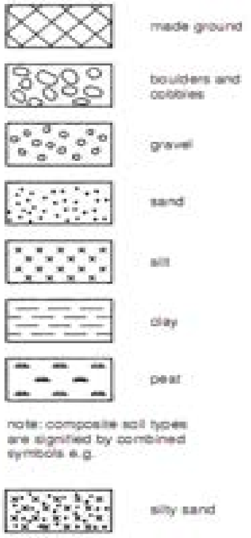
REMARKS: SAMPLED FROM TP 11 @ GOLOMOTI SOLAR PV

GEOCONSULT	LAB REF: GC499 / 05MAY19 / 15:30		SAMPLE No. GSPV / TP012 / 02MAY19		
	SAMPLED BY: GEOCONSULT		DATE: 02 - 05 - 2019	TIME: 08:27	
	LOCATION: 36L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
	TP 12	0 672 650	8 402 797	547 (m)	0.000-3.800
	TYPE OF MATERIAL:				
	TESTED BY: S.THANGATO		DATE: 02 - 05 - 2019	TIME: 08:27	
+265 0888 846 543	CHECKED BY: G. KACHIWALA		DATE: 27 - 06 - 2019	TIME: 17:00	
sabelli@geoconsult.cc	APPROVED BY: M. MICHELLE		DATE: 27 - 06 - 2019	TIME: 10:00	
PROJECT: GOLOMOTI SOLAR PV			**CLIENT:** JCM		

TRIAL PIT SOIL PROFILE STANDARD: BS 1377

▨	0 200	DRY LIGHT BROWN TOP SOIL
▨	400 600 800 1000 1200 1400	MOIST DARK BROWN SANDY SILTY CLAY
▨	1600 1800 2000 2200 2400 2600 2800 3000	MOIST BROWN SANDY SILTY CLAY
▨	3200 3400 3800	MOIST BROWN REDDISH STIFF LATERITE GRAVELLY SANDY SILTY CLAY

LEGEND



PHOTOGRAPHIC REPORT

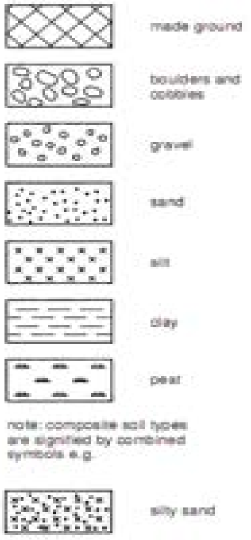
REMARKS: SAMPLED FROM TP 12 @ GOLOMOTI SOLAR PV

GEOCONSULT	LAB REF: GC499 / 05MAY19 / 15:30		SAMPLE No. GSPV / TP013 / 02MAY19		
	SAMPLED BY: GEOCONSULT		DATE: 02 - 05 - 2019	TIME: 07:00	
	LOCATION: 36L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
	TP 13	0 672 640	8 402 630	550 (m)	0.000-3.800
	TYPE OF MATERIAL:				
	TESTED BY: S.THANGATO		DATE: 02 - 05 - 2019	TIME: 07:00	
+265 0888 846 543	CHECKED BY: G. KACHIWALA		DATE: 27 - 06 - 2019	TIME: 17:00	
sabelli@geoconsult.cc	APPROVED BY: M. MICHELLE		DATE: 27 - 06 - 2019	TIME: 10:00	
PROJECT: GOLOMOTI SOLAR PV			**CLIENT:** JCM		

TRIAL PIT SOIL PROFILE STANDARD: BS 1377

▨	0 200	DRY LIGHT BROWN TOP SOIL	
▨	400 600 800 1000	MOIST BROWN MOLTLED SANDY SILTY CLAY	
▨	1200 1400 1600 1800 2000	MOIST BROWN SANDY SILTY CLAY	
▨	2200 2400 2600 2800 3000 3200 3400 3800 4000	MOIST BROWN REDDISH STIFF LATERITE GRAVELLY SANDY SILTY CLAY	

LEGEND



PHOTOGRAPHIC REPORT

REMARKS: SAMPLED FROM TP 13 @ GOLOMOTI SOLAR PV

GEOCONSULT	LAB REF: GC499 / 05MAY19 / 15:30		SAMPLE No. GSPV / TP014 / 01MAY19		
	SAMPLED BY: GEOCONSULT		DATE: 01 - 05 - 2019	TIME: 16:15	
	LOCATION: 36L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
	TP 14	0 672 645	8 402 499	546 (m)	0.000-3.800
	TYPE OF MATERIAL:				
	TESTED BY: S.THANGATO		DATE: 01 - 05 - 2019	TIME: 16:15	
+265 0888 846 543	CHECKED BY: G. KACHIWALA		DATE: 27 - 06 - 2019	TIME: 17:00	
sabelli@geoconsult.cc	APPROVED BY: M. MICHELLE		DATE: 27 - 06 - 2019	TIME: 10:00	

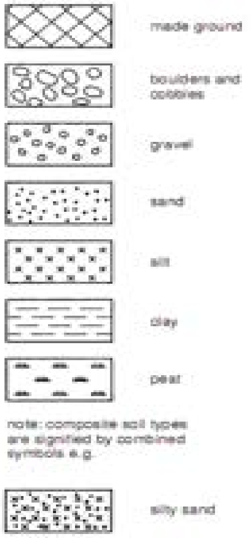
PROJECT: GOLOMOTI SOLAR PV

CLIENT: JCM

TRIAL PIT SOIL PROFILE STANDARD: BS 1377

▨	0 200	DRY LIGHT BROWN TOP SOIL
▨	400 600 800 1000	MOIST DARK BROWN SANDY SILTY CLAY
▨	1200 1400 1600 1800 2000 2200 2400 2600 2800 3000 3200 3400 3800	MOIST BROWN SANDY SILTY CLAY

LEGEND

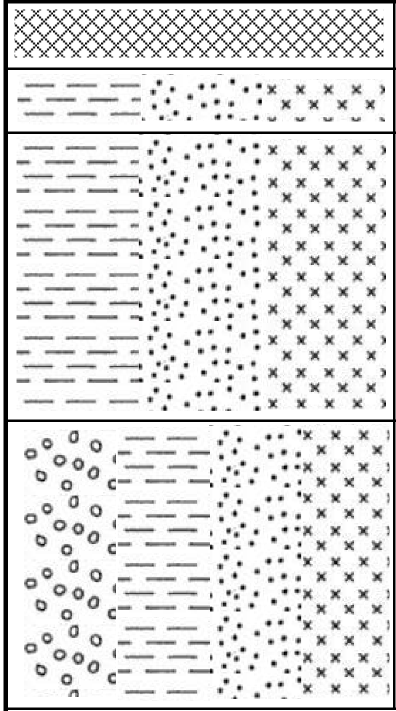


PHOTOGRAPHIC REPORT

REMARKS: SAMPLED FROM TP 14 @ GOLOMOTI SOLAR PV

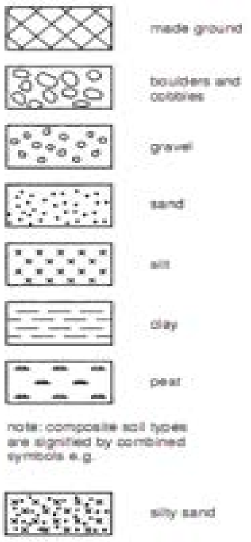
GEOCONSULT	LAB REF: GC499 / 05MAY19 / 15:30		SAMPLE No. GSPV / TP015 / 02MAY19		
	SAMPLED BY: GEOCONSULT		DATE: 02 - 05 - 2019	TIME: 10:15	
	LOCATION: 36L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
	TP 15	0 672 384	8 402 794	546 (m)	0.000-4.300
	TYPE OF MATERIAL:				
	TESTED BY: S.THANGATO		DATE: 02 - 05 - 2019	TIME: 10:15	
+265 0888 846 543	CHECKED BY: G. KACHIWALA		DATE: 27 - 06 - 2019	TIME: 17:00	
sabelli@geoconsult.cc	APPROVED BY: M. MICHELLE		DATE: 27 - 06 - 2019	TIME: 10:00	
PROJECT: GOLOMOTI SOLAR PV			**CLIENT:** JCM		

TRIAL PIT SOIL PROFILE STANDARD: BS 1377

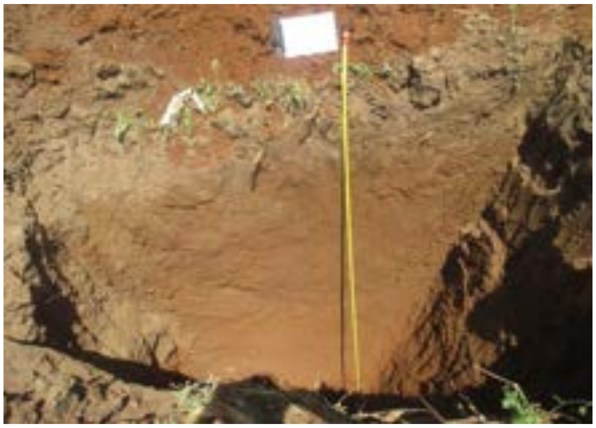


0 200	DRY LIGHT BROWN TOP SOIL
400 600	MOIST DARK BROWN SANDY SILTY CLAY
800 1000 1200 1400 1600 1800 2000 2200 2400	MOIST BROWN REDDISH SANDY SILTY CLAY
2600 2800 3000 3200 3400 3800 4000 4200 4400	MOIST BROWN REDDISH GRAVELLY SANDY SILTY CLAY

LEGEND



PHOTOGRAPHIC REPORT



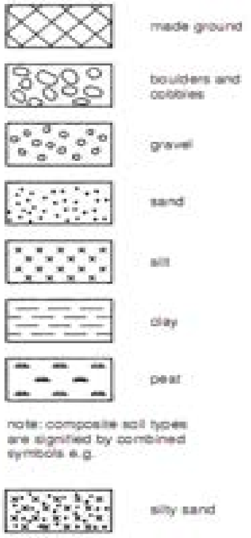
REMARKS: SAMPLED FROM TP 15 @ GOLOMOTI SOLAR PV

GEOCONSULT	LAB REF: GC499 / 05MAY19 / 15:30		SAMPLE No. GSPV / TP016 / 02MAY19		
	SAMPLED BY: GEOCONSULT		DATE: 02 - 05 - 2019	TIME: 10:10	
	LOCATION: 36L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
	TP 16	0 672 342	8 402 660	549 (m)	0.000-4.100
	TYPE OF MATERIAL:				
	TESTED BY: S.THANGATO		DATE: 02 - 05 - 2019	TIME: 10:10	
+265 0888 846 543	CHECKED BY: G. KACHIWALA		DATE: 27 - 06 - 2019	TIME: 17:00	
sabelli@geoconsult.cc	APPROVED BY: M. MICHELLE		DATE: 27 - 06 - 2019	TIME: 10:00	
PROJECT: GOLOMOTI SOLAR PV			**CLIENT:** JCM		

TRIAL PIT SOIL PROFILE STANDARD: BS 1377

▨	0 200	DRY LIGHT BROWN TOP SOIL
▨	400 600 800 1000	MOIST BROWN MOLTLED SANDY SILTY CLAYEY SOFT GRAVEL
▨	1200 1400 1600 1800 2000 2200 2400 2600 2800 3000	MOIST BROWN REDDISH SANDY SILTY CLAYEY LATERITE GRAVEL
▨	3200 3400 3800 4000 4200	MOIST BROWN HARD SANDY SILTY CLAYEY LATERITE GRAVEL

LEGEND



PHOTOGRAPHIC REPORT

REMARKS: SAMPLED FROM TP 16 @ GOLOMOTI SOLAR PV

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LAB REF: GC499 / 05MAY19 / 15:30		SAMPLE No. GSPV / TP017 / 02MAY19		
SAMPLED BY: GEOCONSULT		DATE: 02 - 05 - 2019	TIME: 17:05	
LOCATION: 36L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
TP 17	0 672 016	8 402 656	551 (m)	0.000-4.100
TYPE OF MATERIAL:				
TESTED BY: S.THANGATO		DATE: 02 - 05 - 2019	TIME: 17:05	
CHECKED BY: G. KACHIWALA		DATE: 27 - 06 - 2019	TIME: 17:00	
APPROVED BY: M. MICHELLE		DATE: 27 - 06 - 2019	TIME: 10:00	

PROJECT: GOLOMOTI SOLAR PV

CLIENT: JCM

TRIAL PIT SOIL PROFILE STANDARD: BS 1377

▨	0 200	DRY LIGHT BROWN TOP SOIL
▨	400 600 800 1000	MOIST DARK BROWN SANDY SILTY CLAY
▨	1200 1400 1600 1800 2000 2200 2400	MOIST BROWN GRAVELLY SANDY SILTY CLAY
▨	2600 2800 3000 3200 3400 3800 4000 4200	MOIST BROWN REDDISH STIFF LATERITE GRAVELLY SANDY SILTY CLAY

LEGEND

▨	made ground
▨	boulders and cobbles
▨	gravel
▨	sand
▨	silt
▨	clay
▨	peat

note: composite soil types are signified by combined symbols e.g.

▨	silty sand

PHOTOGRAPHIC REPORT

REMARKS: SAMPLED FROM TP 17 @ GOLOMOTI SOLAR PV

GEOCONSULT

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LAB REF: GC499 / 05MAY19 / 15:30		SAMPLE No. GSPV / TP018 / 03MAY19		
SAMPLED BY: GEOCONSULT		DATE: 03 - 05 - 2019	TIME: 09:30	
LOCATION: 36L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
TP 18	0 671 938	8 402 608	557 (m)	0.000-4.000
TYPE OF MATERIAL:				
TESTED BY: S.THANGATO		DATE: 03 - 05 - 2019	TIME: 09:30	
CHECKED BY: G. KACHIWALA		DATE: 27 - 06 - 2019	TIME: 17:00	
APPROVED BY: M. MICHELLE		DATE: 27 - 06 - 2019	TIME: 10:00	

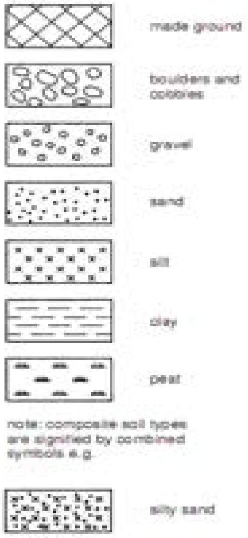
PROJECT: GOLOMOTI SOLAR PV

CLIENT: JCM

TRIAL PIT SOIL PROFILE STANDARD: BS 1377

▨	0 200	DRY LIGHT BROWN TOP SOIL
▨	400	MOIST LIGHT BROWN SANDY SILTY CLAY
▨	600 800 1000 1200 1400 1600 1800 2000	MOIST BROWN SOFT SANDY SILTY CLAYEY LATERITE GRAVEL
▨	2200 2400 2600 2800 3000 3200 3400 3800 4000	MOIST BROWN REDDISH SANDY SILTY CLAYEY LATERITE GRAVEL

LEGEND



PHOTOGRAPHIC REPORT

REMARKS: SAMPLED FROM TP 18 @ GOLOMOTI SOLAR PV

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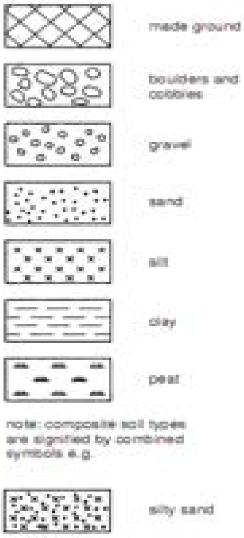
LAB REF: GC499 / 05MAY19 / 15:30		SAMPLE No. GSPV / TP019 / 02MAY19		
SAMPLED BY: GEOCONSULT		DATE: 02 - 05 - 2019	TIME: 14:05	
LOCATION: 36L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
TP 19	0 671 989	8 402 554	556 (m)	0.000-4.100
TYPE OF MATERIAL:				
TESTED BY: S.THANGATO		DATE: 02 - 05 - 2019	TIME: 14:05	
CHECKED BY: G. KACHIWALA		DATE: 27 - 06 - 2019	TIME: 17:00	
APPROVED BY: M. MICHELLE		DATE: 27 - 06 - 2019	TIME: 10:00	

PROJECT: GOLOMOTI SOLAR PV | **CLIENT:** JCM

TRIAL PIT SOIL PROFILE STANDARD: BS 1377

▨	0 200	DRY LIGHT BROWN TOP SOIL
▨	400 600	MOIST DARK BROWN SANDY SILTY CLAY
▨	800 1000 1200 1400 1600 1800 2000	MOIST BROWN REDDISH SANDY SILTY CLAY
▨	2200 2400 2600 2800 3000 3200 3400 3800 4000 4200	MOIST BROWN REDDISH GRAVELLY SANDY SILTY CLAY

LEGEND



note: composite soil types are signified by combined symbols e.g.

PHOTOGRAPHIC REPORT

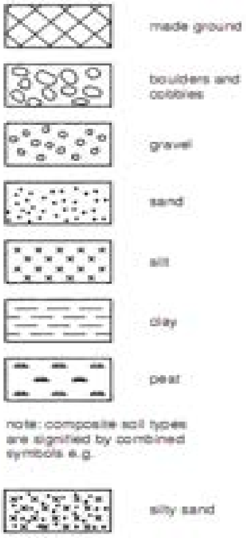
REMARKS: SAMPLED FROM TP 19 @ GOLOMOTI SOLAR PV

GEOCONSULT	LAB REF: GC499 / 05MAY19 / 15:30		SAMPLE No. GSPV / TP020 / 03MAY19		
	SAMPLED BY: GEOCONSULT		DATE: 03 - 05 - 2019	TIME: 14:05	
	LOCATION: 36L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
	TP 20	0 671 990	8 402 438	561 (m)	0.000-4.200
	TYPE OF MATERIAL:				
	TESTED BY: S.THANGATO		DATE: 03 - 05 - 2019	TIME: 14:05	
+265 0888 846 543	CHECKED BY: G. KACHIWALA		DATE: 27 - 06 - 2019	TIME: 17:00	
sabelli@geoconsult.cc	APPROVED BY: M. MICHELLE		DATE: 27 - 06 - 2019	TIME: 10:00	
PROJECT: GOLOMOTI SOLAR PV			**CLIENT:** JCM		

TRIAL PIT SOIL PROFILE STANDARD: BS 1377

▨	0 200	DRY LIGHT BROWN TOP SOIL
▨	400 600 800 1000	MOIST DARK BROWN SANDY SILTY CLAY
▨	1200 1400 1600 1800 2000	MOIST BROWN REDDISH GRAVELLY SANDY SILTY CLAY
▨	2200 2400 2600 2800 3000 3200 3400 3800 4000 4200	MOIST BROWN REDDISH LATERITE GRAVELLY SANDY SILTY CLAY

LEGEND



PHOTOGRAPHIC REPORT

REMARKS: SAMPLED FROM TP 20 @ GOLOMOTI SOLAR PV

3.2 Summary of Test Results

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LAB. REF. No. GC499 / 05MY19 / 15:00

SAMPLE No. GSPV / TRIAL PIT 1-TP6 / 05MAY19

SAMPLED BY: GEOCONSULT LABORATORY TEAM

DATE: 05 / 05 / 2019

TIME:

LOCATION:

GOLOMOTI SOLAR PV

EASTING	NORTHING	ELEVATION (m)	DEPTH (m)

TYPE OF MATERIAL:

TEST STANDARD: BS 1377

TESTED BY: GEOCONSULT LABORATORY TEAM

DATE: 05 / 05 / 2019

TIME:

CHECKED BY: G. L. KACHIWALA

DATE: 06 / 05 / 2018

TIME:

APPROVED: M. SABELLI

DATE: 06 / 05 / 2018

TIME:

PROJECT: GOLOMOTI SOLAR PV

CLIENT: JCM

SUMMARY OF TEST RESULTS

LAB. REFERENCE No.	DEPTH (m)	TRIAL PIT No.	SIEVE ANALYSIS			LL %	PI	LS %	LS / P	Classification	FI	NMC	**Remarks**
			2.36 pass	0.425 pass	0.075 pass								
GC499 / 05MAY2019	0.200-1.000	1	99	72	37	21.6	11	6.1	439	A - 6 (0)	407	6.8	SELECTED FILL MATERIAL
	1.000-2.000	1	97	67	40	34.3	21	12.5	838	A - 6 (4)	840	12	SELECTED FILL MATERIAL
	2.000-3.000	1	96	68	49	42.5	29	12.0	816	A-7-6(9)	1421	11.7	SELECTED FILL MATERIAL
	3.000-4.000	1	94	68	48	38.6	21	10.2	694	A - 6 (6)	1008	10.3	SELECTED FILL MATERIAL
GC499 / 05MAY2019	0.200-1.000	2	98	72	47	38.5	22	9.4	677	A - 6 (6)	1034	10.6	SELECTED FILL MATERIAL
	1.000-3.300	2	97	68	39	32.9	19	8.5	578	A - 6 (3)	741	10.8	SELECTED FILL MATERIAL
	3.300-4.000	2	98	71	46	34.2	16	7.7	547	A - 6 (4)	736	19.4	SELECTED FILL MATERIAL
GC499 / 05MAY2019	0.200-1.000	3	98	71	45	41.1	23	12	852	A-7-6(6)	1035	10.8	SELECTED FILL MATERIAL
	1.000-3.500	3	98	90	78	49.0	13	6.9	621	A-7-5(3)	1014	11.9	SELECTED FILL MATERIAL
	3.500-4.200	3	99	88	65	37.3	21	7.7	678	A - 6 (10)	1365	11.0	SELECTED FILL MATERIAL
GC499 / 05MAY2019	0.250-1.000	4	99	78	48	36.4	13	6.1	476	A - 6 (3)	624	10.1	SELECTED FILL MATERIAL
	1.000-2.000	4	98	74	40	48.6	25	12.9	955	A-7-6(5)	1000	14.5	SELECTED FILL MATERIAL
	2.000-4.000	4	99	90	69	35.6	20	9.4	846	A - 6 (10)	1380	8.0	SELECTED FILL MATERIAL
GC499 / 05MAY2019	0.100-1.500	5	98	87	75	43	26	12.9	1122	A-7-6(15)	1950	12.4	SELECTED FILL MATERIAL
	1.500-3.000	5	98	85	71	41	19	10.2	867	A - 6 (11)	1349	11.8	SELECTED FILL MATERIAL
	3.000-4.000	5	99	82	63	40	19	12.0	984	A - 6 (9)	1197	14.5	SELECTED FILL MATERIAL
GC499 / 05MAY2019	0.200-1.000	6	98	80	55	41	23	11.2	896	A-7-6(9)	1265	6.8	SELECTED FILL MATERIAL
	1.000-3000	6	98	83	62	38	23	11.1	921	A - 6 (10)	1426	10.1	SELECTED FILL MATERIAL
	3.000-4.000	6	97	79	52	41	24	12.0	948	A-7-6(9)	1248	9.1	SELECTED FILL MATERIAL

REMARKS: SAMPLED FROM GOLOMOTI SOLAR PV **SITE TRIAL PITS**

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LAB. REF. No. GC499 / 05MY19 / 15:00

SAMPLE No. GSPV / TRIAL PIT 7-12 / 05MAY19

SAMPLED BY: GEOCONSULT LABORATORY TEAM

DATE: 05 / 05 / 2019

TIME:

LOCATION:	EASTING	NORTHING	ELEVATION (m)	DEPTH (m)
GOLOMOTI SOLAR PV				

TYPE OF MATERIAL:

TEST STANDARD: BS 1377

TESTED BY: GEOCONSULT LABORATORY TEAM	DATE: 05 / 05 / 2019	TIME:
CHECKED BY: G. L. KACHIWALA	DATE: 06 / 05 / 2018	TIME:
APPROVED: M. SABELLI	DATE: 06 / 05 / 2018	TIME:

PROJECT: GOLOMOTI SOLAR PV

CLIENT: JCM

SUMMARY OF TEST RESULTS

LAB. REFERENCE	DEPTH	TRIAL PIT	SIEVE ANALYSIS			LL	PI	LS	LS / P	Classification	FI	NMC	**Remarks**
No.	(m)	No.	2.36 pass	0.425 pass	0.075 pass	%		%					
GC499 / 05MAY2019	0.200-1.000	7	98	67	37	40.8	22	11.1	744	A -7-6 (3)	814	11.1	SELECTED FILL MATERIAL
	1.000-2.500	7	99	85	66	32.3	12	6.9	587	A -6 (6)	792	10.8	SELECTED FILL MATERIAL
	2.500-4.000	7	96	75	53	32.3	11	6.1	458	A -6 (3)	583	7.1	SELECTED FILL MATERIAL
GC499 / 05MAY2019	0.100-0.800	8	99	86	70	39.6	21	13.8	1187	A -7-6 (13)	1470	11.1	SELECTED FILL MATERIAL
	0.800-2.500	8	96	78	51	38.7	20	9.4	733	A -6 (6)	1020	9.2	SELECTED FILL MATERIAL
	2.500-4.000	8	96	78	50	38.6	15	6.1	476	A -6 (5)	750	8.3	SELECTED FILL MATERIAL
GC499 / 05MAY2019	0.100-1.000	9	98	86	70	39.6	21	13.8	1187	A -6 (11)	1470	11.0	SELECTED FILL MATERIAL
	1.000-2.500	9	96	84	67	42.6	27	12.9	1084	A -7-6 (14)	1809	12.0	SELECTED FILL MATERIAL
	2.500-4.000	9	98	86	64	39.0	21	12.0	1032	A -6 (10)	1344	9.9	SELECTED FILL MATERIAL
GC499 / 05MAY2019	0.200-2.000	10	99	91	60	31.4	11	3.7	337	A -6 (4)	660	11	SELECTED FILL MATERIAL
	2.200-3.000	10	99	89	63	36.5	16	7.7	685	A -6 (8)	1008	12.5	SELECTED FILL MATERIAL
	3.000-4.000	10	96	75	47	37.0	19	9.4	705	A -6 (5)	893	12.4	SELECTED FILL MATERIAL
GC499 / 05MAY2019	0.100-2.000	11	97	67	39	38	23	10.2	683	A -6 (4)	897	15.4	SELECTED FILL MATERIAL
	0.100-1.500	11	97	79	48	33	12	8.5	672	A -6 (3)	576	13	SELECTED FILL MATERIAL
GC499 / 05MAY2019	0.100-1.500	12	87	66	48	37.7	15	7.7	508	A -6 (4)	720	8.9	SELECTED FILL MATERIAL
	1.500-3.000	12	96	76	52	37.9	17	8.5	646	A -6 (6)	884	11.7	SELECTED FILL MATERIAL
	3.000-3.800	12	99	85	68	28.4	13	6.1	519	A -6 (6)	884	9.3	SELECTED FILL MATERIAL

REMARKS: SAMPLED FROM GOLOMOTI SOLAR PV **SITE TRIAL PITS**

GEOCONSULT

LAB. REF. No. GC499 / 05MY19 / 15:00			**SAMPLE No. GSPV / TRIAL PIT 12-17 / 05MAY19**		
SAMPLED BY: GEOCONSULT LABORATORY TEAM			DATE: 05 / 05 / 2019		TIME:
LOCATION:	EASTING		NORTHING	ELEVATION (m)	DEPTH (m)
GOLOMOTI SOLAR PV					
TYPE OF MATERIAL:					
TEST STANDARD: BS 1377					
TESTED BY: GEOCONSULT LABORATORY TEAM			DATE: 05 / 05 / 2019		TIME:
CHECKED BY: G. L. KACHIWALA			DATE: 06 / 05 / 2018		TIME:
APPROVED: M. SABELLI			DATE: 06 / 05 / 2018		TIME:

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sabelli@geoconsult.cc

PROJECT: GOLOMOTI SOLAR PV **CLIENT**: JCM

SUMMARY OF TEST RESULTS

LAB. REFERENCE	DEPTH	TRIAL PIT	SIEVE ANALYSIS			LL	PI	LS	LS / P	Classification	FI	NMC	**Remarks**
No.	(m)	No.	2.36 pass	0.425 pass	0.075 pass	%		%					
GC499 / 05MAY2019	0.200-1.000	13	98	82	56	27.5	9	6.1	500	A - 4 (2)	504	5.3	SELECTED FILL MATERIAL
	1.000-2.000	13	91	74	60	30.1	15	6.9	511	A - 6 (6)	900	6.9	SELECTED FILL MATERIAL
	2.500-4.000	13	95	80	56	43.8	19	6.9	552	A -7 -6 (8)	1064	7.1	SELECTED FILL MATERIAL
GC499 / 05MAY2019	0.100-1.000	14	97	83	65	41.5	16	7.7	639	A -7 -6 (9)	1040	6	SELECTED FILL MATERIAL
	1.000-3.000	14	97	84	65	44.0	19	6.9	580	A -7 -6 (10)	1235	11.1	SELECTED FILL MATERIAL
GC499 / 05MAY2018	0.100-0.600	15	99	81	56	28.9	14	6.9	559	A - 6 (3)	784	13.2	SELECTED FILL MATERIAL
	0.600-2.500	15	90	74	55	37.4	21	11.1	821	A - 6 (8)	1155	12.3	SELECTED FILL MATERIAL
	2.500-4.300	15	90	74	56	36.9	17	6.9	511	A - 6 (7)	952	10.1	SELECTED FILL MATERIAL
GC499 / 05MAY2019	0.300-1.000	16	81	54	36	31.1	11	6.1	329	A - 6 (0)	396	6.6	SELECTED FILL MATERIAL
	1.000-3.000	16	80	52	33	33.5	16	8.5	442	A -2-6 (1)	528	12.3	SELECTED FILL MATERIAL
	3.100-4.100	16	83	57	39	36.4	17	6.9	393	A -6 (2)	663	5.5	SELECTED FILL MATERIAL
GC499 / 05MAY2019	0.100-0.600	17	96	73	35	SP	SP	10.2		A -2-4 (0)		13.9	SELECTED FILL MATERIAL
	0.600-2.500	17	90	73	50	34	12	5.3	387	A -6 (3)	600	12.1	SELECTED FILL MATERIAL
	2.500-4.100	17	98	79	50	24	10	13.2	1043	A -4 (2)	500	11.1	SELECTED FILL MATERIAL
GC499 / 05MAY2019	0.200-0.500	18	94	69	39	SP	SP	2.2	152	A -4 (0)		5.0	SELECTED FILL MATERIAL
	0.500-2.000	18	94	70	26	34.6	14	6.1	427	A -2-6 (0)	364	5.6	SELECTED FILL MATERIAL
	2.000-4.000	18	99	84	64	33.1	16	8.5	714	A -6 (7)	1024	13.2	SELECTED FILL MATERIAL

REMARKS: SAMPLED FROM GOLOMOTI SOLAR PV **SITE TRIAL PITS**

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LAB. REF. No. GC499 / 05MY19 / 15:00

SAMPLE No. GSPV / TP19-TP20 / 05MAY19

SAMPLED BY: GEOCONSULT LABORATORY TEAM — DATE: 05 / 05 / 2019 — TIME:

LOCATION:	EASTING	NORTHING	ELEVATION (m)	DEPTH (m)
GOLOMOTI SOLAR PV				

TYPE OF MATERIAL:

TEST STANDARD: BS 1377

TESTED BY: GEOCONSULT LABORATORY TEAM — DATE: 05 / 05 / 2019 — TIME:

CHECKED BY: G. L. KACHIWALA — DATE: 06 / 05 / 2018 — TIME:

APPROVED: M. SABELLI — DATE: 06 / 05 / 2018 — TIME:

PROJECT: GOLOMOTI SOLAR PV

CLIENT: JCM

SUMMARY OF TEST RESULTS

LAB. REFERENCE	DEPTH	TRIAL PIT	SIEVE ANALYSIS			LL	PI	LS	LS / P	Classification	FI	NMC	**Remarks**
No.	(m)	No.	2.36 pass	0.425 pass	0.075 pass	%		%					
GC499 / 05MAY2019	0.100-0.500	19	99	76	40	SP	SP	1.4	106	A - 6 (6)		5.4	SELECTED FILL MATERIAL
	0.500-2.000	19	92	73	51	36.3	18	8.5	621	A - 6 (6)	918	10.7	SELECTED FILL MATERIAL
	2.000-4.100	19	97	86	54	35.4	17	7.7	662	A - 6 (6)	918	11.2	SELECTED FILL MATERIAL
GC499 / 05MAY2019	0.100-1.000	20	99	75	46	37.5	16	9.4	705	A - 6 (4)	736	9.7	SELECTED FILL MATERIAL
	1.000-2.000	20	85	61	38	36.8	14	7.7	470	A - 6 (1)	532	10.3	SELECTED FILL MATERIAL
	2.000-4.000	20	94	76	47	31.7	20	11.1	844	A - 6 (5)	940	12.4	SELECTED FILL MATERIAL

REMARKS: SAMPLED FROM GOLOMOTI SOLAR PV **SITE TRIAL PITS**

3.3 DCP

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LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP001 / DCP001 / 26APR19		
SAMPLED BY: GEOCONSULT LAB		DATE: 26 / 04 / 2019	TIME: 09:37	
LOCATION: UTM 36 L	EASTING	NORTHING	ELEVATION	DEPTH
TRIAL PIT 01	0 672 496	8 403 452	543 m	840
TYPE OF MATERIAL:				
TESTED BY: M. MILANZI		DATE: 26 / 04 / 2019	TIME: 09:37	
CHECKED BY: S.THANGATO		DATE: 26 / 04 / 2019	TIME: 09:37	
APPROVED BY: M. SABELLI		DATE: 27 / 04 / 2019	TIME: 10:37	

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

DYNAMIC CONE PENETRATION TEST (DCP) STANDARD: ASTM D6951/D6951M - 09

Initial Reading (mm): 110

No of Blows	Pen (mm)	Difference (mm)	Cum. Pen (mm)	mm / Blow	CBR (%)
5	289	179	179	36	5
10	554	265	444	53	3
15	750	196	640	39	5
20	929	179	819	36	5
25	950	21	840	4	60

REMARKS: DCP TEST FROM TRIAL PIT 01 AT THE DEPTH OF 1.000m. GOLOMOTI SOLAR SITE INVESTIGATION

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LAB REF: GC499 / 04MAY19 / 15:00	SAMPLE No. GSPV / TP002 / DCP002 / 27APR19
SAMPLED BY: GEOCONSULT LAB	DATE: 27 / 04 / 2019 TIME: 09:37

LOCATION: UTM 36 L	EASTING	NORTHING	ELEVATION	DEPTH
TRIAL PIT 02	0 672 496	8 403 306	549 m	850

TYPE OF MATERIAL:

TESTED BY: M. MILANZI	DATE: 27 / 04 / 2019	TIME: 09:37
CHECKED BY: S.THANGATO	DATE: 27 / 04 / 2019	TIME: 09:37
APPROVED BY: M. SABELLI	DATE: 28 / 04 / 2019	TIME: 10:37

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

DYNAMIC CONE PENETRATION TEST (DCP) STANDARD: ASTM D6951/D6951M - 09

Initial Reading (mm): 100

No of Blows	Pen (mm)	Difference (mm)	Cum. Pen (mm)	mm / Blow	CBR (%)
5	270	170	170	34	6
10	454	184	354	37	5
15	642	188	542	38	5
20	672	30	572	6	40
25	889	217	789	43	4
27	950	61	850	31	6

REMARKS: DCP TEST FROM TRIAL PIT 02 AT THE DEPTH OF 1.000m. GOLOMOTI SOLAR SITE INVESTIGATION

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LAB REF: GC499 / 04MAY19 / 15:00
SAMPLE No. GSPV / TP003 / DCP003 / 30APR19
SAMPLED BY: GEOCONSULT LAB
DATE: 30 / 04 / 2019
TIME: 09:37

LOCATION: UTM 36 L	EASTING	NORTHING	ELEVATION	DEPTH
TRIAL PIT 03	0 672 315	8 403 152	546 m	875

TYPE OF MATERIAL:

TESTED BY: M. MILANZI	DATE: 30 / 04 / 2019	TIME: 09:37
CHECKED BY: S.THANGATO	DATE: 01 / 05 / 2019	TIME: 09:37
APPROVED BY: M. SABELLI	DATE: 05 / 05 / 2019	TIME: 10:37

PROJECT: GOLOMOTI SOLAR PV
CLIENT: JCM

DYNAMIC CONE PENETRATION TEST (DCP) STANDARD: ASTM D6951/D6951M - 09

Initial Reading (mm): 75

No of Blows	Pen (mm)	Difference (mm)	Cum. Pen (mm)	mm / Blow	CBR (%)
5	136	61	61	12	18
10	199	63	124	13	16
15	251	52	176	10	20
20	310	59	235	12	18
25	361	51	286	10	20
30	410	49	335	10	20
35	471	61	396	12	18
40	529	58	454	12	18
45	594	65	519	13	16
50	655	61	580	12	18
55	705	50	630	10	20
60	770	65	695	13	16
65	809	39	734	8	30
70	860	51	785	10	20
75	899	39	824	8	30
80	950	51	875	10	20

REMARKS: DCP TEST FROM TRIAL PIT 03 AT THE DEPTH OF 1.000m. GOLOMOTI SOLAR SITE INVESTIGATION

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LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP004 / DCP004 / 30APR19			
SAMPLED BY: GEOCONSULT LAB		DATE: 30 / 04 / 2019	TIME: 09:37		
LOCATION: UTM 36 L	EASTING	NORTHING	ELEVATION	DEPTH	
TRIAL PIT 04	0 672 315	8 403 152	546 m	860	
TYPE OF MATERIAL:					
TESTED BY: M. MILANZI		DATE: 30 / 04 / 2019	TIME: 09:37		
CHECKED BY: S.THANGATO		DATE: 01 / 05 / 2019	TIME: 09:37		
APPROVED BY: M. SABELLI		DATE: 05 / 05 / 2019	TIME: 10:37		

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

DYNAMIC CONE PENETRATION TEST (DCP) STANDARD: ASTM D6951/D6951M - 09

Initial Reading (mm): 90

No of Blows	Pen (mm)	Difference (mm)	Cum. Pen (mm)	mm / Blow	CBR (%)
5	299	209	209	42	4
10	485	186	395	37	5
15	599	114	509	23	9
20	685	86	595	17	12
25	747	62	657	12	18
30	801	54	711	11	20
35	855	54	765	11	20
40	901	46	811	9	25
45	945	44	855	9	25
50	950	5	860	1	100

REMARKS: DCP TEST FROM TRIAL PIT 04 AT THE DEPTH OF 1.000m. GOLOMOTI SOLAR SITE INVESTIGATION

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LAB REF: GC499 / 04MAY19 / 15:00
SAMPLE No. GSPV / TP005 / DCP005 / 30APR19
SAMPLED BY: GEOCONSULT LAB
DATE: 30 / 04 / 2019
TIME: 13:52

LOCATION: UTM 36 L	EASTING	NORTHING	ELEVATION	DEPTH
TRIAL PIT 05	0 672 768	8 403 213	545 m	912

TYPE OF MATERIAL:

TESTED BY: M. MILANZI	DATE: 30 / 04 / 2019	TIME: 13:52
CHECKED BY: S.THANGATO	DATE: 01 / 05 / 2019	TIME: 09:37
APPROVED BY: M. SABELLI	DATE: 05 / 05 / 2019	TIME: 10:37

PROJECT: GOLOMOTI SOLAR PV
CLIENT: JCM

DYNAMIC CONE PENETRATION TEST (DCP) STANDARD: ASTM D6951/D6951M - 09

Initial Reading (mm): 38

No of Blows	Pen (mm)	Difference (mm)	Cum. Pen (mm)	mm / Blow	CBR (%)
5	109	71	71	14	15
10	161	52	123	10	20
15	208	47	170	9	25
20	259	51	221	10	20
25	304	45	266	9	25
30	356	52	318	10	20
35	406	50	368	10	20
40	406	0	368	0	100
45	449	43	411	9	25
50	499	50	461	10	20
55	536	37	498	7	35
60	579	43	541	9	25
65	623	44	585	9	25
70	667	44	629	9	25
75	709	42	671	8	30
80	760	51	722	10	20
85	851	91	813	18	11
90	911	60	873	12	18
95	950	39	912	8	30

REMARKS: DCP TEST FROM TRIAL PIT 05 AT THE DEPTH OF 1.000m. GOLOMOTI SOLAR SITE INVESTIGATION

GEOCONSULT	LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP006 / DCP006 / 30APR19		
	SAMPLED BY: GEOCONSULT LAB		DATE: 30 / 04 / 2019	TIME: 15:54	
	LOCATION: UTM 36 L	EASTING	NORTHING	ELEVATION	DEPTH
	TRIAL PIT 06	0 673 025	8 402 675	540 m	907
	TYPE OF MATERIAL:				
	TESTED BY: M. MILANZI		DATE: 30 / 04 / 2019	TIME: 15:54	
+265 0888 846 543	CHECKED BY: S.THANGATO		DATE: 01 / 05 / 2019	TIME: 09:57	
sabelli@geoconsult.cc	APPROVED BY: M. SABELLI		DATE: 05 / 05 / 2019	TIME: 11:37	

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

DYNAMIC CONE PENETRATION TEST (DCP) STANDARD: ASTM D6951/D6951M - 09

Initial Reading (mm): 43

No of Blows	Pen (mm)	Difference (mm)	Cum. Pen (mm)	mm / Blow	CBR (%)
5	69	26	26	5	50
10	99	30	56	6	40
15	132	33	89	7	35
20	164	32	121	6	40
25	194	30	151	6	40
30	229	35	186	7	35
35	268	39	225	8	30
40	303	35	260	7	35
45	335	32	292	6	40
50	369	34	326	7	35
55	406	37	363	7	35
60	450	44	407	9	25
65	486	36	443	7	35
70	527	41	484	8	30
75	565	38	522	8	30
80	601	36	558	7	35
85	641	40	598	8	30
90	685	44	642	9	25
95	733	48	690	10	20
100	776	43	733	9	25
105	820	44	777	9	25
110	864	44	821	9	25
115	909	45	866	9	25
120	950	41	907	8	30

REMARKS: DCP TEST FROM TRIAL PIT 06 AT THE DEPTH OF 1.000m. GOLOMOTI SOLAR SITE INVESTIGATION

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LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP007 / DCP007 / 30APR19		
SAMPLED BY: GEOCONSULT LAB		DATE: 30 / 04 / 2019	TIME: 13:52	
LOCATION: UTM 36 L	EASTING	NORTHING	ELEVATION	DEPTH
TRIAL PIT 07	0 672 863	8 402 795	544 m	889
TYPE OF MATERIAL:				
TESTED BY: M. MILANZI		DATE: 30 / 04 / 2019	TIME: 13:52	
CHECKED BY: S.THANGATO		DATE: 01 / 05 / 2019	TIME: 09:57	
APPROVED BY: M. SABELLI		DATE: 05 / 05 / 2019	TIME: 11:37	

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

DYNAMIC CONE PENETRATION TEST (DCP) STANDARD: ASTM D6951/D6951M - 09

Initial Reading (mm): 61

No of Blows	Pen (mm)	Difference (mm)	Cum. Pen (mm)	mm / Blow	CBR (%)
5	195	134	134	27	7
10	284	89	223	18	11
15	372	88	311	18	11
20	436	64	375	13	16
25	489	53	428	11	20
30	530	41	469	8	30
35	562	32	501	6	40
40	589	27	528	5	50
45	624	35	563	7	35
50	665	41	604	8	30
55	679	14	618	3	80
60	710	31	649	6	40
65	736	26	675	5	50
70	764	28	703	6	40
75	795	31	734	6	40
80	830	35	769	7	35
85	871	41	810	8	30
90	929	58	868	12	18
95	950	21	889	4	60

REMARKS: DCP TEST FROM TRIAL PIT 07 AT THE DEPTH OF 1.000m. GOLOMOTI SOLAR SITE INVESTIGATION

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LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP008 / DCP008 / 30APR19		
SAMPLED BY: GEOCONSULT LAB		DATE: 30 / 04 / 2019	TIME: 15:54	
LOCATION: UTM 36 L	EASTING	NORTHING	ELEVATION	DEPTH
TRIAL PIT 08	0 673 025	8 402 675	540 m	861
TYPE OF MATERIAL:				
TESTED BY: M. MILANZI		DATE: 30 / 04 / 2019	TIME: 15:54	
CHECKED BY: S.THANGATO		DATE: 01 / 05 / 2019	TIME: 09:57	
APPROVED BY: M. SABELLI		DATE: 05 / 05 / 2019	TIME: 11:37	

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

DYNAMIC CONE PENETRATION TEST (DCP) STANDARD: ASTM D6951/D6951M - 09

Initial Reading (mm): 37

No of Blows	Pen (mm)	Difference (mm)	Cum. Pen (mm)	mm / Blow	CBR (%)
5	79	42	42	8	30
10	119	40	82	8	30
15	166	47	129	9	25
20	205	39	168	8	30
25	235	30	198	6	40
30	269	34	232	7	35
35	300	31	263	6	40
40	336	36	299	7	35
45	378	42	341	8	30
50	411	33	374	7	35
55	444	33	407	7	35
60	472	28	435	6	40
65	505	33	468	7	35
70	535	30	498	6	40
75	564	29	527	6	40
80	593	29	556	6	40
85	626	33	589	7	35
90	664	38	627	8	30
95	670	6	633	1	100
100	729	59	692	12	18
105	758	29	721	6	40
110	780	22	743	4	60
115	811	31	774	6	40
120	840	29	803	6	40
125	869	29	832	6	40
130	898	29	861	6	40

REMARKS: DCP TEST FROM TRIAL PIT 08 AT THE DEPTH OF 1.000m. GOLOMOTI SOLAR SITE INVESTIGATION

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LAB REF: GC499 / 04MAY19 / 15:00
SAMPLE No. GSPV / TP009 / DCP009 / 30APR19
SAMPLED BY: GEOCONSULT LAB
DATE: 30 / 04 / 2019
TIME: 15:54

LOCATION: UTM 36 L	EASTING	NORTHING	ELEVATION	DEPTH
TRIAL PIT 9	0 673 025	8 402 675	542 m	875

TYPE OF MATERIAL:

TESTED BY: M. MILANZI
DATE: 30 / 04 / 2019
TIME: 15:54
CHECKED BY: S.THANGATO
DATE: 01 / 05 / 2019
TIME: 09:57
APPROVED BY: M. SABELLI
DATE: 05 / 05 / 2019
TIME: 11:37

PROJECT: GOLOMOTI SOLAR PV
CLIENT: JCM

DYNAMIC CONE PENETRATION TEST (DCP) STANDARD: ASTM D6951/D6951M - 09

Initial Reading (mm): 75

No of Blows	Pen (mm)	Difference (mm)	Cum. Pen (mm)	mm / Blow	CBR (%)
5	136	61	61	12	18
10	209	73	134	15	14
15	290	81	215	16	13
20	347	57	272	11	20
25	395	48	320	10	20
30	440	45	365	9	25
35	489	49	414	10	20
40	529	40	454	8	30
45	571	42	496	8	30
50	620	49	545	10	20
55	662	42	587	8	30
60	695	33	620	7	35
65	734	39	659	8	30
70	775	41	700	8	30
75	815	40	740	8	30
80	850	35	775	7	35
85	889	39	814	8	30
90	930	41	855	8	30
95	950	20	875	4	60

REMARKS: DCP TEST FROM TRIAL PIT 09 AT THE DEPTH OF 1.000m. GOLOMOTI SOLAR SITE INVESTIGATION

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LAB REF: GC499 / 04MAY19 / 15:00
SAMPLE No. GSPV / TP010 / DCP010 / 01MAY19
SAMPLED BY: GEOCONSULT LAB
DATE: 01 / 05 / 2019
TIME: 15:54

LOCATION: UTM 36 L	EASTING	NORTHING	ELEVATION	DEPTH
TRIAL PIT 10	0 673 013	8 402 587	542 m	823

TYPE OF MATERIAL:

TESTED BY: M. MILANZI
DATE: 01 / 05 / 2019
TIME: 15:54
CHECKED BY: S.THANGATO
DATE: 01 / 05 / 2019
TIME: 09:57
APPROVED BY: M. SABELLI
DATE: 05 / 05 / 2019
TIME: 11:37

PROJECT: GOLOMOTI SOLAR PV
CLIENT: JCM

DYNAMIC CONE PENETRATION TEST (DCP) STANDARD: ASTM D6951/D6951M - 09

Initial Reading (mm): 127

No of Blows	Pen (mm)	Difference (mm)	Cum. Pen (mm)	mm / Blow	CBR (%)
5	446	319	319	64	3
10	594	148	467	30	6
15	682	88	555	18	11
20	700	18	573	4	60
25	805	105	678	21	10
30	853	48	726	10	20
35	895	42	768	8	30
40	935	40	808	8	30
41	950	15	823	15	14

REMARKS: DCP TEST FROM TRIAL PIT 010 AT THE DEPTH OF 1.000m. GOLOMOTI SOLAR SITE INVESTIGATION

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LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP011 / DCP011 / 01MAY19		
SAMPLED BY: GEOCONSULT LAB		DATE: 01 / 05 / 2019	TIME: 15:54	
LOCATION: UTM 36 L	EASTING	NORTHING	ELEVATION	DEPTH
TRIAL PIT 11	0 672 996	8 402 996	546 m	860
TYPE OF MATERIAL:				
TESTED BY: M. MILANZI		DATE: 01 / 05 / 2019	TIME: 15:54	
CHECKED BY: S.THANGATO		DATE: 01 / 05 / 2019	TIME: 09:57	
APPROVED BY: M. SABELLI		DATE: 05 / 05 / 2019	TIME: 11:37	

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

DYNAMIC CONE PENETRATION TEST (DCP) STANDARD: ASTM D6951/D6951M - 09

Initial Reading (mm): 90

No of Blows	Pen (mm)	Difference (mm)	Cum. Pen (mm)	mm / Blow	CBR (%)
5	303	213	213	43	4
10	429	126	339	25	8
15	525	96	435	19	11
20	615	90	525	18	11
25	680	65	590	13	16
30	722	42	632	8	30
35	779	57	689	11	20
40	812	33	722	7	35
45	852	40	762	8	30
50	893	41	803	8	30
55	915	22	825	4	60
60	950	35	860	7	35

REMARKS: DCP TEST FROM TRIAL PIT 011 AT THE DEPTH OF 1.000m. GOLOMOTI SOLAR SITE INVESTIGATION

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LAB REF: GC499 / 04MAY19 / 15:00
SAMPLE No. GSPV / TP012 / DCP012 / 02MAY19
SAMPLED BY: GEOCONSULT LAB
DATE: 02 / 05 / 2019
TIME: 15:54

LOCATION: UTM 36 L	EASTING	NORTHING	ELEVATION	DEPTH
TRIAL PIT 12	0 672 650	8 402 797	547 m	897

TYPE OF MATERIAL:

TESTED BY: M. MILANZI	DATE: 02 / 05 / 2019	TIME: 15:54
CHECKED BY: S.THANGATO	DATE: 02 / 05 / 2019	TIME: 09:57
APPROVED BY: M. SABELLI	DATE: 10 / 05 / 2019	TIME: 11:37

PROJECT: GOLOMOTI SOLAR PV
CLIENT: JCM

DYNAMIC CONE PENETRATION TEST (DCP) STANDARD: ASTM D6951/D6951M - 09

Initial Reading (mm): 53

No of Blows	Pen (mm)	Difference (mm)	Cum. Pen (mm)	mm / Blow	CBR (%)
5	119	66	66	13	16
10	180	61	127	12	18
15	253	73	200	15	14
20	335	82	282	16	13
25	409	74	356	15	14
30	444	35	391	7	35
35	523	79	470	16	13
40	584	61	531	12	18
45	623	39	570	8	30
50	652	29	599	6	40
55	691	39	638	8	30
60	730	39	677	8	30
65	760	30	707	6	40
70	792	32	739	6	40
75	825	33	772	7	35
80	850	25	797	5	50
85	889	39	836	8	30
90	935	46	882	9	25
93	950	15	897	5	50

REMARKS: DCP TEST FROM TRIAL PIT 012 AT THE DEPTH OF 1.000m. GOLOMOTI SOLAR SITE INVESTIGATION

GEOCONSULT

+265 0888 846 543
sabelli@geoconsult.cc

LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP013 / DCP013 / 02MAY19			
SAMPLED BY: GEOCONSULT LAB		DATE: 02 / 05 / 2019	TIME: 15:54		
LOCATION: UTM 36 L	EASTING	NORTHING	ELEVATION	DEPTH	
TRIAL PIT 13	0 672 650	8 402 263	550 m	889	
TYPE OF MATERIAL:					
TESTED BY: M. MILANZI		DATE: 02 / 05 / 2019	TIME: 15:54		
CHECKED BY: S.THANGATO		DATE: 02 / 05 / 2019	TIME: 09:57		
APPROVED BY: M. SABELLI		DATE: 10 / 05 / 2019	TIME: 11:37		

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

DYNAMIC CONE PENETRATION TEST (DCP) STANDARD: ASTM D6951/D6951M - 09

Initial Reading (mm): 61

No of Blows	Pen (mm)	Difference (mm)	Cum. Pen (mm)	mm / Blow	CBR (%)
5	114	53	53	11	20
10	169	55	108	11	20
15	279	110	218	22	9
20	330	51	269	10	20
25	404	74	343	15	14
30	441	37	380	7	35
35	519	78	458	16	13
40	572	53	511	11	20
45	618	46	557	9	25
50	643	25	582	5	50
55	687	44	626	9	25
60	726	39	665	8	30
65	755	29	694	6	40
70	813	58	752	12	18
75	846	33	785	7	35
80	920	74	859	15	14
85	950	30	889	6	40

REMARKS: DCP TEST FROM TRIAL PIT 013 AT THE DEPTH OF 1.000m. GOLOMOTI SOLAR SITE INVESTIGATION

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LAB REF: GC499 / 04MAY19 / 15:00
SAMPLE No. GSPV / TP014 / DCP014 / 02MAY19

SAMPLED BY: GEOCONSULT LAB
DATE: 02 / 05 / 2019
TIME: 15:54

LOCATION: UTM 36 L	EASTING	NORTHING	ELEVATION	DEPTH
TRIAL PIT 14	0 672 645	8 402 499	546 m	907

TYPE OF MATERIAL:

TESTED BY: M. MILANZI	DATE: 02 / 05 / 2019	TIME: 15:54
CHECKED BY: S.THANGATO	DATE: 02 / 05 / 2019	TIME: 09:57
APPROVED BY: M. SABELLI	DATE: 10 / 05 / 2019	TIME: 11:37

PROJECT: GOLOMOTI SOLAR PV
CLIENT: JCM

DYNAMIC CONE PENETRATION TEST (DCP) STANDARD: ASTM D6951/D6951M - 09

Initial Reading (mm): 43

No of Blows	Pen (mm)	Difference (mm)	Cum. Pen (mm)	mm / Blow	CBR (%)
5	94	51	51	10	20
10	140	46	97	9	25
15	179	39	136	8	30
20	222	43	179	9	25
25	273	51	230	10	20
30	333	60	290	12	18
35	377	44	334	9	25
40	429	52	386	10	20
45	565	136	522	27	7
50	609	44	566	9	25
55	650	41	607	8	30
60	692	42	649	8	30
65	731	39	688	8	30
70	766	35	723	7	35
75	800	34	757	7	35
80	835	35	792	7	35
85	874	39	831	8	30
90	910	36	867	7	35
95	929	19	886	4	60
100	950	21	907	4	60

REMARKS: DCP TEST FROM TRIAL PIT 014 AT THE DEPTH OF 1.000m. GOLOMOTI SOLAR SITE INVESTIGATION

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LAB REF: GC499 / 04MAY19 / 15:00
SAMPLE No. GSPV / TP015 / DCP015 / 02MAY19
SAMPLED BY: GEOCONSULT LAB
DATE: 02 / 05 / 2019
TIME: 10:25

LOCATION: UTM 36 L	EASTING	NORTHING	ELEVATION	DEPTH
TRIAL PIT 15	0 672 384	8 402 794	546 m	886

TYPE OF MATERIAL:

TESTED BY: M. MILANZI	DATE: 02 / 05 / 2019	TIME: 10:25
CHECKED BY: S.THANGATO	DATE: 02 / 05 / 2019	TIME: 09:57
APPROVED BY: M. SABELLI	DATE: 10 / 05 / 2019	TIME: 11:37

PROJECT: GOLOMOTI SOLAR PV
CLIENT: JCM

DYNAMIC CONE PENETRATION TEST (DCP) STANDARD: ASTM D6951/D6951M - 09

Initial Reading (mm): 64

No of Blows	Pen (mm)	Difference (mm)	Cum. Pen (mm)	mm / Blow	CBR (%)
5	221	157	157	31	6
10	365	144	301	29	7
15	505	140	441	28	7
20	649	144	585	29	7
25	810	161	746	32	6
30	950	140	886	28	7

REMARKS: DCP TEST FROM TRIAL PIT 015 AT THE DEPTH OF 1.000m. GOLOMOTI SOLAR SITE INVESTIGATION

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LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP016 / DCP016 / 02MAY19		
SAMPLED BY: GEOCONSULT LAB		DATE: 02 / 05 / 2019	TIME: 15:23	
LOCATION: UTM 36 L	EASTING	NORTHING	ELEVATION	DEPTH
TRIAL PIT 16	0 672 342	8 402 660	549 m	871
TYPE OF MATERIAL:				
TESTED BY: M. MILANZI		DATE: 02 / 05 / 2019	TIME: 15:23	
CHECKED BY: S.THANGATO		DATE: 02 / 05 / 2019	TIME: 09:57	
APPROVED BY: M. SABELLI		DATE: 10 / 05 / 2019	TIME: 11:37	

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

DYNAMIC CONE PENETRATION TEST (DCP) STANDARD: ASTM D6951/D6951M - 09

Initial Reading (mm): 79

No of Blows	Pen (mm)	Difference (mm)	Cum. Pen (mm)	mm / Blow	CBR (%)
5	147	68	68	14	15
10	179	32	100	6	40
15	268	89	189	18	11
20	350	82	271	16	13
25	399	49	320	10	20
30	459	60	380	12	18
35	495	36	416	7	35
40	535	40	456	8	30
45	571	36	492	7	35
50	595	24	516	5	50
55	620	25	541	5	50
60	645	25	566	5	50
65	665	20	586	4	60
70	689	24	610	5	50
75	711	22	632	4	60
80	733	22	654	4	60
85	775	42	696	8	30
90	796	21	717	4	60
95	820	24	741	5	50
100	845	25	766	5	50
105	871	26	792	5	50
110	893	22	814	4	60
115	921	28	842	6	40
116	950	29	871	29	7

REMARKS: DCP TEST FROM TRIAL PIT 016 AT THE DEPTH OF 1.000m. GOLOMOTI SOLAR SITE INVESTIGATION

GEOCONSULT	LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP017 / DCP017 / 02MAY19		
	SAMPLED BY: GEOCONSULT LAB		DATE: 02 / 05 / 2019	TIME: 17:09	
	LOCATION: UTM 36 L	EASTING	NORTHING	ELEVATION	DEPTH
	TRIAL PIT 17	0 672 016	8 402 656	551 m	878
	TYPE OF MATERIAL:				
	TESTED BY: M. MILANZI		DATE: 02 / 05 / 2019	TIME: 17:09	
+265 0888 846 543	CHECKED BY: S.THANGATO		DATE: 02 / 05 / 2019	TIME: 09:57	
sabelli@geoconsult.cc	APPROVED BY: M. SABELLI		DATE: 10 / 05 / 2019	TIME: 11:37	

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

DYNAMIC CONE PENETRATION TEST (DCP) STANDARD: ASTM D6951/D6951M - 09

Initial Reading (mm): 72

No of Blows	Pen (mm)	Difference (mm)	Cum. Pen (mm)	mm / Blow	CBR (%)
5	205	133	133	27	7
10	256	51	184	10	20
15	502	246	430	49	4
20	667	165	595	33	6
25	825	158	753	32	6
30	939	114	867	23	9
35	950	11	878	2	100

REMARKS: DCP TEST FROM TRIAL PIT 017 AT THE DEPTH OF 1.000m. GOLOMOTI SOLAR SITE INVESTIGATION

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LAB REF: GC499 / 04MAY19 / 15:00	SAMPLE No. GSPV / TP018 / DCP018 / 03MAY19		
SAMPLED BY: GEOCONSULT LAB	DATE: 03 / 05 / 2019	TIME:09:39	

LOCATION: UTM 36 L	EASTING	NORTHING	ELEVATION	DEPTH
TRIAL PIT 18	0 671 938	8 402 608	557 m	859

TYPE OF MATERIAL:

TESTED BY: M. MILANZI	DATE: 03 / 05 / 2019	TIME:09:39
CHECKED BY: S.THANGATO	DATE: 02 / 05 / 2019	TIME: 09:57
APPROVED BY: M. SABELLI	DATE: 10 / 05 / 2019	TIME: 11:37

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

DYNAMIC CONE PENETRATION TEST (DCP) STANDARD: ASTM D6951/D6951M - 09

Initial Reading (mm): 91

No of Blows	Pen (mm)	Difference (mm)	Cum. Pen (mm)	mm / Blow	CBR (%)
5	251	160	160	32	6
10	352	101	261	20	10
15	400	48	309	10	20
20	505	105	414	21	10
25	576	71	485	14	15
30	640	64	549	13	16
35	711	71	620	14	15
40	799	88	708	18	11
45	876	77	785	15	14
50	950	74	859	15	14

REMARKS: DCP TEST FROM TRIAL PIT 018 AT THE DEPTH OF 1.000m. GOLOMOTI SOLAR SITE INVESTIGATION

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LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP019 / DCP019 / 03MAY19		
SAMPLED BY: GEOCONSULT LAB		DATE: 03 / 05 / 2019	TIME: 09:39	
LOCATION: UTM 36 L	EASTING	NORTHING	ELEVATION	DEPTH
TRIAL PIT 19	0 671 938	8 402 608	557 m	900
TYPE OF MATERIAL:				
TESTED BY: M. MILANZI		DATE: 03 / 05 / 2019	TIME: 09:39	
CHECKED BY: S.THANGATO		DATE: 02 / 05 / 2019	TIME: 09:57	
APPROVED BY: M. SABELLI		DATE: 10 / 05 / 2019	TIME: 11:37	

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

DYNAMIC CONE PENETRATION TEST (DCP) STANDARD: ASTM D6951/D6951M - 09

Initial Reading (mm): 50

No of Blows	Pen (mm)	Difference (mm)	Cum. Pen (mm)	mm / Blow	CBR (%)
5	128	78	78	16	13
10	200	72	150	14	15
15	269	69	219	14	15
20	349	80	299	16	13
25	441	92	391	18	11
30	545	104	495	21	10
35	652	107	602	21	10
40	759	107	709	21	10
45	801	42	751	8	30
50	950	149	900	30	6

REMARKS: DCP TEST FROM TRIAL PIT 019 AT THE DEPTH OF 1.000m. GOLOMOTI SOLAR SITE INVESTIGATION

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LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP020 / DCP020 / 03MAY19		
SAMPLED BY: GEOCONSULT LAB		DATE: 03 / 05 / 2019	TIME: 15:30	
LOCATION: UTM 36 L	EASTING	NORTHING	ELEVATION	DEPTH
TRIAL PIT 20	0 671 990	8 402 438	561 m	897
TYPE OF MATERIAL:				
TESTED BY: M. MILANZI		DATE: 03 / 05 / 2019	TIME: 15:30	
CHECKED BY: S.THANGATO		DATE: 03 / 05 / 2019	TIME: 09:57	
APPROVED BY: M. SABELLI		DATE: 10 / 05 / 2019	TIME: 11:37	

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

DYNAMIC CONE PENETRATION TEST (DCP) STANDARD: ASTM D6951/D6951M - 09

Initial Reading (mm): 53

No of Blows	Pen (mm)	Difference (mm)	Cum. Pen (mm)	mm / Blow	CBR (%)
5	190	137	137	27	7
10	295	105	242	21	10
15	419	124	366	25	8
20	425	6	372	1	100
25	613	188	560	38	5
30	709	96	656	19	11
35	795	86	742	17	12
40	809	14	756	3	80
45	950	141	897	28	7

REMARKS: DCP TEST FROM TRIAL PIT 020 AT THE DEPTH OF 1.000m. GOLOMOTI SOLAR SITE INVESTIGATION

3.4 Trial Pit 01

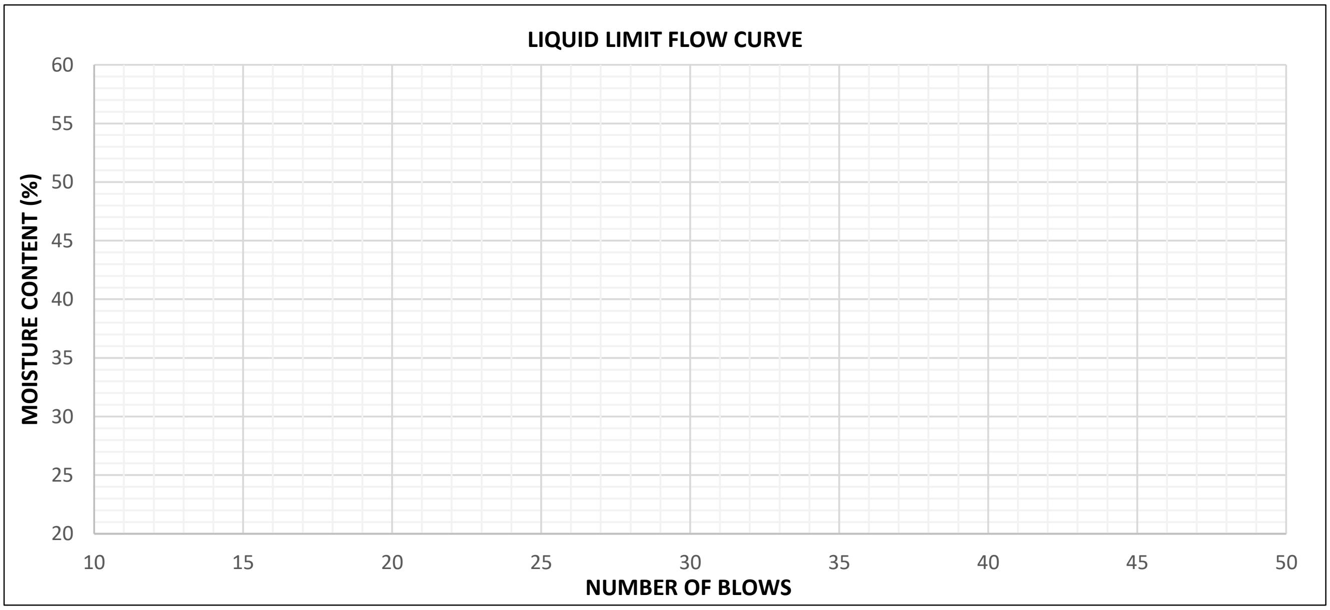
GEOCONSULT	LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP01 / AL004 / 27APR19		
	SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 27 - 04 - 2019	TIME: 11:30	
	LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
	GOLOMOTI - SOLAR PV	0 672 496	8 403 452	(m)	3.000-4.000
	TYPE OF MATERIAL: VERY MOIST BROWN GRAVELLY SANDY SILTY CLAY CONTAINS SPOTS OF DECOMPOSED ROCK				
	TESTED BY: S. MATCHADO		DATE: 31 - 05-2019	TIME: 08:44	
+265 0888 846 543	CHECKED BY: S. THANGATO		DATE: 01 - 06 - 2019	TIME: 09:35	
sabelli@geoconsult.cc	APPROVED BY: M. SABELLI		DATE: 01 - 06 - 2019	TIME: 14:18	

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

ATTERBURG LIMITS STANDARD: BS 1377, 2 (C)

TYPE OF TEST	LIQUID LIMITS (LL)				PLASTIC LIMITS (PL)		
TEST No.	1	2	3	4	1	2	3
CONTAINER No.	C19		R21		B	R19	A
MASS OF WET SOIL + CONTAINER(g)	44.5		49.0		45.5	45.5	44.5
MASS OF DRY SOIL + CONTAINER(g)	39.0		43.5		43.0	43.0	42.0
MASS OF CONTAINER (g)	25		29		29	28.5	27.5
MASS OF DRY SOIL (g)	14.0		14.5		14.0	14.5	14.5
MASS OF WATER (g)	5.50		5.50		2.50	2.50	2.50
MOISTURE CONTENT %	39.3	40.1	37.9	37.2	17.9	17.2	17.2
No. BLOWS	30		20			17.4	

LINEAR SHRINKAGE	17
INITIAL LENGTH OF SPECIMEN (cm)	14.0
LENGTH OF OVERN DRY SPECIMEN (cm)	12.7
LINEAR SHRINKAGE %	10.2
LIQUID LIMIT (LL) %	38.6
PLASTIC LIMIT (PL) %	17.4
PLASTICITY INDEX (PI)	**21**
NATURAL MOISTURE CONTENT %	10.3
FINENESS INDEX	1008.0



REMARKS: SAMPLED FROM TRIAL PIT 01 @ 3.000-4.000M. SOLAR PV SITE INVESTIGATION

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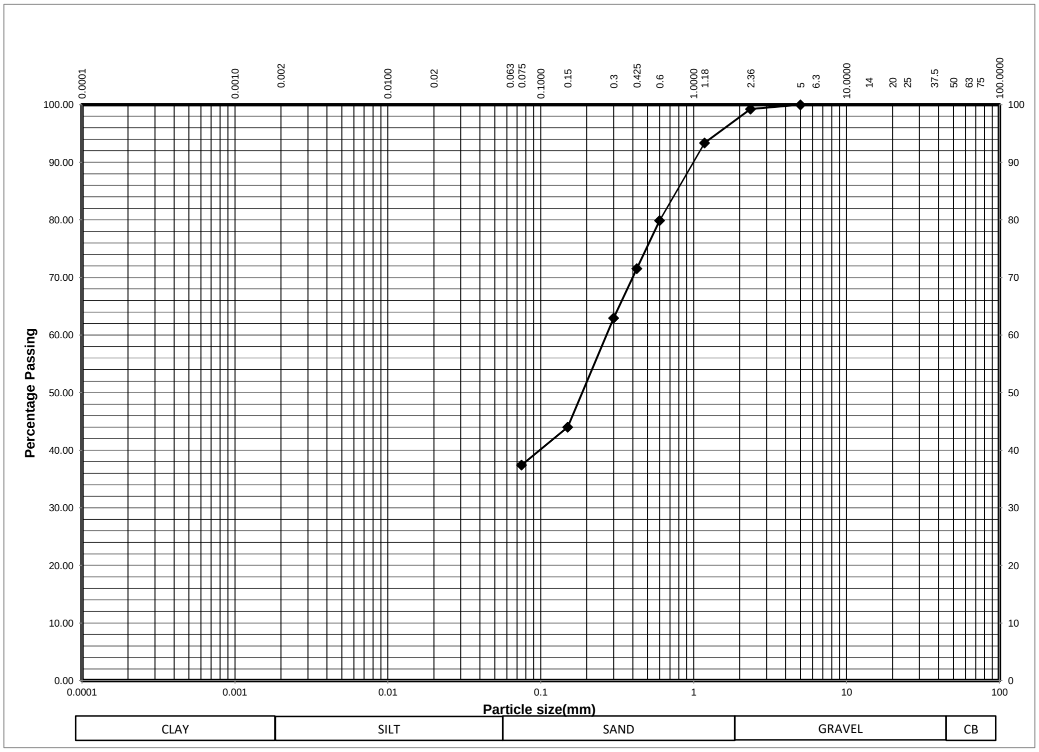
sabelli@geoconsult.cc

LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP01 / G001 / 27APR19		
SAMPLED BY: GEOCONSULT LAB TEAM		DATE: 27 / 04 / 2019	TIME: 11:30	
LOCATION:	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 672 496	8 403 452	(m)	0.200-1.000
TYPE OF MATERIAL: MOIST DARK BROWN SANDY SILTY CLAY				
TESTED BY:S. MATCHADO		DATE: 06 - 06 - 2019	TIME: 11:51	
CHECKED BY: G.KACHIWALA		DATE: 07 - 06 - 2019	TIME: 13:30	
APPROVED BY: M. SABELLI		DATE: 07 - 06 - 2019	TIME: 15:00	

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

SIEVE ANALYSIS (GRADATION) STANDARD: TRH14:1985

SIEVE	MASS	PERCENTAGE			GRADATION SPECIFICATION			ZONE
(mm)	RETAINED	RETAINED	PASSING		BASE	SUBBASE	SL SEAL	
75.000								
50.000								
37.500								
28.000								
25.000								
20.000								
14.000								
12.500								
10.000								
6.300								
5.000	0.00	0.00	100.00	100				
2.360	6.00	0.76	99.24	99				
1.180	52.50	6.64	93.36	93				
0.600	159.00	20.10	79.90	80				
0.425	225.00	28.45	71.55	72				
0.300	293.00	37.04	62.96	63				
0.150	443.00	56.01	43.99	44				
0.075	495.00	62.58	37.42	37				
0 pan	296.00	37.42						
TOTAL (g)	791.00							



REMARKS: SAMPLED FROM TRIAL PIT 01 @ 0.200-1.00M. **SOLAR PV SITE INVESTIGATION**

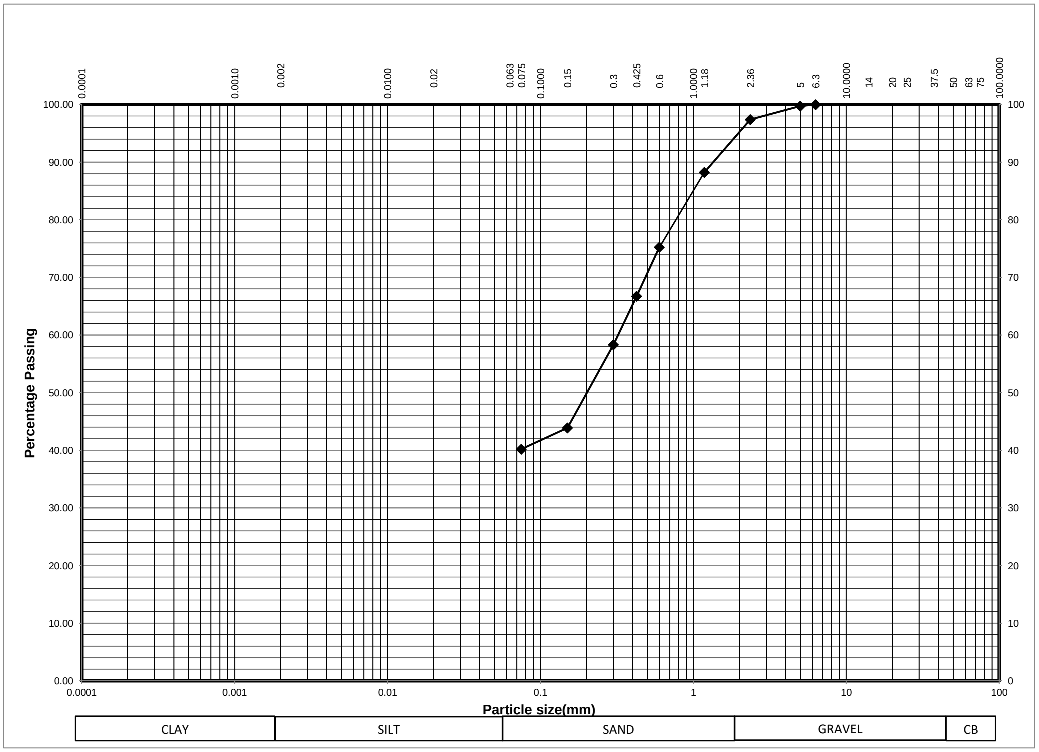
PAGE No.

GEOCONSULT	LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP01 / G002 / 27APR19	
	SAMPLED BY: GEOCONSULT LAB TEAM		DATE: 27 / 04 / 2019	TIME: 16:20
	LOCATION: GOLOMOTI - SOLAR PV	EASTING 0 672 496	NORTHING 8 403 452	ELEVATION (m) / DEPTH (m) 1.000-2.000
	TYPE OF MATERIAL: MOIST BROWN YELLOWISH SANDY SILTY CLAY			
	TESTED BY: I. MITOMONI		DATE: 25 - 05 - 2019	TIME: 11:20
+265 0888 846 543	CHECKED BY: E. NKHUKU		DATE: 29 - 05 - 2019	TIME: 13:30
sabelli@geoconsult.cc	APPROVED BY: M. SABELLI		DATE: 29 - 05 - 2019	TIME: 15:00

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

SIEVE ANALYSIS (GRADATION) STANDARD: TRH14:1985

SIEVE	MASS	PERCENTAGE			GRADATION SPECIFICATION			ZONE
(mm)	RETAINED	RETAINED	PASSING		BASE	SUBBASE	SL SEAL	
75.000								
50.000								
37.500								
28.000								
25.000								
20.000								
14.000								
12.500								
10.000								
6.300	0.00	0.00	100.00	100				
5.000	1.50	0.25	99.75	100				
2.360	15.50	2.59	97.41	97				
1.180	70.50	11.76	88.24	88				
0.600	148.50	24.77	75.23	75				
0.425	199.50	33.28	66.72	67				
0.300	250.00	41.70	58.30	58				
0.150	336.50	56.13	43.87	44				
0.075	358.50	59.80	40.20	40				
0 pan	241.00	40.20						
TOTAL (g)	599.50							



REMARKS: SAMPLED FROM TRIAL PIT 01 @ 1.000-2.000M. **SOLAR PV SITE INVESTIGATION**

PAGE No.

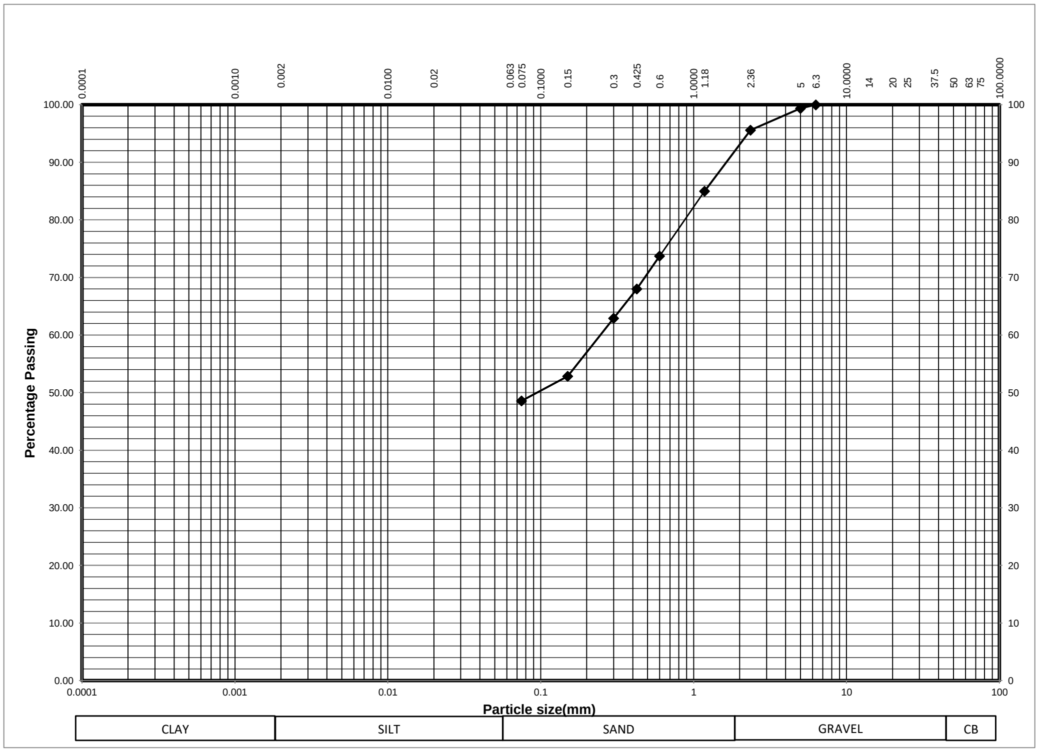
GEOCONSULT	LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP01 / G003 / 27APR19		
	SAMPLED BY: GEOCONSULT LAB TEAM		DATE: 27 / 04 / 2019	TIME: 16:20	
	LOCATION:	EASTING	NORTHING	ELEVATION	DEPTH (m)
	GOLOMOTI - SOLAR PV	0 672 496	8 403 452	(m)	2.000-3.000
	TYPE OF MATERIAL: MOIST BROWN YELLOWISH GRAVELLY SANDY SILTY CLAY				
	TESTED BY: I. MITOMONI		DATE: 25 - 05 - 2019	TIME: 11:20	
+265 0888 846 543	CHECKED BY: E. NKHUKU		DATE: 29 - 05 - 2019	TIME: 13:30	
sabelli@geoconsult.cc	APPROVED BY: M. SABELLI		DATE: 29 - 05 - 2019	TIME: 15:00	

PROJECT: GOLOMOTI SOLAR PV

CLIENT: JCM

SIEVE ANALYSIS (GRADATION) STANDARD: TRH14:1985

SIEVE	MASS	PERCENTAGE			GRADATION SPECIFICATION			ZONE
(mm)	RETAINED	RETAINED	PASSING		BASE	SUBBASE	SL SEAL	
75.000								
50.000								
37.500								
28.000								
25.000								
20.000								
14.000								
12.500								
10.000								
6.300	0.00	0.00	100.00	100				
5.000	4.50	0.64	99.36	99				
2.360	31.00	4.43	95.57	96				
1.180	105.00	15.00	85.00	85				
0.600	184.00	26.29	73.71	74				
0.425	224.00	32.00	68.00	68				
0.300	259.50	37.07	62.93	63				
0.150	330.00	47.14	52.86	53				
0.075	360.00	51.43	48.57	49				
0 pan	340.00	48.57						
TOTAL (g)	700.00							



REMARKS: SAMPLED FROM TRIAL PIT 01 @ 2.000-3.000M. **SOLAR PV SITE INVESTIGATION**

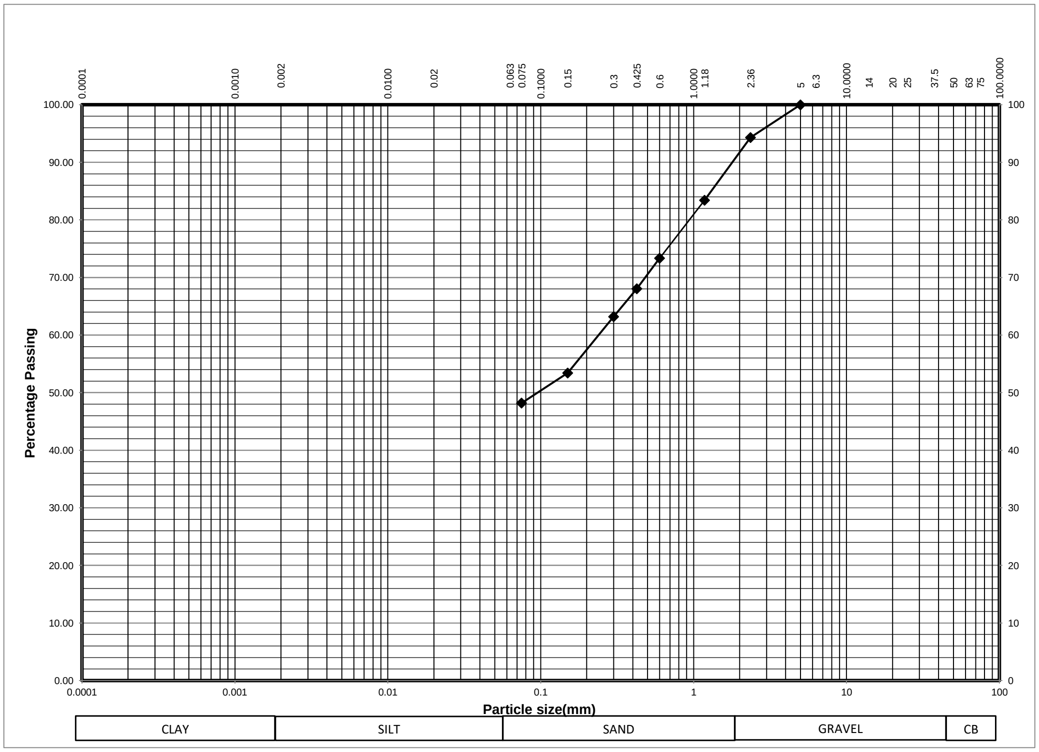
PAGE No.

GEOCONSULT	LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP01 / G004 / 27APR19		
	SAMPLED BY: GEOCONSULT LAB TEAM		DATE: 27 / 04 / 2019	TIME: 11:30	
	LOCATION:	EASTING	NORTHING	ELEVATION	DEPTH (m)
	GOLOMOTI - SOLAR PV	0 672 496	8 403 452	(m)	3.000-4.000
	TYPE OF MATERIAL: VERY MOIST BROWN GRAVELLY SANDY SILTY CLAY CONTAINS SPOTS OF DECOMPOSED ROCK				
	TESTED BY: I. MITOMONI		DATE: 25 - 05 - 2019	TIME: 11:35	
+265 0888 846 543	CHECKED BY: E. NKHUKU		DATE: 29 - 05 - 2019	TIME: 13:30	
sabelli@geoconsult.cc	APPROVED BY: M. SABELLI		DATE: 29 - 05 - 2019	TIME: 15:00	

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

SIEVE ANALYSIS (GRADATION) STANDARD: TRH14:1985

SIEVE	MASS	PERCENTAGE			GRADATION SPECIFICATION			ZONE
(mm)	RETAINED	RETAINED	PASSING		BASE	SUBBASE	SL SEAL	
75.000								
50.000								
37.500								
28.000								
25.000								
20.000								
14.000								
12.500								
10.000								
6.300								
5.000	0.00	0.00	100.00	100				
2.360	49.50	5.70	94.30	94				
1.180	144.00	16.58	83.42	83				
0.600	231.50	26.66	73.34	73				
0.425	277.50	31.95	68.05	68				
0.300	319.50	36.79	63.21	63				
0.150	404.50	46.57	53.43	53				
0.075	450.00	51.81	48.19	48				
0 pan	418.50	48.19						
TOTAL (g)	868.50							



REMARKS: SAMPLED FROM TRIAL PIT 01 @ 3.000-4.000M. **SOLAR PV SITE INVESTIGATION** **PAGE No.**

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LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP01 / NMC001 / 27APR19		
SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 27 - 04 - 2019	TIME: 11:30	
LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 672 496	8 403 452	(m)	0.200-1.000
TYPE OF MATERIAL: MOIST DARK BROWN SANDY SILTY CLAY				
TESTED BY: C. NDALAMA		DATE: 05 - 05 - 2019	TIME: 09:00	
CHECKED BY: G. KACHIWALA		DATE: 06 - 05 - 2019	TIME: 09:45	
APPROVED BY: M. SABELLI		DATE: 06 - 05 - 2019	TIME: 10:00	

PROJECT: GOLOMOTI SOLAR PV

CLIENT: JCM

NATURAL MOISTURE CONTENT - OVEN DRYING METHOD STANDARD: ASTM D7263

MASS OF WET SOIL + CONTAINER (g)		418.0	
MASS OF DRY SOIL AND CONTAINER (g)		399.5	
CONTAINER No.		GOK	
MASS OF CONTAINER (g)		126.0	
MASS OF DRY SOIL (g)		273.5	
MASS OF WATER (g)		18.5	
MOISTURE CONTENT %		6.8	
AVERAGE MOISTURE CONTENT %		**6.8**	

REMARKS: SAMPLED FROM TRIAL PIT 01 @ 0.200-1.000M. **SOLAR PV SITE INVESTIGATION**

PAGE No.

GEOCONSULT	LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP01 / NMC002 / 27APR19		
	SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 27 - 04 - 2019	TIME: 11:30	
	LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
	GOLOMOTI - SOLAR PV	0 672 496	8 403 452	(m)	1.000-2000
	TYPE OF MATERIAL: MOIST BROWN YELLOWISH SANDY SILTY CLAY				
	TESTED BY: C. NDALAMA		DATE: 05 - 05 - 2019	TIME: 09:00	
+265 0888 846 543	CHECKED BY: G. KACHIWALA		DATE: 05 - 05 - 2019	TIME: 09:45	
sabelli@geoconsult.cc	APPROVED BY: M. SABELLI		DATE: 05 - 05 - 2019	TIME: 10:00	

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

NATURAL MOISTURE CONTENT - OVEN DRYING METHOD STANDARD: ASTM D7263

MASS OF WET SOIL + CONTAINER (g)		383.5	
MASS OF DRY SOIL AND CONTAINER (g)		350.0	
CONTAINER No.		GC12	
MASS OF CONTAINER (g)		70.0	
MASS OF DRY SOIL (g)		280.0	
MASS OF WATER (g)		33.5	
MOISTURE CONTENT %		12.0	
AVERAGE MOISTURE CONTENT %		**12.0**	

REMARKS: SAMPLED FROM TRIAL PIT 01 @ 1.000-2.000M. **SOLAR PV SITE INVESTIGATION** **PAGE No.**

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LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP01 / NMC003 / 27APR19		
SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 27 - 04 - 2019	TIME: 09:01	
LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 672 496	8 403 452	(m)	2.000-3000
TYPE OF MATERIAL: MOIST BROWN YELLOWISH GRAVELLY SANDY SILTY CLAY				
TESTED BY: C. NDALAMA		DATE: 05 - 05 - 2019	TIME: 09:00	
CHECKED BY: G. KACHIWALA		DATE: 05 - 05 - 2019	TIME: 09:45	
APPROVED BY: M. SABELLI		DATE: 05 - 05 - 2019	TIME: 10:00	

PROJECT: GOLOMOTI SOLAR PV

CLIENT: JCM

NATURAL MOISTURE CONTENT - OVEN DRYING METHOD STANDARD: ASTM D7263

MASS OF WET SOIL + CONTAINER (g)		422.0	
MASS OF DRY SOIL AND CONTAINER (g)		385.5	
CONTAINER No.		GC7	
MASS OF CONTAINER (g)		73.5	
MASS OF DRY SOIL (g)		312.0	
MASS OF WATER (g)		36.5	
MOISTURE CONTENT %		11.7	
AVERAGE MOISTURE CONTENT %		**11.7**	

REMARKS: SAMPLED FROM TRIAL PIT 01 @ 2.000-3.000M. **SOLAR PV SITE INVESTIGATION**

PAGE No.

GEOCONSULT +265 0888 846 543 sabelli@geoconsult.cc	LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP01 / NMC004 / 27APR19		
	SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 27 - 04 - 2019	TIME: 09:01	
	LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
	GOLOMOTI - SOLAR PV	0 672 496	8 403 452	(m)	3.000-4000
	TYPE OF MATERIAL: VERY MOIST BROWN GRAVELLY SANDY SILTY CLAY CONTAINS SPOTS OF DECOMPOSED ROCK				
	TESTED BY: C. NDALAMA		DATE: 05 - 05 - 2019	TIME: 09:00	
	CHECKED BY: G. KACHIWALA		DATE: 05 - 05 - 2019	TIME: 09:45	
	APPROVED BY: M. SABELLI		DATE: 05 - 05 - 2019	TIME: 10:00	

PROJECT: GOLOMOTI SOLAR PV

CLIENT: JCM

NATURAL MOISTURE CONTENT - OVEN DRYING METHOD STANDARD: ASTM D7263

MASS OF WET SOIL + CONTAINER (g)		471.0	
MASS OF DRY SOIL AND CONTAINER (g)		434.0	
CONTAINER No.		GCV2	
MASS OF CONTAINER (g)		73.5	
MASS OF DRY SOIL (g)		360.5	
MASS OF WATER (g)		37.0	
MOISTURE CONTENT %		10.3	
AVERAGE MOISTURE CONTENT %		**10.3**	

REMARKS: SAMPLED FROM TRIAL PIT 01 @ 3.000-4.000M. **SOLAR PV SITE INVESTIGATION**

PAGE No.

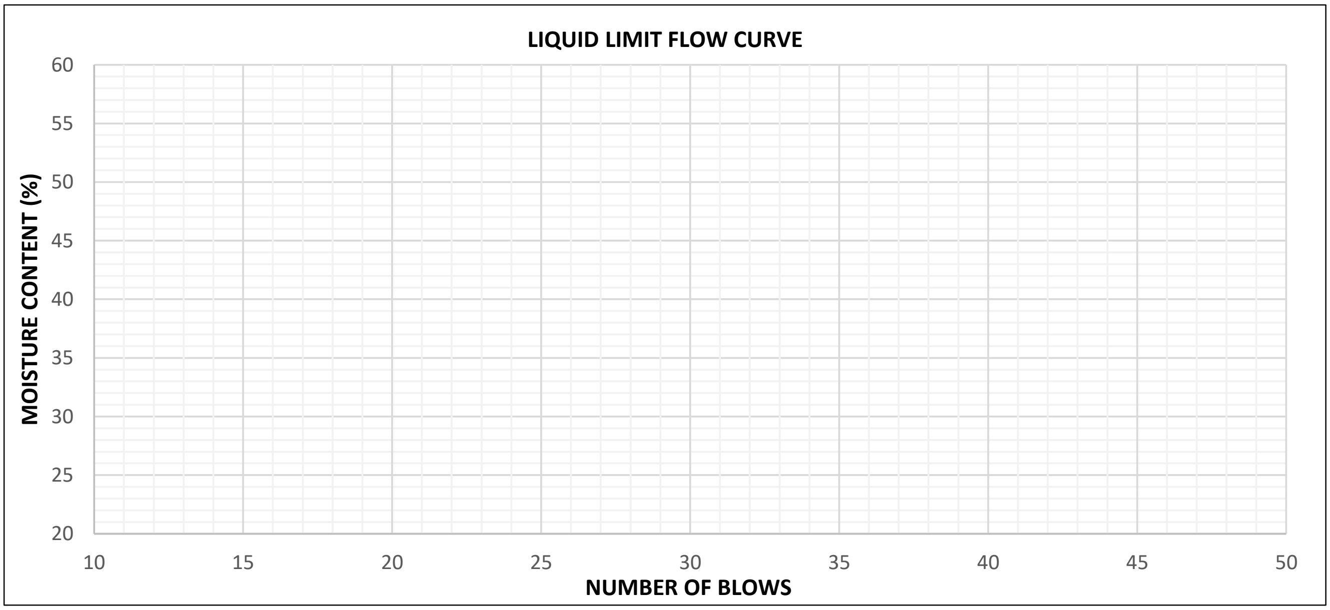
GEOCONSULT	LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP01 / AL001 / 27APR19		
	SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 27 - 04 - 2019	TIME: 11:30	
	LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
	GOLOMOTI - SOLAR PV	0 672 496	8 403 452	(m)	0.200-1.000
	TYPE OF MATERIAL: MOIST DARK BROWN SANDY SILTY CLAY				
	TESTED BY: M. MILANZI		DATE: 10 - 06 - 2019	TIME: 15:21	
+265 0888 846 543	CHECKED BY: S. THANGATO		DATE: 11 - 06 - 2019	TIME: 09:35	
sabelli@geoconsult.cc	APPROVED BY: M. SABELLI		DATE: 11 - 06 - 2019	TIME: 14:18	

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

ATTERBURG LIMITS STANDARD: BS 1377, 2 (C)

TYPE OF TEST	LIQUID LIMITS (LL)				PLASTIC LIMITS (PL)		
TEST No.	1	2	3	4	1	2	3
CONTAINER No.	R12		C31		C	C15	R15
MASS OF WET SOIL + CONTAINER(g)	78.5		80.0		72.5	61.5	42.5
MASS OF DRY SOIL + CONTAINER(g)	70.0		70.5		68.5	57.0	41.5
MASS OF CONTAINER (g)	29		30.0		30	15	31.5
MASS OF DRY SOIL (g)	41.0		40.5		38.5	42.0	10.0
MASS OF WATER (g)	8.50		9.50		4.00	4.50	1.00
MOISTURE CONTENT %	20.7	20.7	23.5	22.5	10.4	10.7	10.0
No. BLOWS	26		16			10.4	

LINEAR SHRINKAGE	14
INITIAL LENGTH OF SPECIMEN (cm)	14.0
LENGTH OF OVERN DRY SPECIMEN (cm)	13.2
LINEAR SHRINKAGE %	6.1
LIQUID LIMIT (LL) %	21.6
PLASTIC LIMIT (PL) %	10.4
PLASTICITY INDEX (PI)	**11**
NATURAL MOISTURE CONTENT %	6.8
FINENESS INDEX	407



REMARKS: SAMPLED FROM TRIAL PIT 01 @ 0.200-1.000M. SOLAR PV SITE INVESTIGATION

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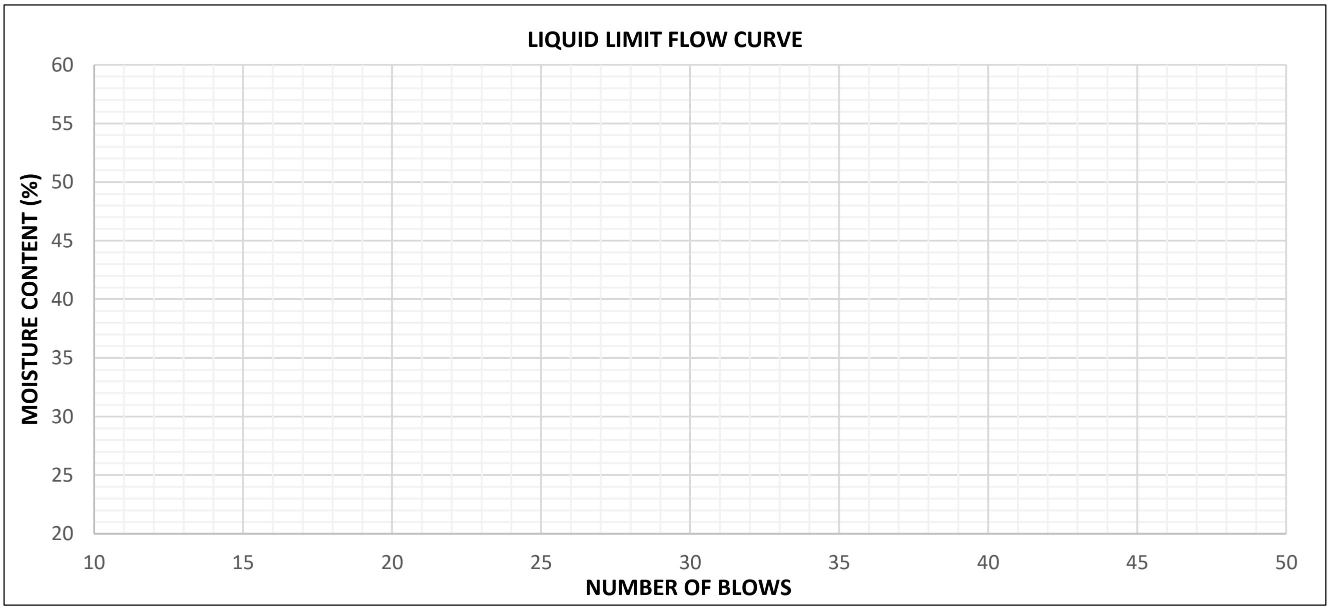
LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP01 / AL002 / 27APR19			
SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 27 - 04 - 2019	TIME: 11:30		
LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)	
GOLOMOTI - SOLAR PV	0 672 496	8 403 452	(m)	1.000-2.000	
TYPE OF MATERIAL: MOIST BROWN YELLOWISH SANDY SILTY CLAY					
TESTED BY: M. MILANZI		DATE: 31 - 05-2019	TIME: 08:44		
CHECKED BY: G. KACHIWALA		DATE: 01 - 06 - 2019	TIME: 09:35		
APPROVED BY: M. SABELLI		DATE: 01 - 06 - 2019	TIME: 14:18		

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

ATTERBURG LIMITS STANDARD: BS 1377, 2 (C)

TYPE OF TEST	**LIQUID LIMITS (LL)**				**PLASTIC LIMITS (PL)**		
TEST No.	1	2	3	4	1	2	3
CONTAINER No.	C11		R22		K3	R19	C23
MASS OF WET SOIL + CONTAINER(g)	55.0		55.0		40.5	45.5	40.3
MASS OF DRY SOIL + CONTAINER(g)	49.0		48.0		39.0	44.0	38.0
MASS OF CONTAINER (g)	30		29		28	33	21.5
MASS OF DRY SOIL (g)	19.0		19.0		11.0	11.0	16.5
MASS OF WATER (g)	6.00		7.00		1.50	1.50	2.30
MOISTURE CONTENT %	31.6	32.2	36.8	36.5	13.6	13.6	13.9
No. BLOWS	30		24			13.7	

LINEAR SHRINKAGE	2
INITIAL LENGTH OF SPECIMEN (cm)	14.0
LENGTH OF OVERN DRY SPECIMEN (cm)	12.5
LINEAR SHRINKAGE %	12.0
LIQUID LIMIT (LL) %	34.3
PLASTIC LIMIT (PL) %	13.7
PLASTICITY INDEX (PI)	**21**
NATURAL MOISTURE CONTENT %	12.0
FINENESS INDEX	840



REMARKS: SAMPLED FROM TRIAL PIT 01 @ 1.000-2.000M. SOLAR PV SITE INVESTIGATION

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LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP01 / AL003 / 27APR19		
SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 27 - 04 - 2019	TIME: 11:30	
LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 672 496	8 403 452	(m)	2.000-3.000
TYPE OF MATERIAL: MOIST BROWN YELLOWISH GRAVELLY SANDY SILTY CLAY				
TESTED BY: C. NAMBANZO		DATE: 31 - 05-2019	TIME: 08:44	
CHECKED BY: S. THANGATO		DATE: 01 - 06 - 2019	TIME: 09:35	
APPROVED BY: M. SABELLI		DATE: 01 - 06 - 2019	TIME: 14:18	

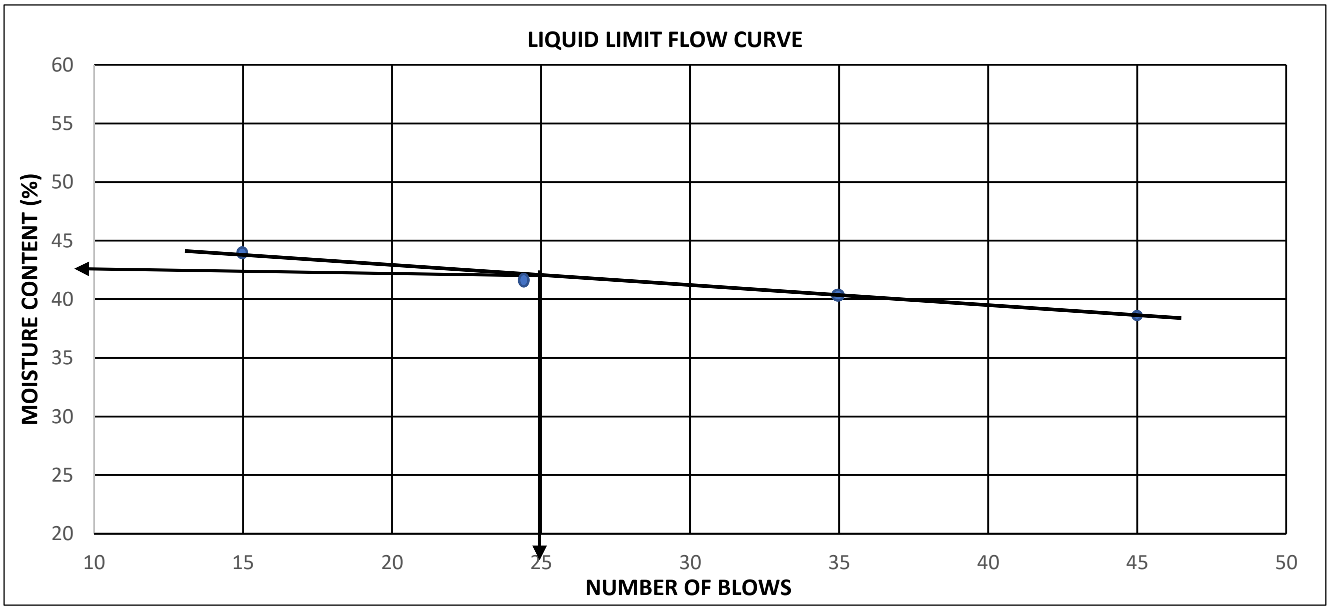
PROJECT: GOLOMOTI SOLAR PV

CLIENT: JCM

ATTERBURG LIMITS STANDARD: BS 1377, 2 (C)

TYPE OF TEST	**LIQUID LIMITS (LL)**				**PLASTIC LIMITS (PL)**		
TEST No.	1	2	3	4	1	2	3
CONTAINER No.	R17	R18	C2	C12	K3	R19	C23
MASS OF WET SOIL + CONTAINER(g)	56.5	58.5	61.5	63.5	40.5	45.5	40.3
MASS OF DRY SOIL + CONTAINER(g)	48.5	50	51.0	52.5	39.0	44.0	38.0
MASS OF CONTAINER (g)	27.50	29.00	26.00	28.00	28	33	21.5
MASS OF DRY SOIL (g)	21.0	21.0	25.0	24.5	11.0	11.0	16.5
MASS OF WATER (g)	8.00	8.50	10.50	11.00	1.50	1.50	2.30
MOISTURE CONTENT %	38.1	40.5	42.0	44.9	13.6	13.6	13.9
No. BLOWS	45	35	24	15		13.7	

LINEAR SHRINKAGE	2
INITIAL LENGTH OF SPECIMEN (cm)	14.0
LENGTH OF OVERN DRY SPECIMEN (cm)	12.5
LINEAR SHRINKAGE %	12.0
LIQUID LIMIT (LL) %	42.5
PLASTIC LIMIT (PL) %	13.7
PLASTICITY INDEX (PI)	**29**
NATURAL MOISTURE CONTENT %	11.7
FINENESS INDEX	1421



REMARKS: SAMPLED FROM TRIAL PIT 01 @ 2.000-3.000M. SOLAR PV SITE INVESTIGATION

	Triaxial test - UU BS 1377 part 7, 1377 part 8			
	Site :	GOLOMOTI SOLAR PV	Levy date :	29-Jun-19
	Technicien's name :		Date of test :	29-Jun-19
GEOCONSULT LIMITED	File N° :	39	Survey depth (m) :	1.000
P.O. BOX 40 LILONGWE	Survey N° :	TRIAL PIT No. 01	Level of water (m) :	
	Kind of soil :	Moist Brown Reddish LateriteGravelley Sandy Silty CLAY		

Identification of samples :

σvo, Total stress of the soil in situ (kPa) : 0.000

Uo, Pore pressure of the soil in situ (kPa) : 0.000

Category of soil : Soft/Granular

Kind of drainage : Without lateral drain

ρs, Grain density (kg/m³) : 0.000

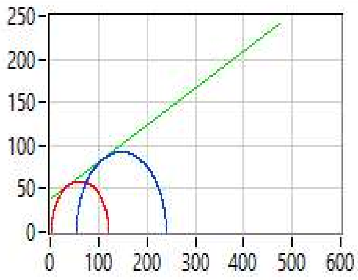
Sm : ☐

Sd : ☐

		Samples before test :								Samples after saturation :		
	N°	Hi (mm)	Di (mm)	mi (g)	ρi (kg/m³)	ρdi (kg/m³)	wi (%)	ei	Sri (%)	Ucp (kPa)	ΔVsat. (mm³)	B (%)
🟦	1	76.00	38	175.0	2030	1694	19.86	-1.000	-0.000		0.000	0.000
🟥	2	76.00	38	144.0	1671	1381	21.01	-1.000	-0.000		0.000	0.000

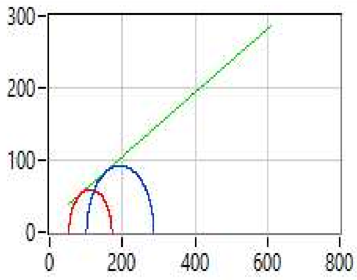
		Samples after consolidation :						Samples after shearing							
	N°	Hs (mm)	Ds (mm)	ΔVs (mm³)	T100 (min)	Vmax (µm/min)	σ'c (kPa)	Hf (mm)	Df (mm)	mf (g)	md (g)	wf (%)	ρdf (kg/m³)	ef	Srf (%)
🟦	1	76.00	38.00	0.000	0.000	0.000	0.000	76.00	38.00	173.5	146.0	18.84	1694	-1.000	-0.000
🟥	2	76.00	38.00	0.000	0.000	0.000	0.000	76.00	38.00	143.5	119.0	20.59	1381	-1.000	-0.000

Total stress :



	Mohr
C (kPa)	37.93
φ (°)	23.02

Effective stress :



	Mohr	Lambe
C' (kPa)	14.65	13.38
φ' (°)	24.05	22.17

Comments :

Visa :

p.1/3

3.5 Trial Pit 02

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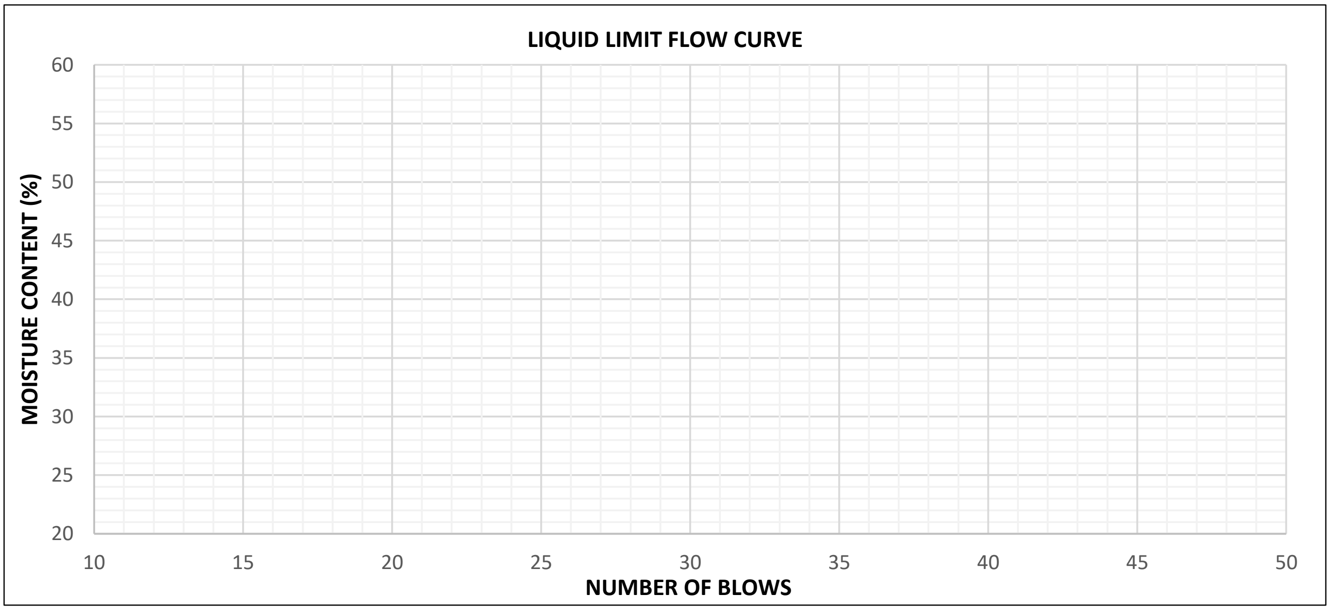
LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP02 / AL007 / 27APR19		
SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 27 - 04 - 2019	TIME: 09:05	
LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 672 496	8 403 452	(m)	3.300-4.000
TYPE OF MATERIAL: VERY MOIST BROWN YELLOWISH GRAVELLY SANDY SILTY CLAY				
TESTED BY: S. MATCHADO		DATE: 31 - 05-2019	TIME: 10:33	
CHECKED BY: S. THANGATO		DATE: 01 - 06 - 2019	TIME: 09:35	
APPROVED BY: M. SABELLI		DATE: 01 - 06 - 2019	TIME: 14:18	

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

ATTERBURG LIMITS STANDARD: BS 1377, 2 (C)

TYPE OF TEST	LIQUID LIMITS (LL)				PLASTIC LIMITS (PL)		
TEST No.	1	2	3	4	1	2	3
CONTAINER No.	C20		R15		R2	R23	R19
MASS OF WET SOIL + CONTAINER(g)	59.0		57.0		44.0	44.0	44.0
MASS OF DRY SOIL + CONTAINER(g)	53.0		50.0		41.5	41.0	41.5
MASS OF CONTAINER (g)	33		32		28	25	28
MASS OF DRY SOIL (g)	20.0		18.0		13.5	16.0	13.5
MASS OF WATER (g)	6.00		7.00		2.50	3.00	2.50
MOISTURE CONTENT %	30.0	30.6	38.9	37.7	18.5	18.8	18.5
No. BLOWS	30		19			18.6	

LINEAR SHRINKAGE	5
INITIAL LENGTH OF SPECIMEN (cm)	14.0
LENGTH OF OVERN DRY SPECIMEN (cm)	13.0
LINEAR SHRINKAGE %	7.7
LIQUID LIMIT (LL) %	34.2
PLASTIC LIMIT (PL) %	18.6
PLASTICITY INDEX (PI)	**16**
NATURAL MOISTURE CONTENT %	19.4
FINENESS INDEX	736.0



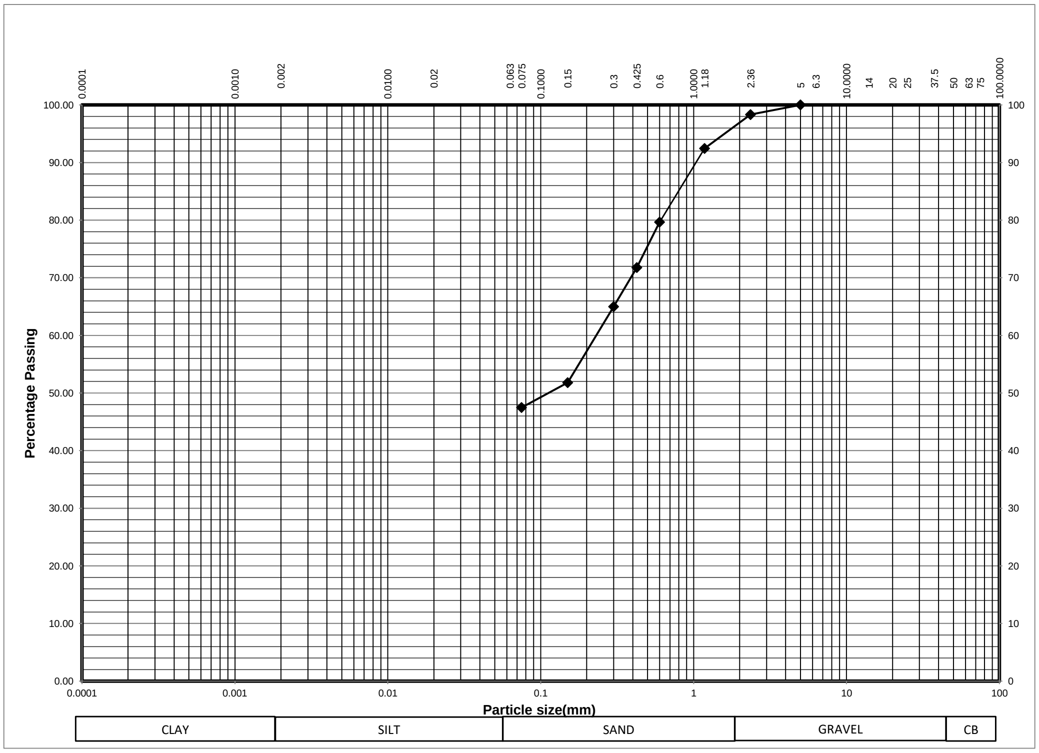
REMARKS: SAMPLED FROM TRIAL PIT 02 @ 3.300-4.000M. SOLAR PV SITE INVESTIGATION

GEOCONSULT	LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP02 / G005 / 27APR19		
	SAMPLED BY: GEOCONSULT LAB TEAM		DATE: 27 / 04 / 2019	TIME: 15:30	
	LOCATION:	EASTING	NORTHING	ELEVATION	DEPTH (m)
	GOLOMOTI - SOLAR PV	0 672 496	8 403 306	(m)	0.200-1.000
	TYPE OF MATERIAL: MOIST DARK BROWN SANDY SILTY CLAY				
	TESTED BY: I. MITOMONI		DATE: 25 - 05 - 2019	TIME: 11:20	
+265 0888 846 543	CHECKED BY: E. NKHUKU		DATE: 29 - 05 - 2019	TIME: 13:30	
sabelli@geoconsult.cc	APPROVED BY: M. SABELLI		DATE: 29 - 05 - 2019	TIME: 15:00	

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

SIEVE ANALYSIS (GRADATION) STANDARD: TRH14:1985

SIEVE	MASS	PERCENTAGE			GRADATION SPECIFICATION			ZONE
(mm)	RETAINED	RETAINED	PASSING		BASE	SUBBASE	SL SEAL	
75.000								
50.000								
37.500								
28.000								
25.000								
20.000								
14.000								
12.500								
10.000								
6.300								
5.000	0.00	0.00	100.00	100				
2.360	11.50	1.65	98.35	98				
1.180	52.50	7.54	92.46	92				
0.600	141.50	20.33	79.67	80				
0.425	196.50	28.23	71.77	72				
0.300	243.50	34.99	65.01	65				
0.150	335.50	48.20	51.80	52				
0.075	365.50	52.51	47.49	47				
0 pan	330.50	47.49						
TOTAL (g)	696.00							



REMARKS: SAMPLED FROM TRIAL PIT 02 @ 0.200-1.00M. **SOLAR PV SITE INVESTIGATION**

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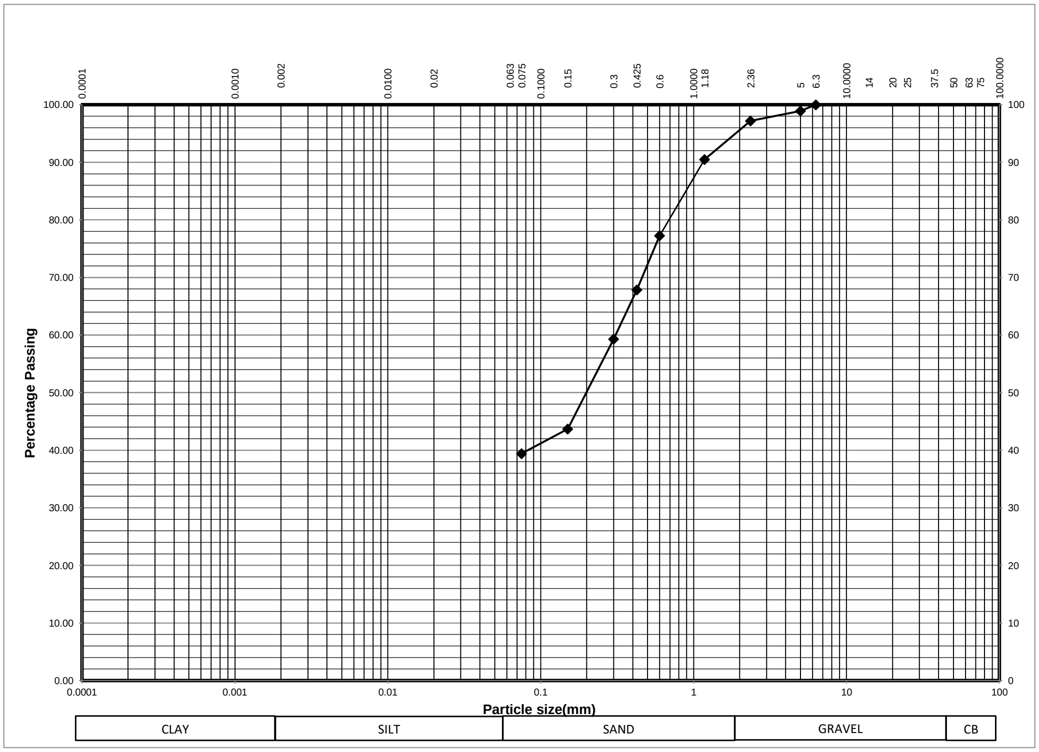
LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP02 / G006 / 27APR19		
SAMPLED BY: GEOCONSULT LAB TEAM		DATE: 27 / 04 / 2019	TIME: 09:01	
LOCATION:	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 672 496	8 403 306	(m)	1.000-3.300
TYPE OF MATERIAL: MOIST BROWN YELLOWISH SANDY SILTY CLAY				
TESTED BY: I. MITOMONI		DATE: 25 - 05 - 2019	TIME: 11:20	
CHECKED BY: E. NKHUKU		DATE: 29 - 05 - 2019	TIME: 13:30	
APPROVED BY: M. SABELLI		DATE: 29 - 05 - 2019	TIME: 15:00	

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

SIEVE ANALYSIS (GRADATION) STANDARD: TRH14:1985

SIEVE	MASS	PERCENTAGE			GRADATION SPECIFICATION			ZONE
(mm)	RETAINED	RETAINED	PASSING		BASE	SUBBASE	SL SEAL	
75.000								
50.000								
37.500								
28.000								
25.000								
20.000								
14.000								
12.500								
10.000								
6.300	0.00	0.00	100.00	100				
5.000	7.50	1.08	98.92	99				
2.360	19.50	2.81	97.19	97				
1.180	66.00	9.50	90.50	91				
0.600	158.00	22.73	77.27	77				
0.425	223.50	32.16	67.84	68				
0.300	283.00	40.72	59.28	59				
0.150	391.50	56.33	43.67	44				
0.075	421.00	60.58	39.42	39				
0 pan	274.00	39.42						
TOTAL (g)	695.00							



REMARKS: SAMPLED FROM TRIAL PIT 02 @ 1.000-3.300M. **SOLAR PV SITE INVESTIGATION** **PAGE No.**

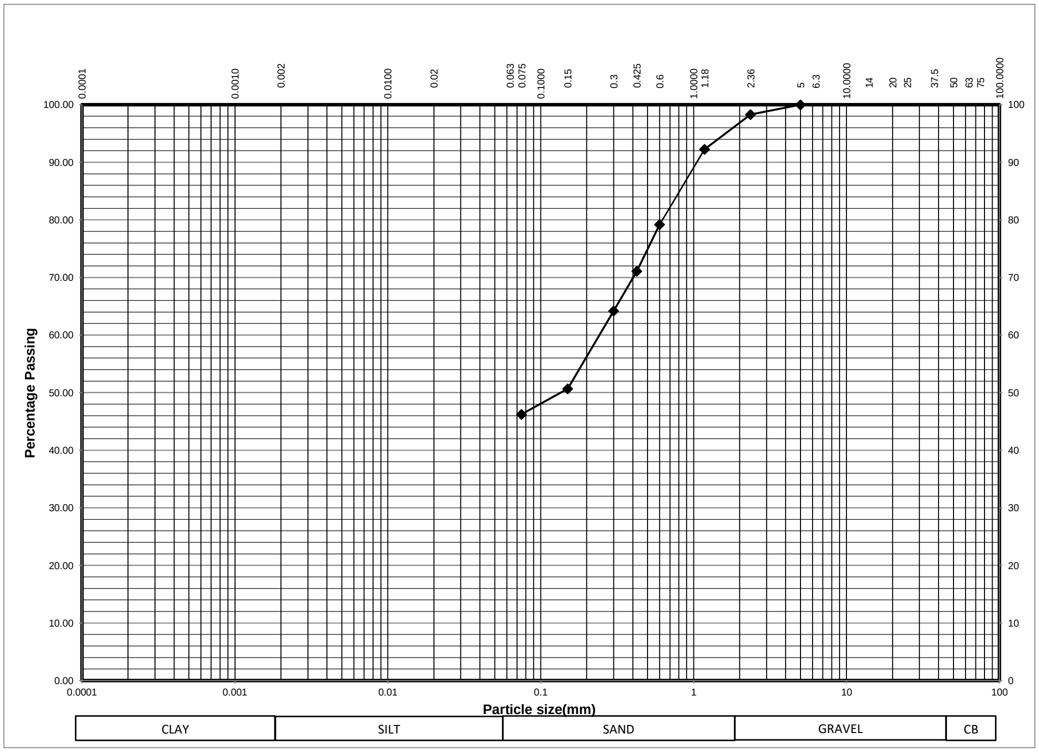
GEOCONSULT	LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP02 / G007 / 27APR19		
	SAMPLED BY: GEOCONSULT LAB TEAM		DATE: 27 / 04 / 2019	TIME: 09:01	
	LOCATION:	EASTING	NORTHING	ELEVATION	DEPTH (m)
	GOLOMOTI - SOLAR PV	0 672 496	8 403 306	(m)	3.300-4.400
	TYPE OF MATERIAL: MOIST BROWN YELLOWISH GRAVELLY SANDY SILTY CLAY				
	TESTED BY: I. MITOMONI		DATE: 25 - 05 - 2019	TIME: 11:20	
+265 0888 846 543	CHECKED BY: E. NKHUKU		DATE: 29 - 05 - 2019	TIME: 13:30	
sabelli@geoconsult.cc	APPROVED BY: M. SABELLI		DATE: 29 - 05 - 2019	TIME: 15:00	

PROJECT: GOLOMOTI SOLAR PV

CLIENT: JCM

SIEVE ANALYSIS (GRADATION) STANDARD: TRH14:1985

SIEVE	MASS	PERCENTAGE			GRADATION SPECIFICATION			ZONE
(mm)	RETAINED	RETAINED	PASSING		BASE	SUBBASE	SL SEAL	
75.000								
50.000								
37.500								
28.000								
25.000								
20.000								
14.000								
12.500								
10.000								
6.300								
5.000	0.00	0.00	100.00	100				
2.360	11.50	1.69	98.31	98				
1.180	52.50	7.72	92.28	92				
0.600	141.50	20.81	79.19	79				
0.425	196.50	28.90	71.10	71				
0.300	243.50	35.81	64.19	64				
0.150	335.50	49.34	50.66	51				
0.075	365.50	53.75	46.25	46				
0 pan	314.50	46.25						
TOTAL (g)	680.00							



REMARKS: SAMPLED FROM TRIAL PIT 02 @ 3.300-4.000M. **SOLAR PV SITE INVESTIGATION**

PAGE No.

GEOCONSULT +265 0888 846 543 sabelli@geoconsult.cc	LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP02 / NMC005 / 27APR19	
	SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 27 - 04 - 2019	TIME: 09:02
	LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
	GOLOMOTI - SOLAR PV	0 672 496	8 403 306	(m)	0.200-1.000
	TYPE OF MATERIAL: MOIST DARK BROWN SANDY SILTY CLAY				
	TESTED BY: C. NDALAMA		DATE: 05 - 05 - 2019	TIME: 09:30
	CHECKED BY: G. KACHIWALA		DATE: 06 - 05 - 2019	TIME: 09:46
	APPROVED BY: M. SABELLI		DATE: 06 - 05 - 2019	TIME: 10:00

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

NATURAL MOISTURE CONTENT - OVEN DRYING METHOD STANDARD: ASTM D7263

MASS OF WET SOIL + CONTAINER (g)		282.5	
MASS OF DRY SOIL AND CONTAINER (g)		260.5	
CONTAINER No.		GC14B	
MASS OF CONTAINER (g)		52.0	
MASS OF DRY SOIL (g)		208.5	
MASS OF WATER (g)		22.0	
MOISTURE CONTENT %		10.6	
AVERAGE MOISTURE CONTENT %		**10.6**	

REMARKS: SAMPLED FROM TRIAL PIT 02 @ 0.200-1.000M. **SOLAR PV SITE INVESTIGATION** **PAGE No.**

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LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP02 / NMC006 / 27APR19		
SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 27 - 04 - 2019	TIME: 09:02	
LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 672 496	8 403 306	(m)	1.000-3.300
TYPE OF MATERIAL: MOIST BROWN YELLOWISH SANDY SILTY CLAY				
TESTED BY: C. NDALAMA		DATE: 05 - 05 - 2019	TIME: 09:30	
CHECKED BY: G. KACHIWALA		DATE: 06 - 05 - 2019	TIME: 09:46	
APPROVED BY: M. SABELLI		DATE: 06 - 05 - 2019	TIME: 10:00	

PROJECT: GOLOMOTI SOLAR PV

CLIENT: JCM

NATURAL MOISTURE CONTENT - OVEN DRYING METHOD STANDARD: ASTM D7263

MASS OF WET SOIL + CONTAINER (g)		473.0	
MASS OF DRY SOIL AND CONTAINER (g)		439.0	
CONTAINER No.		JB	
MASS OF CONTAINER (g)		125.5	
MASS OF DRY SOIL (g)		313.5	
MASS OF WATER (g)		34.0	
MOISTURE CONTENT %		10.8	
AVERAGE MOISTURE CONTENT %		**10.8**	

REMARKS: SAMPLED FROM TRIAL PIT 02 @ 1.000-3.300M. **SOLAR PV SITE INVESTIGATION**

PAGE No.

GEOCONSULT	LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP02 / NMC006 / 27APR19		
	SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 27 - 04 - 2019	TIME: 09:02	
	LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
	GOLOMOTI - SOLAR PV	0 672 496	8 403 306	(m)	1.000-3.300
	TYPE OF MATERIAL: VERY MOIST BROWN YELLOWISH GRAVELLY SANDY SILTY CLAY				
	TESTED BY: C. NDALAMA		DATE: 05 - 05 - 2019	TIME: 09:30	
+265 0888 846 543	CHECKED BY: G. KACHIWALA		DATE: 06 - 05 - 2019	TIME: 09:46	
sabelli@geoconsult.cc	APPROVED BY: M. SABELLI		DATE: 06 - 05 - 2019	TIME: 10:00	

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

NATURAL MOISTURE CONTENT - OVEN DRYING METHOD STANDARD: ASTM D7263

MASS OF WET SOIL + CONTAINER (g)		466.5	
MASS OF DRY SOIL AND CONTAINER (g)		411.5	
CONTAINER No.		GCX	
MASS OF CONTAINER (g)		128.0	
MASS OF DRY SOIL (g)		283.5	
MASS OF WATER (g)		55.0	
MOISTURE CONTENT %		19.4	
AVERAGE MOISTURE CONTENT %		**19.4**	

REMARKS: SAMPLED FROM TRIAL PIT 02 @ 3.300-4.000M. **SOLAR PV SITE INVESTIGATION** **PAGE No.**

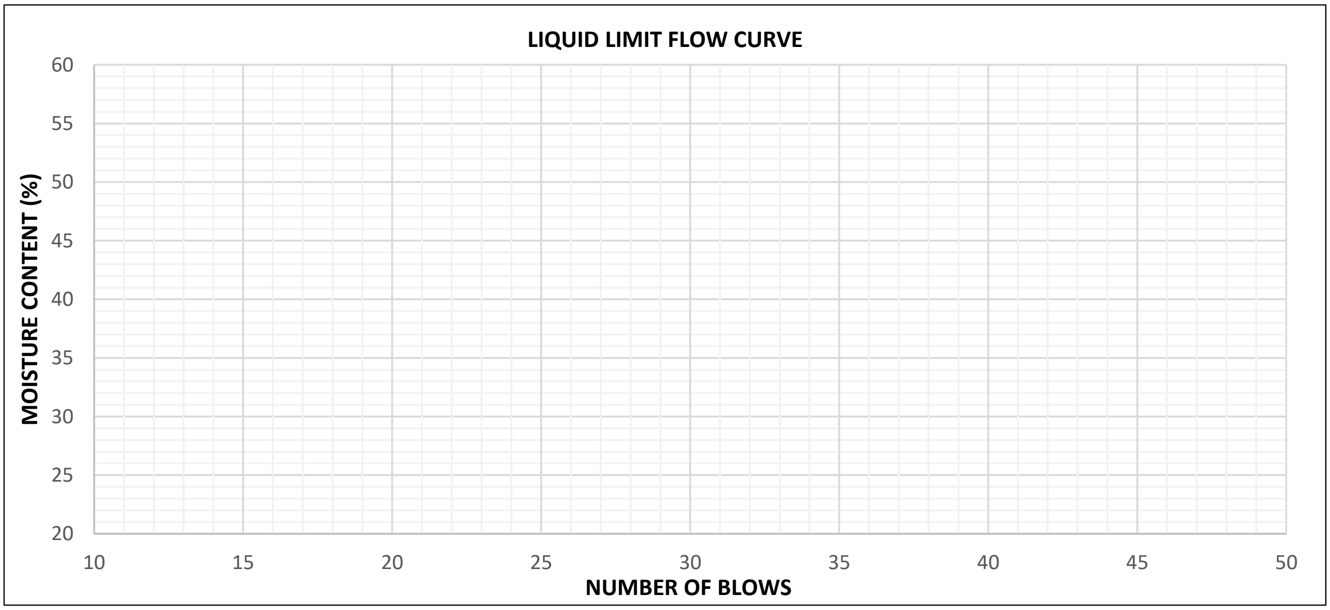
GEOCONSULT	LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP02 / AL005 / 27APR19			
	SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 27 - 04 - 2019	TIME: 09:01		
	LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)	
	GOLOMOTI - SOLAR PV	0 672 496	8 403 306	(m)	0.200-1.000	
	TYPE OF MATERIAL: MOIST DARK BROWN SANDY SILTY CLAY					
	TESTED BY: S. MATCHADO		DATE: 31 - 05-2019	TIME: 08:29		
+265 0888 846 543	CHECKED BY: S. THANGATO		DATE: 01 - 06 - 2019	TIME: 09:35		
sabelli@geoconsult.cc	APPROVED BY: M. SABELLI		DATE: 01 - 06 - 2019	TIME: 14:18		

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

ATTERBURG LIMITS STANDARD: BS 1377, 2 (C)

TYPE OF TEST	LIQUID LIMITS (LL)				PLASTIC LIMITS (PL)		
TEST No.	1	2	3	4	1	2	3
CONTAINER No.	R6		C14		C25	R24	A
MASS OF WET SOIL + CONTAINER(g)	56.0		54.0		43.5	45.5	37.5
MASS OF DRY SOIL + CONTAINER(g)	49.0		46.0		41.5	43.5	36.0
MASS OF CONTAINER (g)	29.5		27		29.65	31	27
MASS OF DRY SOIL (g)	19.5		19.0		11.9	12.5	9.0
MASS OF WATER (g)	7.00		8.00		2.00	2.00	1.50
MOISTURE CONTENT %	35.9	36.3	42.1	40.8	16.9	16.0	16.7
No. BLOWS	27		18			16.5	

LINEAR SHRINKAGE	10
INITIAL LENGTH OF SPECIMEN (cm)	14.0
LENGTH OF OVERN DRY SPECIMEN (cm)	12.8
LINEAR SHRINKAGE %	9.4
LIQUID LIMIT (LL) %	38.5
PLASTIC LIMIT (PL) %	16.5
PLASTICITY INDEX (PI)	**22**
NATURAL MOISTURE CONTENT %	10.6
FINENESS INDEX	1034



REMARKS: SAMPLED FROM TRIAL PIT 02 @ 0.200-1.000M. SOLAR PV SITE INVESTIGATION

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LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP02 / AL006 / 27APR19		
SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 27 - 04 - 2019	TIME: 09:02	
LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 672 496	8 403 452	(m)	1.000-3.300
TYPE OF MATERIAL: MOIST BROWN YELLOWISH SANDY SILTY CLAY				
TESTED BY: M. MILANZI		DATE: 31 - 05-2019	TIME: 08:29	
CHECKED BY: S. THANGATO		DATE: 01 - 06 - 2019	TIME: 09:35	
APPROVED BY: M. SABELLI		DATE: 01 - 06 - 2019	TIME: 14:18	

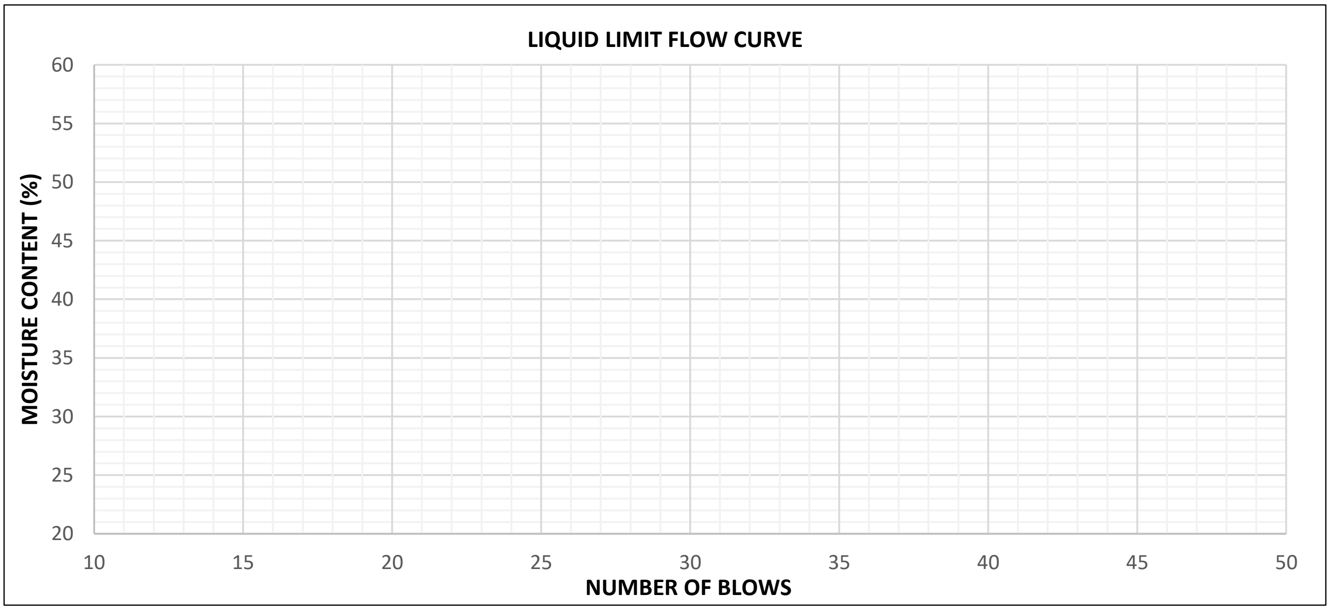
PROJECT: GOLOMOTI SOLAR PV

CLIENT: JCM

ATTERBURG LIMITS STANDARD: BS 1377, 2 (C)

TYPE OF TEST	LIQUID LIMITS (LL)				PLASTIC LIMITS (PL)		
TEST No.	1	2	3	4	1	2	3
CONTAINER No.	C23		C20		R6	R3	C4
MASS OF WET SOIL + CONTAINER(g)	57.5		53.5		42.5	43.5	39.5
MASS OF DRY SOIL + CONTAINER(g)	50.5		46.0		41.0	41.5	37.5
MASS OF CONTAINER (g)	28		25		30	26.5	22.5
MASS OF DRY SOIL (g)	22.5		21.0		11.0	15.0	15.0
MASS OF WATER (g)	7.00		7.50		1.50	2.00	2.00
MOISTURE CONTENT %	31.1	31.4	35.7	34.3	13.6	13.3	13.3
No. BLOWS	28		17			13.4	

LINEAR SHRINKAGE	10
INITIAL LENGTH OF SPECIMEN (cm)	14.0
LENGTH OF OVERN DRY SPECIMEN (cm)	12.9
LINEAR SHRINKAGE %	8.5
LIQUID LIMIT (LL) %	32.9
PLASTIC LIMIT (PL) %	13.4
PLASTICITY INDEX (PI)	**19**
NATURAL MOISTURE CONTENT %	10.8
FINENESS INDEX	741.0



REMARKS: SAMPLED FROM TRIAL PIT 02 @ 1.000-3.300M. SOLAR PV SITE INVESTIGATION

	Triaxial test - UU BS 1377 part 7, 1377 part 8			
	Site :	GOLOMOTI SOALR PV	Levy date :	26-Jun-19
	Technicien's name :		Date of test :	26-Jun-19
GEOCONSULT LIMITED P.O. BOX 40 LILONGWE	File N° :	27	Survey depth (m) :	1.000
	Survey N° :	TRIAL PIT No. 02	Level of water (m) :	
	Kind of soil :			Moist Brown Yellowish Sandy Silty CLAY

Identification of samples :

σvo, Total stress of the soil in situ (kPa) :	0.000	Uo, Pore pressure of the soil in situ (kPa) :	0.000
Category of soil :	Soft/Granular	Kind of drainage :	Without lateral drain
ρs, Grain density (kg/m³) :	0.000		
Sm :	☐	Sd :	☐

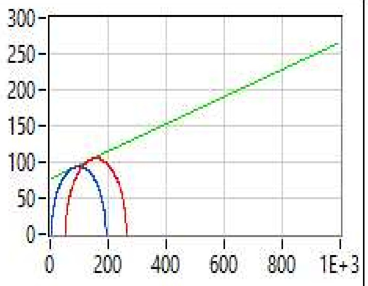
Samples before test : / Samples after saturation :

	N°	Hi (mm)	Di (mm)	mi (g)	ρi (kg/m³)	ρdi (kg/m³)	wi (%)	ei	Sri (%)	Ucp (kPa)	ΔVsat. (mm³)	B (%)
🟦	1	76.00	38	172.5	2001	1653	21.05	-1.000	-0.000		0.000	0.000
🟥	2	76.00	38	168.0	1949	1607	21.30	-1.000	-0.000		0.000	0.000

Samples after consolidation : / Samples after shearing

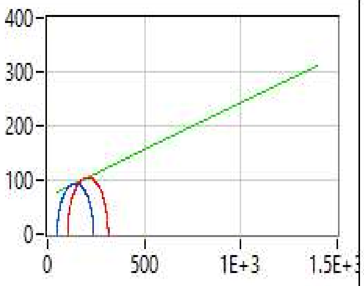
	N°	Hs (mm)	Ds (mm)	ΔVs (mm³)	T100 (min)	Vmax (µm/min)	σ'c (kPa)	Hf (mm)	Df (mm)	mf (g)	md (g)	wf (%)	ρdf (kg/m³)	ef	Srf (%)
🟦	1	76.00	38.00	0.000	0.000	0.000	0.000	76.00	38.00	172.0	142.5	20.70	1653	-1.000	-0.000
🟥	2	76.00	38.00	0.000	0.000	0.000	0.000	76.00	38.00	167.5	138.5	20.94	1607	-1.000	-0.000

Total stress :



	Mohr
C (kPa)	76.94
φ (°)	10.69

Effective stress :



	Mohr	Lambe
C' (kPa)	70.47	69.43
φ' (°)	9.848	9.706

Comments :

Visa :

p.1/3

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P.O. BOX 40 LILONGWE

Triaxial test - UU
BS 1377 part 7, 1377 part 8

Site :	GOLOMOTI SOLAR PV	Levy date :	13-Jun-19
Technicien's name :		Date of test :	13-Jun-19
File N° :	9	Survey depth (m) :	2.000
Survey N° :	2	Level of water (m) :	
Kind of soil :	Moist Brown yellowish sandy silty Clay		

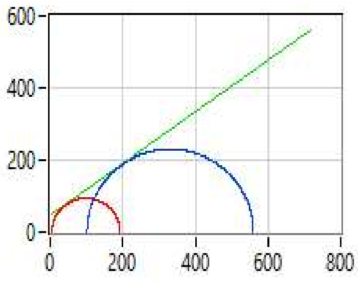
Identification of samples :

σvo, Total stress of the soil in situ (kPa) :	0.000	Uo, Pore pressure of the soil in situ (kPa) :	0.000
Category of soil :	Steep/Strongly overconsolidated	Kind of drainage :	Without lateral drain
ρs, Grain density (kg/m^3) :	0.000		
Sm :	☐	Sd :	☐

	Samples before test :									Samples after saturation :		
	N°	Hi (mm)	Di (mm)	mi (g)	ρi (kg/m^3)	ρdi (kg/m^3)	wi (%)	ei	Sri (%)	Ucp (kPa)	ΔVsat. (mm^3)	B (%)
🟦	1	76.00	38	153.5	1781	1479	20.39	-1.000	-0.000		0.000	0.000
🟥	2	76.00	38	172.5	2001	1653	21.05	-1.000	-0.000		0.000	0.000

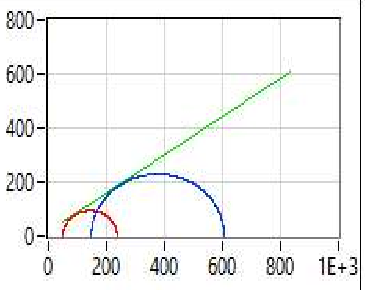
	Samples after consolidation :							Samples after shearing							
	N°	Hs (mm)	Ds (mm)	ΔVs (mm^3)	T100 (min)	Vmax (µm/min)	σ'c (kPa)	Hf (mm)	Df (mm)	mf (g)	md (g)	wf (%)	ρdf (kg/m^3)	ef	Srf (%)
🟦	1	76.00	38.00	0.000	0.000	0.000	0.000	76.00	38.00	152.5	127.5	19.61	1479	-1.000	-0.000
🟥	2	76.00	38.00	0.000	0.000	0.000	0.000	76.00	38.00	172.0	142.5	20.70	1653	-1.000	-0.000

Total stress :



	Mohr
C (kPa)	44.88
φ (°)	35.65

Effective stress :



	Mohr	Lambe
C' (kPa)	13.57	11.06
φ' (°)	35.41	30.09

Comments :

Visa :

p.1/3

3.6 Trial Pit 03

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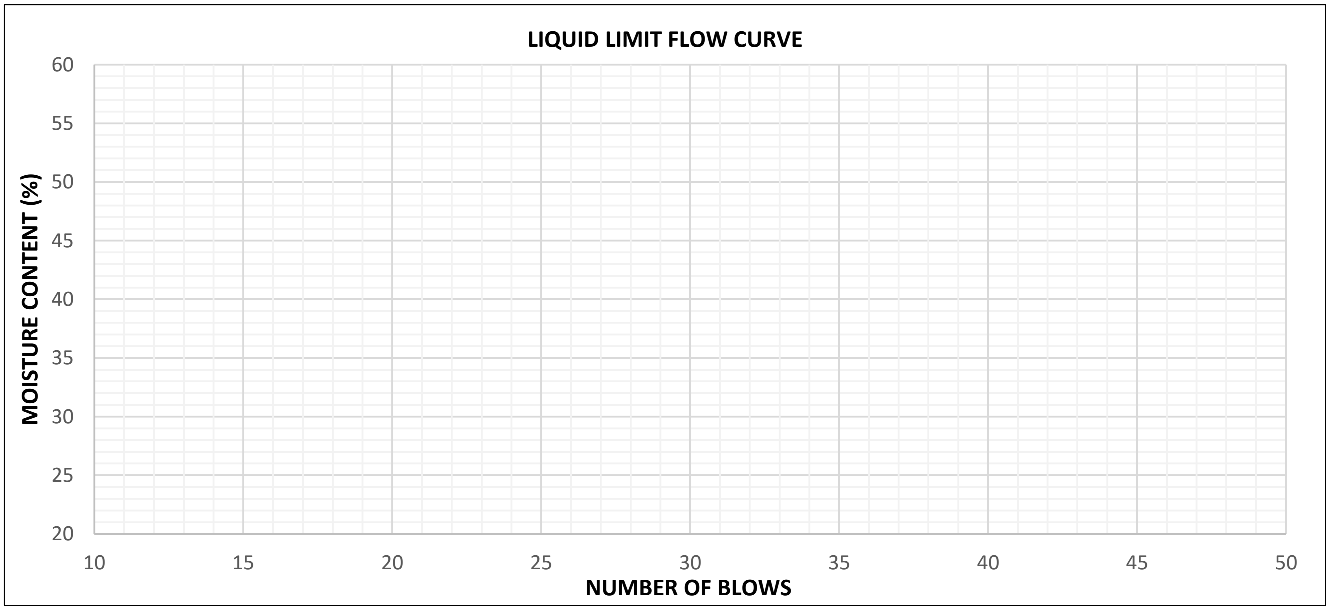
LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP03 / AL010 / 30APR19		
SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 30 - 04 - 2019	TIME: 09:05	
LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 672 315	8 403 152	(m)	3.500-4.200
TYPE OF MATERIAL: MOIST BROWN REDDISH SANDY SILTY CLAY LATERITE GRAVEL				
TESTED BY: S. MATCHADO		DATE: 31 - 05 - 2019	TIME: 10:31	
CHECKED BY: S. THANGATO		DATE: 01 - 06 - 2019	TIME: 09:35	
APPROVED BY: M. SABELLI		DATE: 01 - 06 - 2019	TIME: 14:18	

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

ATTERBURG LIMITS STANDARD: BS 1377, 2 (C)

TYPE OF TEST	**LIQUID LIMITS (LL)**				**PLASTIC LIMITS (PL)**		
TEST No.	1	2	3	4	1	2	3
CONTAINER No.	R16		R17		R30	C2	RAI
MASS OF WET SOIL + CONTAINER(g)	51.5		49.0		41.0	40.5	39.5
MASS OF DRY SOIL + CONTAINER(g)	45.5		42.5		39.0	38.5	38.0
MASS OF CONTAINER (g)	28.5		26		26.5	26	29
MASS OF DRY SOIL (g)	17.0		16.5		12.5	12.5	9.0
MASS OF WATER (g)	6.00		6.50		2.00	2.00	1.50
MOISTURE CONTENT %	35.3	36.0	39.4	38.6	16.0	16.0	16.7
No. BLOWS	33		21			16.2	

LINEAR SHRINKAGE	16
INITIAL LENGTH OF SPECIMEN (cm)	14.0
LENGTH OF OVERN DRY SPECIMEN (cm)	13.0
LINEAR SHRINKAGE %	7.7
LIQUID LIMIT (LL) %	37.3
PLASTIC LIMIT (PL) %	16.2
PLASTICITY INDEX (PI)	**21**
NATURAL MOISTURE CONTENT %	11.0
FINENESS INDEX	1365



REMARKS: SAMPLED FROM TRIAL PIT 03 @ 3.500-4.200M. SOLAR PV SITE INVESTIGATION

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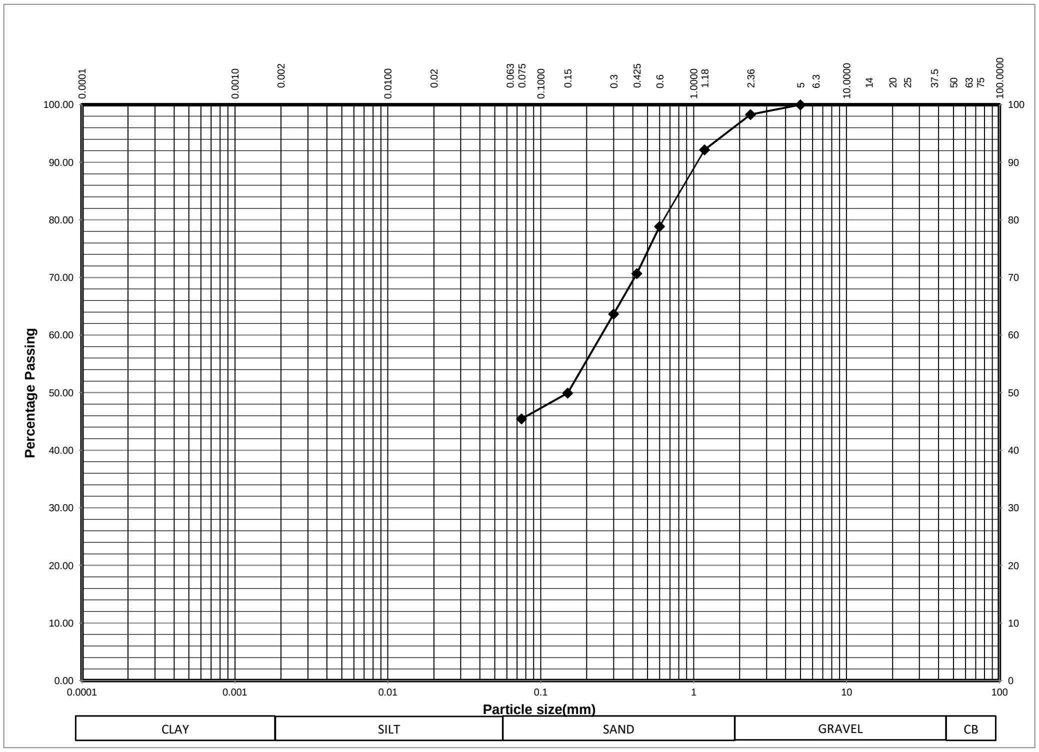
LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP03 / G008 / 30APR19		
SAMPLED BY: GEOCONSULT LAB TEAM		DATE: 30 / 04 / 2019	TIME: 09:01	
LOCATION:	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 672 315	8 403 152	(m)	0.200-1.000
TYPE OF MATERIAL: MOIST STIFF DARK GREY SANDY SILTY CLAY				
TESTED BY: I. MITOMONI		DATE: 25 - 05 - 2019	TIME: 11:20	
CHECKED BY: E. NKHUKU		DATE: 29 - 05 - 2019	TIME: 13:30	
APPROVED BY: M. SABELLI		DATE: 29 - 05 - 2019	TIME: 15:00	

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

SIEVE ANALYSIS (GRADATION) STANDARD: TRH14:1985

SIEVE	MASS	PERCENTAGE			GRADATION SPECIFICATION			ZONE
(mm)	RETAINED	RETAINED	PASSING		BASE	SUBBASE	SL SEAL	
75.000								
50.000								
37.500								
28.000								
25.000								
20.000								
14.000								
12.500								
10.000								
6.300								
5.000	0.00	0.00	100.00	100				
2.360	11.50	1.72	98.28	98				
1.180	52.50	7.84	92.16	92				
0.600	141.50	21.12	78.88	79				
0.425	196.50	29.33	70.67	71				
0.300	243.50	36.34	63.66	64				
0.150	335.50	50.07	49.93	50				
0.075	365.50	54.55	45.45	45				
0 pan	304.50	45.45						
TOTAL (g)	670.00							



REMARKS: SAMPLED FROM TRIAL PIT 03 @ 0.200-1.000M. **SOLAR PV SITE INVESTIGATION**

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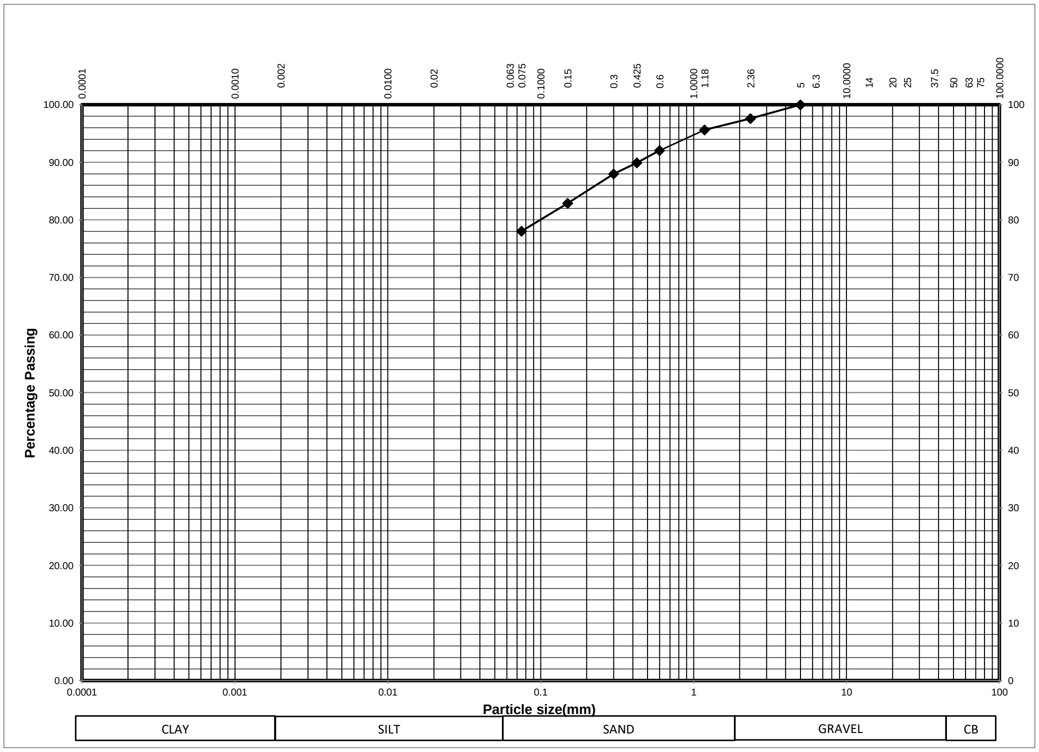
LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP03 / G008 / 30APR19		
SAMPLED BY: GEOCONSULT LAB TEAM		DATE: 30 / 04 / 2019	TIME: 07:31	
LOCATION:	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 672 315	8 403 152	(m)	1.000-3.500
TYPE OF MATERIAL: MOIST STIFF LIGHT BROWN SANDY SILTY CLAY				
TESTED BY: I. MITOMONI		DATE: 25 - 05 - 2019	TIME: 11:20	
CHECKED BY: E. NKHUKU		DATE: 29 - 05 - 2019	TIME: 13:30	
APPROVED BY: M. SABELLI		DATE: 29 - 05 - 2019	TIME: 15:00	

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

SIEVE ANALYSIS (GRADATION) STANDARD: TRH14:1985

SIEVE	MASS	PERCENTAGE			GRADATION SPECIFICATION			ZONE
(mm)	RETAINED	RETAINED	PASSING		BASE	SUBBASE	SL SEAL	
75.000								
50.000								
37.500								
28.000								
25.000								
20.000								
14.000								
12.500								
10.000								
6.300								
5.000	0.00	0.00	100.00	100				
2.360	15.00	2.39	97.61	98				
1.180	27.50	4.38	95.62	96				
0.600	50.00	7.96	92.04	92				
0.425	63.50	10.10	89.90	90				
0.300	75.50	12.01	87.99	88				
0.150	107.50	17.10	82.90	83				
0.075	138.00	21.96	78.04	78				
0 pan	490.50	78.04						
TOTAL (g)	628.50							



REMARKS: SAMPLED FROM TRIAL PIT 03 @ 1.000-3.500M. **SOLAR PV SITE INVESTIGATION**

PAGE No.

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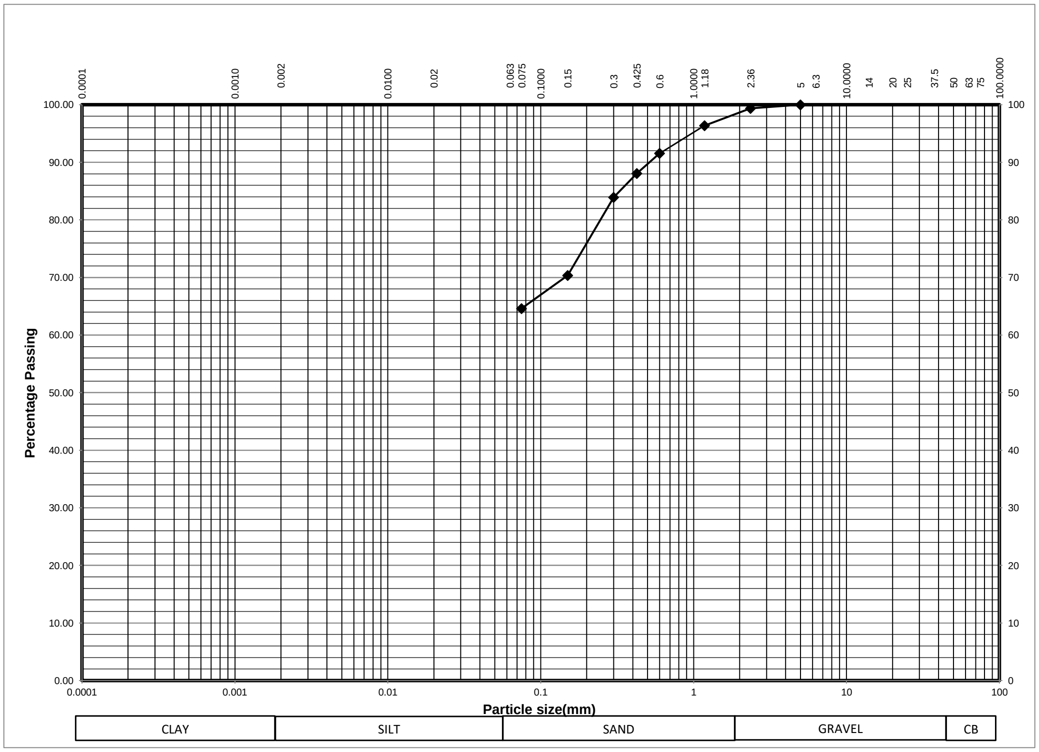
LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP03 / G008 / 30APR19		
SAMPLED BY: GEOCONSULT LAB TEAM		DATE: 30 / 04 / 2019	TIME: 09:01	
LOCATION:	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 672 315	8 403 152	(m)	3.500-4.200
TYPE OF MATERIAL: MOIST BROWN REDDISH SANDY SILTY CLAY LATERITE GRAVEL				
TESTED BY: C. NDALAMA		DATE: 03 - 06 - 2019	TIME: 10:43	
CHECKED BY: G. KACHIWALA		DATE: 04 - 06 - 2019	TIME: 13:30	
APPROVED BY: M. SABELLI		DATE: 04 - 06 - 2019	TIME: 15:00	

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

SIEVE ANALYSIS (GRADATION) STANDARD: TRH14:1985

SIEVE	MASS	PERCENTAGE			GRADATION SPECIFICATION			ZONE
(mm)	RETAINED	RETAINED	PASSING		BASE	SUBBASE	SL SEAL	
75.000								
50.000								
37.500								
28.000								
25.000								
20.000								
14.000								
12.500								
10.000								
6.300								
5.000	0.00	0.00	100.00	100				
2.360	4.50	0.61	99.39	99				
1.180	26.50	3.61	96.39	96				
0.600	62.00	8.45	91.55	92				
0.425	87.50	11.93	88.07	88				
0.300	118.00	16.09	83.91	84				
0.150	217.50	29.65	70.35	70				
0.075	259.50	35.38	64.62	65				
0 pan	474.00	64.62						
TOTAL (g)	733.50							



REMARKS: SAMPLED FROM TRIAL PIT 03 @ 3.500-4.200M. **SOLAR PV SITE INVESTIGATION**

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LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP03 / NMC008 / 30APRT19		
SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 30 - 04 - 2019	TIME: 07:31	
LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 672 315	8 403 152	(m)	0.200-1.000
TYPE OF MATERIAL: MOIST STIFF DARK GREY SANDY SILTY CLAY				
TESTED BY: C. NDALAMA		DATE: 05 - 05 - 2019	TIME: 09:38	
CHECKED BY: G. KACHIWALA		DATE: 06 - 05 - 2019	TIME: 09:46	
APPROVED BY: M. SABELLI		DATE: 06 - 05 - 2019	TIME: 10:00	

PROJECT: GOLOMOTI SOLAR PV

CLIENT: JCM

NATURAL MOISTURE CONTENT - OVEN DRYING METHOD STANDARD: ASTM D7263

MASS OF WET SOIL + CONTAINER (g)		339.0	
MASS OF DRY SOIL AND CONTAINER (g)		318.5	
CONTAINER No.		SDA	
MASS OF CONTAINER (g)		129.0	
MASS OF DRY SOIL (g)		189.5	
MASS OF WATER (g)		20.5	
MOISTURE CONTENT %		10.8	
AVERAGE MOISTURE CONTENT %		**10.8**	

REMARKS: SAMPLED FROM TRIAL PIT 03 @ 0.200-1.000M. **SOLAR PV SITE INVESTIGATION**

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LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP03 / NMC009 / 30APRT19		
SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 30 - 04 - 2019	TIME: 07:31	
LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 672 315	8 403 152	(m)	1.000-3.500
TYPE OF MATERIAL: MOIST TIFF LIGHT BROWN SANDY SILTY CLAY				
TESTED BY: C. NDALAMA		DATE: 05 - 05 - 2019	TIME: 09:38	
CHECKED BY: G. KACHIWALA		DATE: 06 - 05 - 2019	TIME: 09:46	
APPROVED BY: M. SABELLI		DATE: 06 - 05 - 2019	TIME: 10:00	

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

NATURAL MOISTURE CONTENT - OVEN DRYING METHOD STANDARD: ASTM D7263

MASS OF WET SOIL + CONTAINER (g)		293.0	
MASS OF DRY SOIL AND CONTAINER (g)		275.5	
CONTAINER No.		GC91	
MASS OF CONTAINER (g)		129.0	
MASS OF DRY SOIL (g)		146.5	
MASS OF WATER (g)		17.5	
MOISTURE CONTENT %		11.9	
AVERAGE MOISTURE CONTENT %		**11.9**	

REMARKS: SAMPLED FROM TRIAL PIT 03 @ 1.000-3.500M. **SOLAR PV SITE INVESTIGATION** **PAGE No.**

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LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP03 / NMC010 / 30APRT19		
SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 30 - 04 - 2019	TIME: 07:31	
LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 672 315	8 403 152	(m)	3.500-4.200
TYPE OF MATERIAL: MOIST BROWN REDDISH SANDY SILTY CLAY LATERITE GRAVEL				
TESTED BY: C. NDALAMA		DATE: 05 - 05 - 2019	TIME: 09:38	
CHECKED BY: G. KACHIWALA		DATE: 06 - 05 - 2019	TIME: 09:46	
APPROVED BY: M. SABELLI		DATE: 06 - 05 - 2019	TIME: 10:00	

PROJECT: GOLOMOTI SOLAR PV

CLIENT: JCM

NATURAL MOISTURE CONTENT - OVEN DRYING METHOD STANDARD: ASTM D7263

MASS OF WET SOIL + CONTAINER (g)		376.0	
MASS OF DRY SOIL AND CONTAINER (g)		346.0	
CONTAINER No.		GC2B	
MASS OF CONTAINER (g)		73.0	
MASS OF DRY SOIL (g)		273.0	
MASS OF WATER (g)		30.0	
MOISTURE CONTENT %		11.0	
AVERAGE MOISTURE CONTENT %		**11.0**	

REMARKS: SAMPLED FROM TRIAL PIT 03 @ 3.500-4.200M. **SOLAR PV SITE INVESTIGATION**

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LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP03 / AL008 / 27APR19		
SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 27 - 04 - 2019	TIME: 09:05	
LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 672 315	8 403 152	(m)	0.200-1.000
TYPE OF MATERIAL: MOIST STIFF DARK GREY SANDY SILTY CLAY				
TESTED BY: S. MATCHADO		DATE: 31 - 05 - 2019	TIME: 09:18	
CHECKED BY: G. KACHIWALA		DATE: 01 - 06 - 2019	TIME: 09:35	
APPROVED BY: M. SABELLI		DATE: 01 - 06 - 2019	TIME: 14:18	

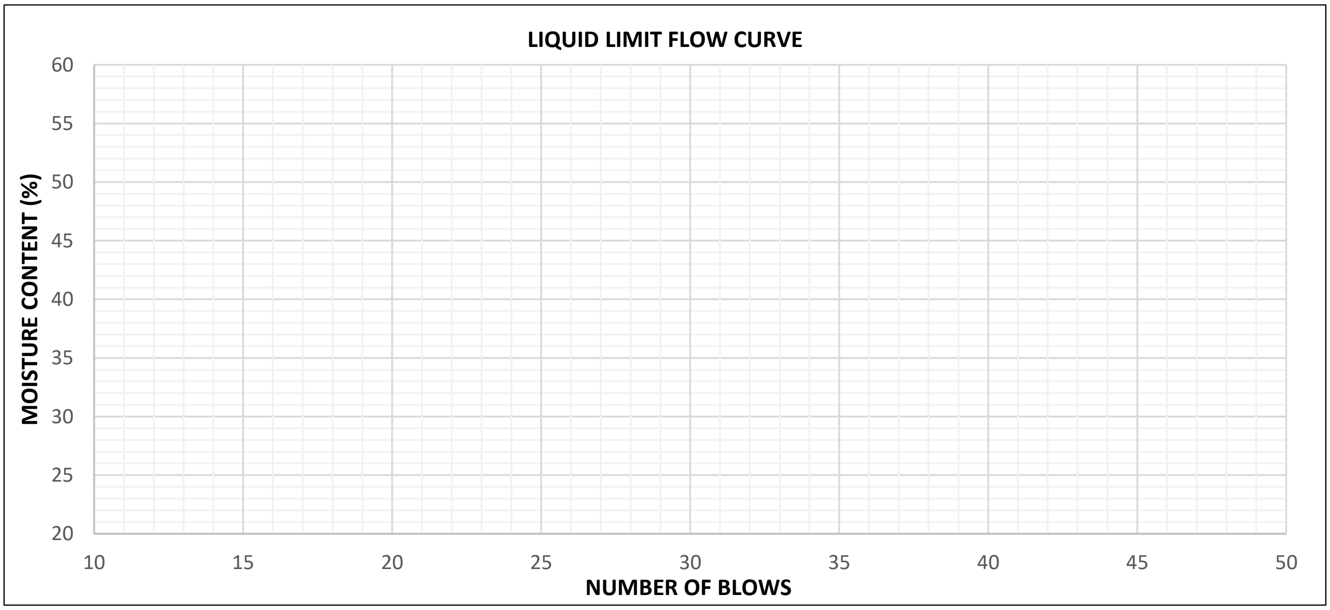
PROJECT: GOLOMOTI SOLAR PV

CLIENT: JCM

ATTERBURG LIMITS STANDARD: BS 1377, 2 (C)

TYPE OF TEST	**LIQUID LIMITS (LL)**				**PLASTIC LIMITS (PL)**		
TEST No.	1	2	3	4	1	2	3
CONTAINER No.	C24		R13		K2	R21	R14
MASS OF WET SOIL + CONTAINER(g)	59.0		56.0		44.0	44.0	44.0
MASS OF DRY SOIL + CONTAINER(g)	52.0		48.0		41.5	41.0	41.5
MASS OF CONTAINER (g)	32		31		28	25	28
MASS OF DRY SOIL (g)	20.0		17.0		13.5	16.0	13.5
MASS OF WATER (g)	7.00		8.00		2.50	3.00	2.50
MOISTURE CONTENT %	35.0	35.7	47.1	46.6	18.5	18.8	18.5
No. BLOWS	30		23			18.6	

LINEAR SHRINKAGE	1
INITIAL LENGTH OF SPECIMEN (cm)	14.0
LENGTH OF OVERN DRY SPECIMEN (cm)	12.5
LINEAR SHRINKAGE %	12.0
LIQUID LIMIT (LL) %	41.1
PLASTIC LIMIT (PL) %	18.6
PLASTICITY INDEX (PI)	**23**
NATURAL MOISTURE CONTENT %	10.8
FINENESS INDEX	1035



REMARKS: SAMPLED FROM TRIAL PIT 03 @ 0.200-1.000M. SOLAR PV SITE INVESTIGATION

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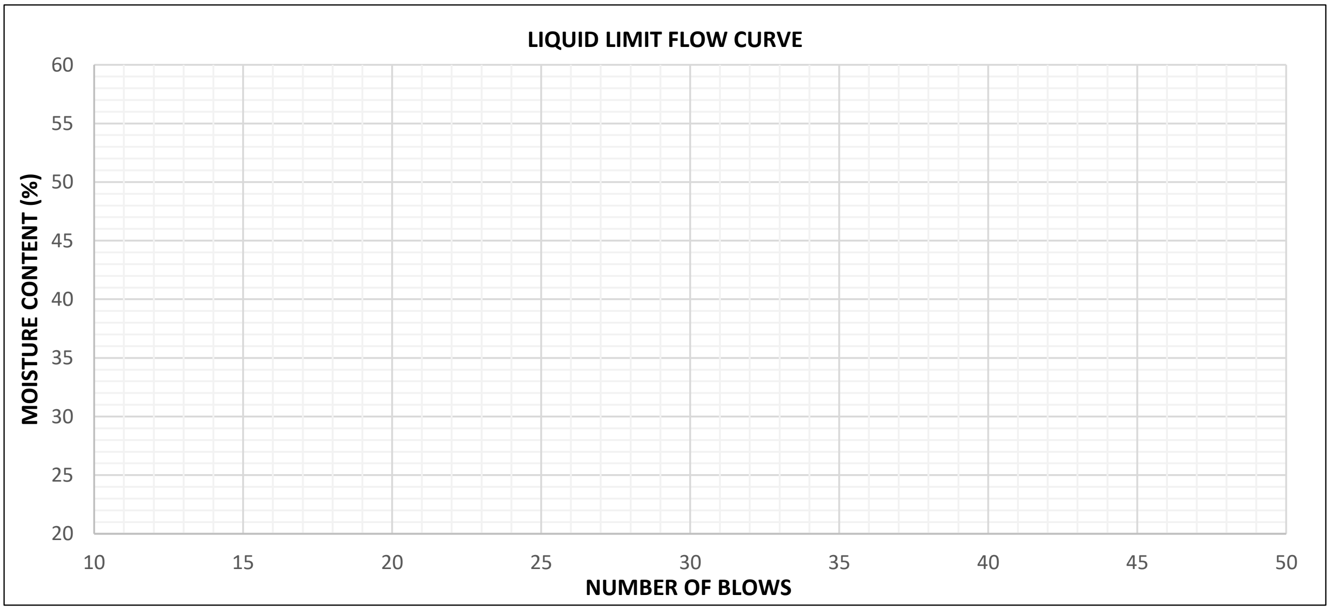
LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP03 / AL009 / 27APR19		
SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 27 - 04 - 2019	TIME: 09:05	
LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 672 315	8 403 152	(m)	1.000-3.500
TYPE OF MATERIAL: MOIST STIFF LIGHT BROWN SANDY SILTY CLAY				
TESTED BY: S. MATCHADO		DATE: 31 - 05 - 2019	TIME: 09:18	
CHECKED BY: S. THANGATO		DATE: 01 - 06 - 2019	TIME: 09:35	
APPROVED BY: M. SABELLI		DATE: 01 - 06 - 2019	TIME: 14:18	

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

ATTERBURG LIMITS STANDARD: BS 1377, 2 (C)

TYPE OF TEST	LIQUID LIMITS (LL)				PLASTIC LIMITS (PL)		
TEST No.	1	2	3	4	1	2	3
CONTAINER No.	R5		R7		R22	C21	R18
MASS OF WET SOIL + CONTAINER(g)	68.5		68.5		42.5	46.0	46.0
MASS OF DRY SOIL + CONTAINER(g)	56.0		55.0		39.0	41.5	41.5
MASS OF CONTAINER (g)	29		29.5		29.5	29	29
MASS OF DRY SOIL (g)	27.0		25.5		9.5	12.5	12.5
MASS OF WATER (g)	12.50		13.50		3.50	4.50	4.50
MOISTURE CONTENT %	46.3	47.2	52.9	50.8	36.8	36.0	36.0
No. BLOWS	30		16			36.3	

LINEAR SHRINKAGE	8
INITIAL LENGTH OF SPECIMEN (cm)	14.0
LENGTH OF OVERN DRY SPECIMEN (cm)	13.1
LINEAR SHRINKAGE %	6.9
LIQUID LIMIT (LL) %	49.0
PLASTIC LIMIT (PL) %	36.3
PLASTICITY INDEX (PI)	**13**
NATURAL MOISTURE CONTENT %	11.9
FINENESS INDEX	1014



REMARKS: SAMPLED FROM TRIAL PIT 03 @ 1.000-3.500M. SOLAR PV SITE INVESTIGATION

GEOCONSULT LIMITED P.O. BOX 40 LILONGWE	**Triaxial test - UU** **BS 1377 part 7, 1377 part 8**

Site :	GOLOMOTI SOALR PV	Levy date :	21-Jun-19
Technicien's name :		Date of test :	21-Jun-19
File N° :	21	Survey depth (m) :	1.000
Survey N° :	TRIAL PIT No. 03	Level of water (m) :	
Kind of soil :			MOIST TIFF LIGHT BROWN SANDY SILTY CLAY

Identification of samples :

σvo, Total stress of the soil in situ (kPa) :	0.000	Uo, Pore pressure of the soil in situ (kPa) :	0.000
Category of soil :	Soft/Granular	Kind of drainage :	Without lateral drain
ρs, Grain density (kg/m³) :	0.000		
Sm :	☐	Sd :	☐

Samples before test :

Samples after saturation :

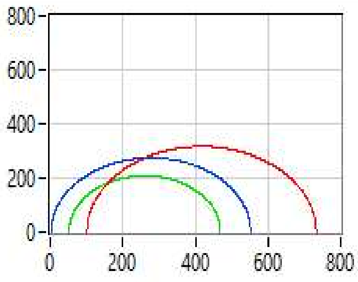
	N°	Hi (mm)	Di (mm)	mi (g)	ρi (kg/m³)	ρdi (kg/m³)	wi (%)	ei	Sri (%)	Ucp (kPa)	ΔVsat. (mm³)	B (%)
🟦	1	76.00	38	165.5	1920	1624	18.21	-1.000	-0.000		0.000	0.000
🟥	2	76.00	38	169.0	1961	1647	19.01	-1.000	-0.000		0.000	0.000
🟩	3	76.00	38	164.0	1903	1607	18.41	-1.000	-0.000		0.000	0.000

Samples after consolidation :

Samples after shearing

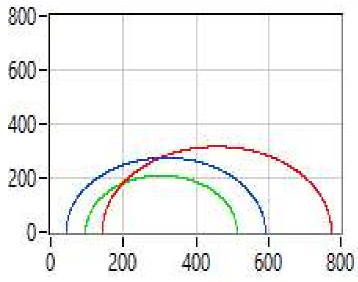
	N°	Hs (mm)	Ds (mm)	ΔVs (mm³)	T100 (min)	Vmax (µm/min)	σ'c (kPa)	Hf (mm)	Df (mm)	mf (g)	md (g)	wf (%)	ρdf (kg/m³)	ef	Srf (%)
🟦	1	76.00	38.00	0.000	0.000	0.000	0.000	76.00	38.00	166.0	140.0	18.57	1624	-1.000	-0.000
🟥	2	76.00	38.00	0.000	0.000	0.000	0.000	76.00	38.00	168.5	142.0	18.66	1647	-1.000	-0.000
🟩	3	76.00	38.00	0.000	0.000	0.000	0.000	76.00	38.00	164.5	138.5	18.77	1607	-1.000	-0.000

Total stress :



	Mohr
C (kPa)	NaN
φ (°)	NaN

Effective stress :



	Mohr	Lambe
C' (kPa)	NaN	75.90
φ' (°)	NaN	27.89

Comments :

Visa :

	Triaxial test - UU BS 1377 part 7, 1377 part 8			
	Site :	GOLOMOTI SOLAR PV	Levy date :	27-Jun-19
	Technicien's name :		Date of test :	27-Jun-19
GEOCONSULT LIMITED	File N° :	31	Survey depth (m) :	2.000
P.O. BOX 40 LILONGWE	Survey N° :	TRIAL PIT No. 03	Level of water (m) :	
	Kind of soil :			Moist Stiff Light Brown Sandy Silty CLAY

Identification of samples :

σvo, Total stress of the soil in situ (kPa) :	0.000	Uo, Pore pressure of the soil in situ (kPa) :	0.000
Category of soil :	Soft/Granular	Kind of drainage :	Without lateral drain
ρs, Grain density (kg/m³) :	0.000		
Sm :	☐	Sd :	☐

Samples before test :

	N°	Hi (mm)	Di (mm)	mi (g)	ρi (kg/m³)	ρdi (kg/m³)	wi (%)	ei	Sri (%)
🟦	1	76.00	38	166.5	1932	1555	24.25	-1.000	-0.000
🟥	2	76.00	38	166.5	1932	1543	25.19	-1.000	-0.000
🟩	3	76.00	38	167.0	1938	1555	24.63	-1.000	-0.000

Samples after saturation :

Ucp (kPa)	ΔVsat. (mm³)	B (%)
	0.000	0.000
	0.000	0.000
	0.000	0.000

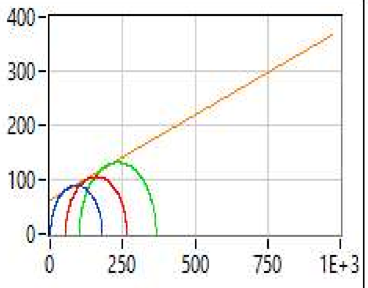
Samples after consolidation :

	N°	Hs (mm)	Ds (mm)	ΔVs (mm³)	T100 (min)	Vmax (µm/min)	σ'c (kPa)
🟦	1	76.00	38.00	0.000	0.000	0.000	0.000
🟥	2	76.00	38.00	0.000	0.000	0.000	0.000
🟩	3	76.00	38.00	0.000	0.000	0.000	0.000

Samples after shearing

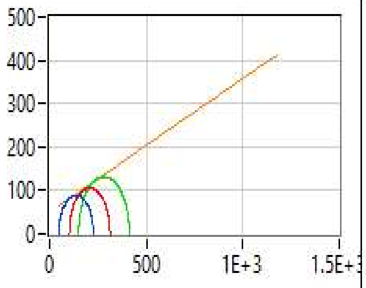
Hf (mm)	Df (mm)	mf (g)	md (g)	wf (%)	ρdf (kg/m³)	ef	Srf (%)
76.00	38.00	166.0	134.0	23.88	1555	-1.000	-0.000
76.00	38.00	167.0	133.0	25.56	1543	-1.000	-0.000
76.00	38.00	167.0	134.0	24.63	1555	-1.000	-0.000

Total stress :



	Mohr
C (kPa)	62.64
φ (°)	17.32

Effective stress :



	Mohr	Lambe
C' (kPa)	48.37	47.57
φ' (°)	17.18	16.46

Comments :

Visa :

p.1/3

3.7 Trial Pit 04

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LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP04 / AL013 / 27APR19		
SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 27 - 04 - 2019	TIME: 08:10	
LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 672 616	8 403 213	(m)	2.000-4.000
TYPE OF MATERIAL: MOIST BROWN REDDISH LATERITE GRAVELLY SANDY SILTY CLAY				
TESTED BY: M. MILANZI		DATE: 27 - 05 - 2019	TIME: 10:00	
CHECKED BY: S. THANGATO		DATE: 01 - 06 - 2019	TIME: 09:35	
APPROVED BY: M. SABELLI		DATE: 01 - 06 - 2019	TIME: 14:18	

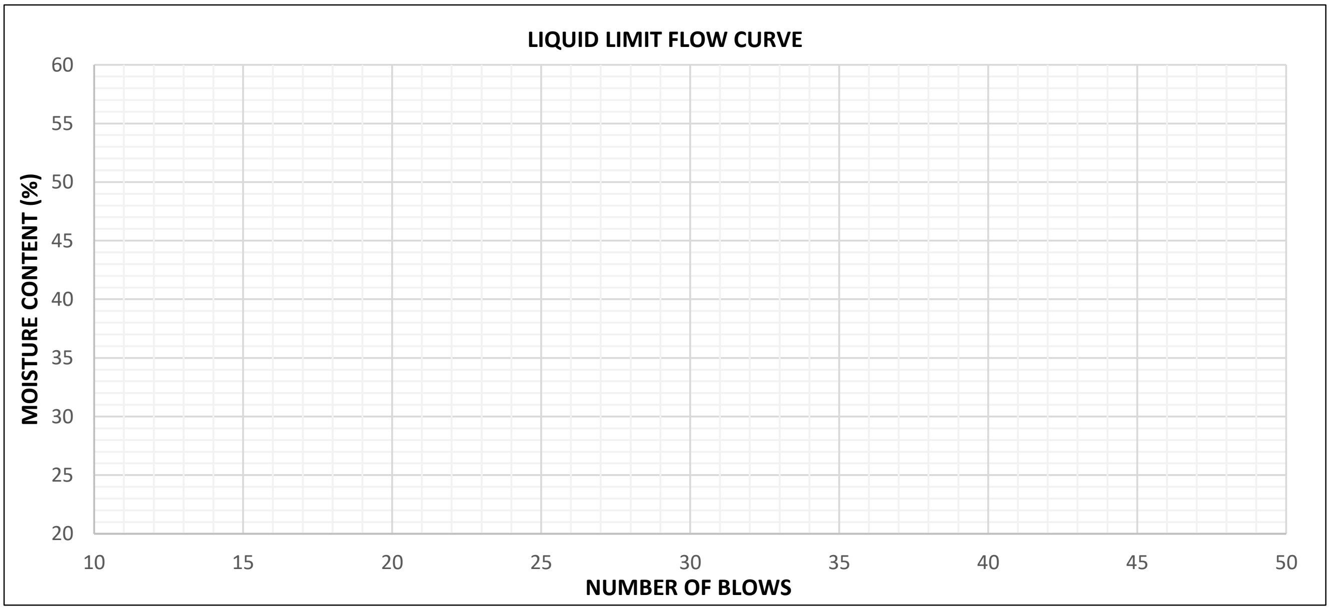
PROJECT: GOLOMOTI SOLAR PV

CLIENT: JCM

ATTERBURG LIMITS STANDARD: BS 1377, 2 (C)

TYPE OF TEST	**LIQUID LIMITS (LL)**				**PLASTIC LIMITS (PL)**		
TEST No.	1	2	3	4	1	2	3
CONTAINER No.	R20		R15		R22	C9	C32
MASS OF WET SOIL + CONTAINER(g)	47.0		52.0		37.0	39.0	36.5
MASS OF DRY SOIL + CONTAINER(g)	42.5		43.5		36.0	37.5	35.0
MASS OF CONTAINER (g)	28.5		22		29.5	28	25
MASS OF DRY SOIL (g)	14.0		21.5		6.5	9.5	10.0
MASS OF WATER (g)	4.50		8.50		1.00	1.50	1.50
MOISTURE CONTENT %	32.1	32.8	39.5	38.3	15.4	15.8	15.0
No. BLOWS	30		19			15.4	

LINEAR SHRINKAGE	1
INITIAL LENGTH OF SPECIMEN (cm)	14.0
LENGTH OF OVERN DRY SPECIMEN (cm)	12.8
LINEAR SHRINKAGE %	9.4
LIQUID LIMIT (LL) %	35.6
PLASTIC LIMIT (PL) %	15.4
PLASTICITY INDEX (PI)	**20**
NATURAL MOISTURE CONTENT %	8.0
FINENESS INDEX	1380



REMARKS: SAMPLED FROM TRIAL PIT 04 @ 2.000-4.000M. SOLAR PV SITE INVESTIGATION

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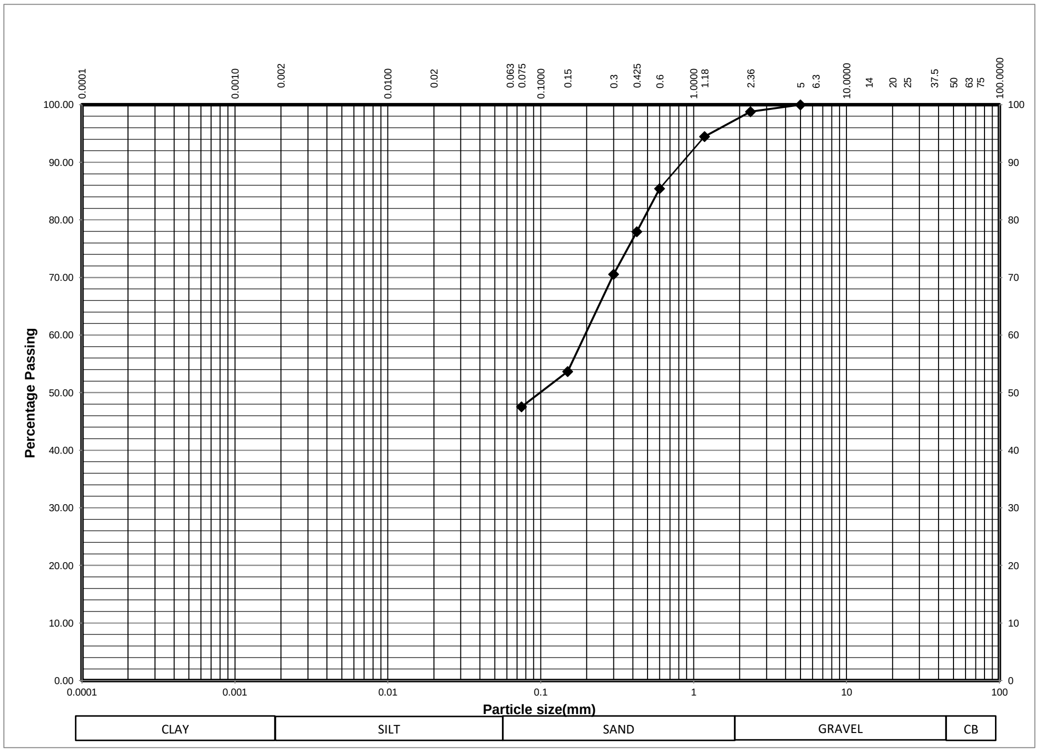
LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP04 / G011 / 27APR19		
SAMPLED BY: GEOCONSULT LAB TEAM		DATE: 30 / 04 / 2019	TIME: 12:26	
LOCATION:	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 672 616	8 403 213	(m)	0.250-1.000
TYPE OF MATERIAL: MOIST LIGHT BROWN SANDY SILTY CLAY				
TESTED BY: C. NDALAMA		DATE: 06 - 06 - 2019	TIME: 11:17	
CHECKED BY: G. KACHIWALA		DATE: 04 - 06 - 2019	TIME: 13:30	
APPROVED BY: M. SABELLI		DATE: 04 - 06 - 2019	TIME: 15:00	

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

SIEVE ANALYSIS (GRADATION) STANDARD: TRH14:1985

SIEVE	MASS	PERCENTAGE			GRADATION SPECIFICATION			ZONE
(mm)	RETAINED	RETAINED	PASSING		BASE	SUBBASE	SL SEAL	
75.000								
50.000								
37.500								
28.000								
25.000								
20.000								
14.000								
12.500								
10.000								
6.300								
5.000	0.00	0.00	100.00	100				
2.360	8.00	1.21	98.79	99				
1.180	36.50	5.51	94.49	94				
0.600	96.50	14.57	85.43	85				
0.425	146.00	22.04	77.96	78				
0.300	195.00	29.43	70.57	71				
0.150	307.00	46.34	53.66	54				
0.075	347.50	52.45	47.55	48				
0 pan	315.00	47.55						
TOTAL (g)	662.50							



REMARKS: SAMPLED FROM TRIAL PIT 04 @ 0.250-1.000M. **SOLAR PV SITE INVESTIGATION** **PAGE No.**

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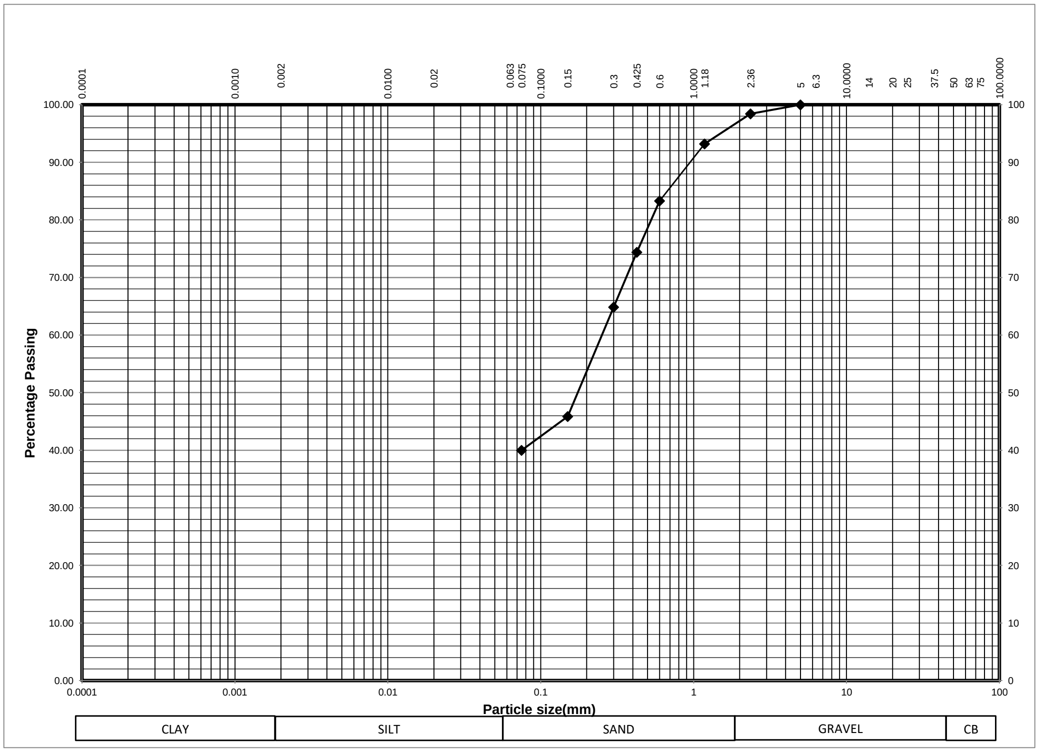
LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP04 / G012 / 30APR19		
SAMPLED BY: GEOCONSULT LAB TEAM		DATE: 30 / 04 / 2019	TIME: 10:58	
LOCATION:	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 672 616	8 403 213	(m)	1.000-2.000
TYPE OF MATERIAL: MOIST BROWNISH GREY SANDY SILTY CLAY				
TESTED BY: C. NDALAMA		DATE: 03 - 06 - 2019	TIME: 10:43	
CHECKED BY: G. KACHIWALA		DATE: 04 - 06 - 2019	TIME: 13:30	
APPROVED BY: M. SABELLI		DATE: 04 - 06 - 2019	TIME: 15:00	

PROJECT: GOLOMOTI SOLAR PV

CLIENT: JCM

SIEVE ANALYSIS (GRADATION) STANDARD: TRH14:1985

SIEVE (mm)	MASS RETAINED	PERCENTAGE RETAINED	PASSING		GRADATION SPECIFICATION BASE	SUBBASE	SL SEAL	ZONE
75.000								
50.000								
37.500								
28.000								
25.000								
20.000								
14.000								
12.500								
10.000								
6.300								
5.000	0.00	0.00	100.00	100				
2.360	12.50	1.57	98.43	98				
1.180	54.00	6.80	93.20	93				
0.600	132.50	16.69	83.31	83				
0.425	203.50	25.63	74.37	74				
0.300	279.00	35.14	64.86	65				
0.150	430.00	54.16	45.84	46				
0.075	476.50	60.01	39.99	40				
0 pan	317.50	39.99						
TOTAL (g)	794.00							



REMARKS: SAMPLED FROM TRIAL PIT 04 @ 1.000-2.000M. **SOLAR PV SITE INVESTIGATION**

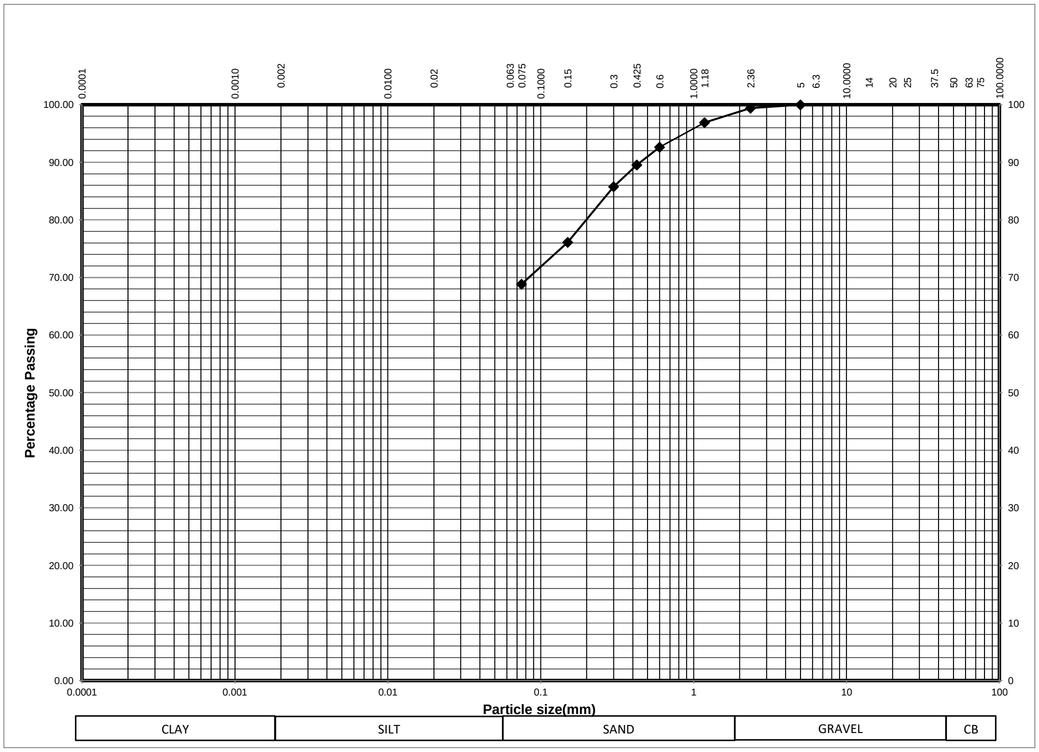
PAGE No.

	LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP04 / G013 / 30APR19		
	SAMPLED BY: GEOCONSULT LAB TEAM		DATE: 30 / 04 / 2019	TIME: 10:58	
	LOCATION:	EASTING	NORTHING	ELEVATION	DEPTH (m)
	GOLOMOTI - SOLAR PV	0 672 616	8 403 213	(m)	2.000-4.000
	TYPE OF MATERIAL: MOIST BROWN REDDISH LATERITE GRAVELLY SANDY SILTY CLAY				
	TESTED BY: C. NDALAMA		DATE: 03 - 06 - 2019	TIME: 10:43	
+265 0888 846 543	CHECKED BY: G. KACHIWALA		DATE: 04 - 06 - 2019	TIME: 13:30	
sabelli@geoconsult.cc	APPROVED BY: M. SABELLI		DATE: 04 - 06 - 2019	TIME: 15:00	

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

SIEVE ANALYSIS (GRADATION) STANDARD: TRH14:1985

SIEVE	MASS	PERCENTAGE			GRADATION SPECIFICATION			ZONE
(mm)	RETAINED	RETAINED	PASSING		BASE	SUBBASE	SL SEAL	
75.000								
50.000								
37.500								
28.000								
25.000								
20.000								
14.000								
12.500								
10.000								
6.300								
5.000	0.00	0.00	100.00	100				
2.360	2.50	0.57	99.43	99				
1.180	13.50	3.10	96.90	97				
0.600	32.00	7.36	92.64	93				
0.425	45.50	10.46	89.54	90				
0.300	62.00	14.25	85.75	86				
0.150	104.00	23.91	76.09	76				
0.075	135.50	31.15	68.85	69				
0 pan	299.50	68.85						
TOTAL (g)	435.00							



REMARKS: SAMPLED FROM TRIAL PIT 04 @ 2.000-4.000M. **SOLAR PV SITE INVESTIGATION** **PAGE No.**

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LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP04 / NMC011 / 27APR19		
SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 27 - 04 - 2019	TIME: 02:26	
LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 672 616	8 403 213	(m)	0.250-1.000
TYPE OF MATERIAL: MOIST LIGHT BROWN SANDY SILTY CLAY				
TESTED BY: C. NDALAMA		DATE: 05 - 05 - 2019	TIME: 09:38	
CHECKED BY: G. KACHIWALA		DATE: 06 - 05 - 2019	TIME: 09:46	
APPROVED BY: M. SABELLI		DATE: 06 - 05 - 2019	TIME: 10:00	

PROJECT: GOLOMOTI SOLAR PV

CLIENT: JCM

NATURAL MOISTURE CONTENT - OVEN DRYING METHOD STANDARD: ASTM D7263

MASS OF WET SOIL + CONTAINER (g)		304.5	
MASS OF DRY SOIL AND CONTAINER (g)		285.0	
CONTAINER No.		GC100	
MASS OF CONTAINER (g)		91.5	
MASS OF DRY SOIL (g)		193.5	
MASS OF WATER (g)		19.5	
MOISTURE CONTENT %		10.1	
AVERAGE MOISTURE CONTENT %		**10.1**	

REMARKS: SAMPLED FROM TRIAL PIT 04 @ 0.250-1.000M. **SOLAR PV SITE INVESTIGATION**

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LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP04 / NMC012 / 27APR19		
SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 27 - 04 - 2019	TIME: 12:52	
LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 672 616	8 403 213	(m)	1.000-2.000
TYPE OF MATERIAL: MOIST BROWNISH GREY SANDY SILTY CLAY				
TESTED BY: C. NDALAMA		DATE: 05 - 05 - 2019	TIME: 09:38	
CHECKED BY: G. KACHIWALA		DATE: 06 - 05 - 2019	TIME: 09:46	
APPROVED BY: M. SABELLI		DATE: 06 - 05 - 2019	TIME: 10:00	

PROJECT: GOLOMOTI SOLAR PV

CLIENT: JCM

NATURAL MOISTURE CONTENT - OVEN DRYING METHOD STANDARD: ASTM D7263

MASS OF WET SOIL + CONTAINER (g)		392.5	
MASS OF DRY SOIL AND CONTAINER (g)		355.0	
CONTAINER No.		GCB2	
MASS OF CONTAINER (g)		96.0	
MASS OF DRY SOIL (g)		259.0	
MASS OF WATER (g)		37.5	
MOISTURE CONTENT %		14.5	
AVERAGE MOISTURE CONTENT %		**14.5**	

REMARKS: SAMPLED FROM TRIAL PIT 04 @ 1.000-2.000M. **SOLAR PV SITE INVESTIGATION**

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LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP04 / NMC013 / 27APR19		
SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 27 - 04 - 2019	TIME: 10:58	
LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 672 616	8 403 213	(m)	3.000-4.000
TYPE OF MATERIAL: MOIST BROWN REDDISH LATERITE GRAVELLY SANDY SILTY CLAY				
TESTED BY: C. NDALAMA		DATE: 05 - 05 - 2019	TIME: 09:38	
CHECKED BY: G. KACHIWALA		DATE: 06 - 05 - 2019	TIME: 09:46	
APPROVED BY: M. SABELLI		DATE: 06 - 05 - 2019	TIME: 10:00	

PROJECT: GOLOMOTI SOLAR PV

CLIENT: JCM

NATURAL MOISTURE CONTENT - OVEN DRYING METHOD   STANDARD: ASTM D7263

MASS OF WET SOIL + CONTAINER (g)		314.0	
MASS OF DRY SOIL AND CONTAINER (g)		300.0	
CONTAINER No.		NCIC	
MASS OF CONTAINER (g)		125.0	
MASS OF DRY SOIL (g)		175.0	
MASS OF WATER (g)		14.0	
MOISTURE CONTENT %		8.0	
AVERAGE MOISTURE CONTENT %		**8.0**	

REMARKS: SAMPLED FROM TRIAL PIT 04 @ 2.000-4.000M. **SOLAR PV SITE INVESTIGATION**

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LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP04 / AL011 / 27APR19		
SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 27 - 04 - 2019	TIME:12:26	
LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 672 616	8 403 213	(m)	0.250-1.000
TYPE OF MATERIAL: MOIST LIGHT BROWN SANDY SILTY CLAY				
TESTED BY: M. MILANZI		DATE: 08 - 06 - 2019	TIME: 10:00	
CHECKED BY: S. THANGATO		DATE: 10 - 06 - 2019	TIME: 09:35	
APPROVED BY: M. SABELLI		DATE: 10 - 06 - 2019	TIME: 14:18	

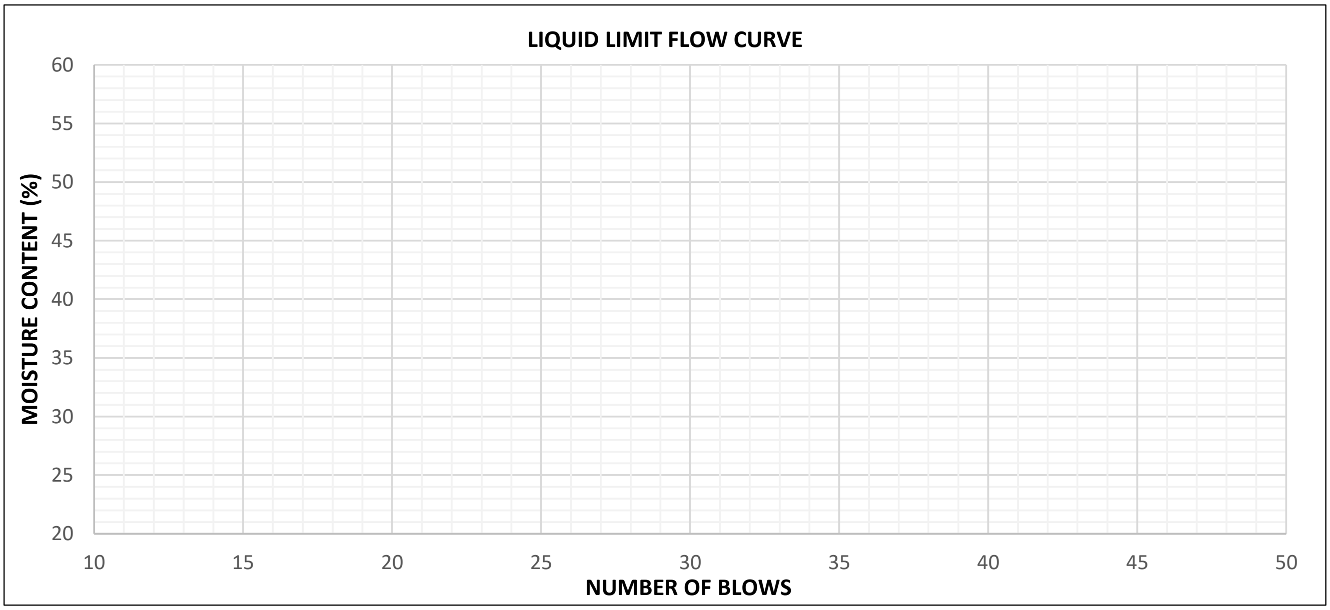
PROJECT: GOLOMOTI SOLAR PV

CLIENT: JCM

ATTERBURG LIMITS STANDARD: BS 1377, 2 (C)

TYPE OF TEST	LIQUID LIMITS (LL)				PLASTIC LIMITS (PL)		
TEST No.	1	2	3	4	1	2	3
CONTAINER No.	R14		C16		C29	C4	C5
MASS OF WET SOIL + CONTAINER(g)	47.0		51.5		42.5	35.5	36.5
MASS OF DRY SOIL + CONTAINER(g)	42.0		44.5		39.0	33.5	34.5
MASS OF CONTAINER (g)	27		27		24	25	26
MASS OF DRY SOIL (g)	15.0		17.5		15.0	8.5	8.5
MASS OF WATER (g)	5.00		7.00		3.50	2.00	2.00
MOISTURE CONTENT %	33.3	34.0	40.0	38.8	23.3	23.5	23.5
No. BLOWS	31		18			23.5	

LINEAR SHRINKAGE	16
INITIAL LENGTH OF SPECIMEN (cm)	14.0
LENGTH OF OVERN DRY SPECIMEN (cm)	13.2
LINEAR SHRINKAGE %	6.1
LIQUID LIMIT (LL) %	36.4
PLASTIC LIMIT (PL) %	23.5
PLASTICITY INDEX (PI)	**13**
NATURAL MOISTURE CONTENT %	10.1
FINENESS INDEX	624



REMARKS: SAMPLED FROM TRIAL PIT 04 @ 0.250-1.000M. SOLAR PV SITE INVESTIGATION

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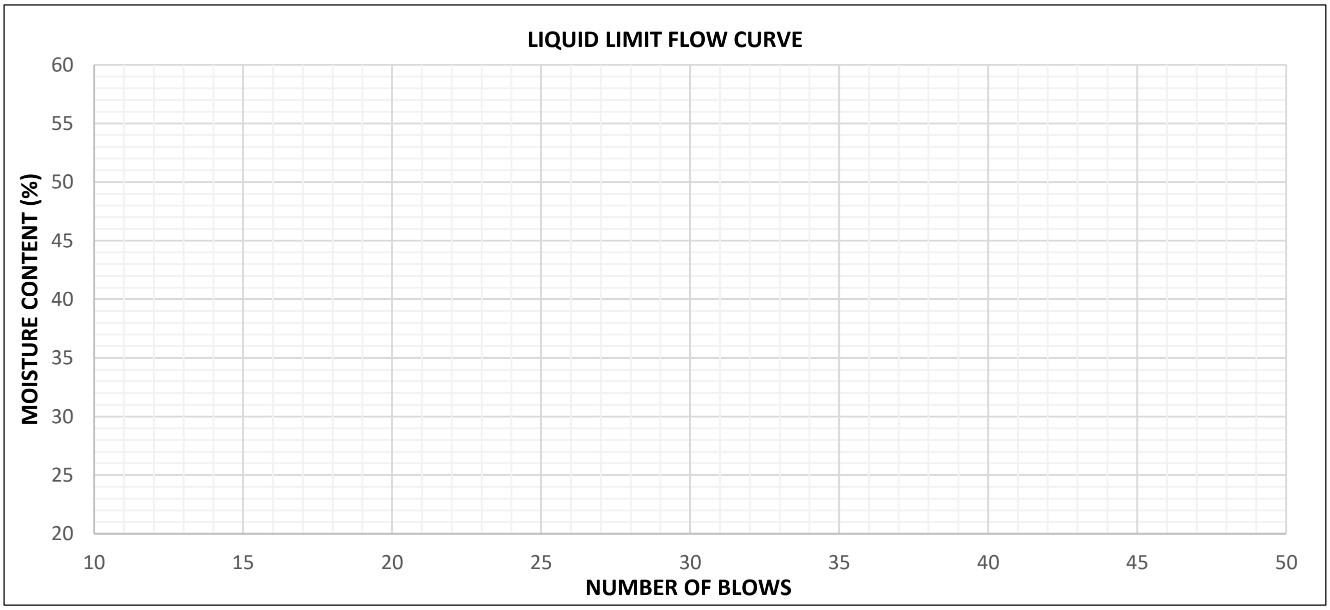
LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP04 / AL012 / 30APR19		
SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 30 - 04 - 2019	TIME: 08:10	
LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 672 616	8 403 213	(m)	1.000-2.000
TYPE OF MATERIAL: MOIST BROWNISH GREY SANDY SILTY CLAY				
TESTED BY: M. MILANZI		DATE: 27 - 05 - 2019	TIME: 10:00	
CHECKED BY: G. KACHIWALA		DATE: 01 - 06 - 2019	TIME: 09:35	
APPROVED BY: M. SABELLI		DATE: 01 - 06 - 2019	TIME: 14:18	

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

ATTERBURG LIMITS STANDARD: BS 1377, 2 (C)

TYPE OF TEST	LIQUID LIMITS (LL)				PLASTIC LIMITS (PL)		
TEST No.	1	2	3	4	1	2	3
CONTAINER No.	R16		C4		RAI	R21	R18
MASS OF WET SOIL + CONTAINER(g)	62.5		69.0		37.5	37.0	39.5
MASS OF DRY SOIL + CONTAINER(g)	51.5		54.5		35.5	35.5	37.5
MASS OF CONTAINER (g)	28.5		25.5		27	29	29
MASS OF DRY SOIL (g)	23.0		29.0		8.5	6.5	8.5
MASS OF WATER (g)	11.00		14.50		2.00	1.50	2.00
MOISTURE CONTENT %	47.8	48.8	50.0	48.5	23.5	23.1	23.5
No. BLOWS	31		19			23.4	

LINEAR SHRINKAGE	14
INITIAL LENGTH OF SPECIMEN (cm)	14.0
LENGTH OF OVERN DRY SPECIMEN (cm)	12.4
LINEAR SHRINKAGE %	12.9
LIQUID LIMIT (LL) %	48.6
PLASTIC LIMIT (PL) %	23.4
PLASTICITY INDEX (PI)	**25**
NATURAL MOISTURE CONTENT %	14.5
FINENESS INDEX	1000



REMARKS: SAMPLED FROM TRIAL PIT 04 @ 1.000-2.000M. SOLAR PV SITE INVESTIGATION

Triaxial test - UU
BS 1377 part 7, 1377 part 8

GEOCONSULT LIMITED

P.O. BOX 40 LILONGWE

Site :	GOLOMOTI SOLAR PV	Levy date :	13-Jun-19
Technicien's name :		Date of test :	13-Jun-19
File N° :	10	Survey depth (m) :	1.000
Survey N° :	TRIAL PIT No. 4	Level of water (m) :	
Kind of soil :	MOIST LIGHT BROWN SANDY SILTY CLAY		

Identification of samples :

σvo, Total stress of the soil in situ (kPa) : 0.000

Uo, Pore pressure of the soil in situ (kPa) : 0.000

Category of soil : Steep/Strongly overconsolidated

Kind of drainage : Without lateral drain

ρs, Grain density (kg/m³) : 0.000

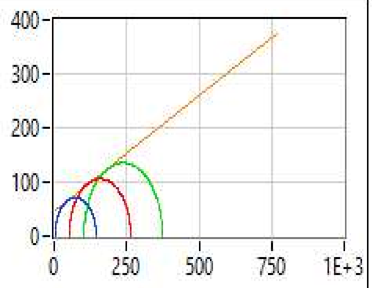
Sm : ☐

Sd : ☐

	Samples before test :									Samples after saturation :		
	N°	Hi (mm)	Di (mm)	mi (g)	ρi (kg/m³)	ρdi (kg/m³)	wi (%)	ei	Sri (%)	Ucp (kPa)	ΔVsat. (mm³)	B (%)
🟦	1	76.00	38	152.5	1769	1456	21.51	-1.000	-0.000		0.000	0.000
🟥	2	76.00	38	153.5	1781	1526	16.73	-1.000	-0.000		0.000	0.000
🟩	3	76.00	38	161.0	1868	1531	21.97	-1.000	-0.000		0.000	0.000

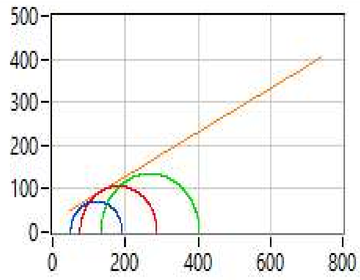
	Samples after consolidation :							Samples after shearing								
	N°	Hs (mm)	Ds (mm)	ΔVs (mm³)	T100 (min)	Vmax (µm/min)	σ'c (kPa)	Hf (mm)	Df (mm)	mf (g)	md (g)	wf (%)	ρdf (kg/m³)	ef	Srf (%)
🟦	1	76.00	38.00	0.000	0.000	0.000	0.000	76.00	38.00	152.5	125.5	21.51	1456	-1.000	-0.000
🟥	2	76.00	38.00	0.000	0.000	0.000	0.000	76.00	38.00	153.0	131.5	16.35	1526	-1.000	-0.000
🟩	3	76.00	38.00	0.000	0.000	0.000	0.000	76.00	38.00	160.0	132.0	21.21	1531	-1.000	-0.000

Total stress :



	Mohr
C (kPa)	47.11
φ (°)	23.11

Effective stress :



	Mohr	Lambe
C' (kPa)	23.84	22.94
φ' (°)	27.18	23.19

Comments :

Visa :

p.1/3

	Triaxial test - UU **BS 1377 part 7, 1377 part 8**			
	Site :	GOLOMOTI SOLAR PV	Levy date :	29-Jun-19
	Technicien's name :		Date of test :	29-Jun-19
GEOCONSULT LIMITED	File N° :	38	Survey depth (m) :	2.000
P.O. BOX 40 LILONGWE	Survey N° :	TRIAL PIT No. 04	Level of water (m) :	
	Kind of soil :	Moist Brown Reddish LateriteGravelley Sandy Silty CLAY		

Identification of samples :

σvo, Total stress of the soil in situ (kPa) : 0.000

Uo, Pore pressure of the soil in situ (kPa) : 0.000

Category of soil : Soft/Granular

Kind of drainage : Without lateral drain

ρs, Grain density (kg/m^3) : 0.000

Sm : ☐

Sd : ☐

Samples before test :

	N°	Hi (mm)	Di (mm)	mi (g)	ρi (kg/m^3)	ρdi (kg/m^3)	wi (%)	ei	Sri (%)
🟦	1	76.00	38	163.0	1891	1543	22.56	-1.000	-0.000
🟥	2	76.00	38	165.0	1914	1566	22.22	-1.000	-0.000
🟩	3	76.00	38	163.5	1897	1560	21.56	-1.000	-0.000

Samples after saturation :

Ucp (kPa)	ΔVsat. (mm^3)	B (%)
	0.000	0.000
	0.000	0.000
	0.000	0.000

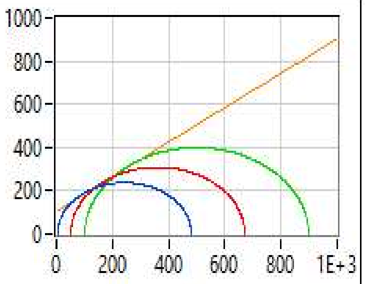
Samples after consolidation :

	N°	Hs (mm)	Ds (mm)	ΔVs (mm^3)	T100 (min)	Vmax (µm/min)	σ'c (kPa)
🟦	1	76.00	38.00	0.000	0.000	0.000	0.000
🟥	2	76.00	38.00	0.000	0.000	0.000	0.000
🟩	3	76.00	38.00	0.000	0.000	0.000	0.000

Samples after shearing

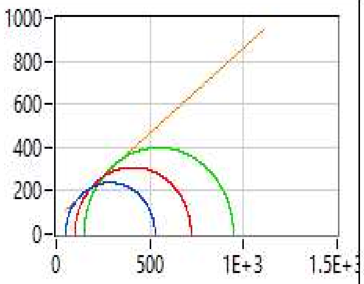
Hf (mm)	Df (mm)	mf (g)	md (g)	wf (%)	ρdf (kg/m^3)	ef	Srf (%)
76.00	38.00	161.0	133.0	21.05	1543	-1.000	-0.000
76.00	38.00	163.5	135.0	21.11	1566	-1.000	-0.000
76.00	38.00	162.0	134.5	20.45	1560	-1.000	-0.000

Total stress :



	Mohr
C (kPa)	110.5
φ (°)	38.36

Effective stress :



	Mohr	Lambe
C' (kPa)	74.24	59.02
φ' (°)	38.17	31.76

Comments :

Visa :

p.1/3

3.8 Trial Pit 05

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LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP05 / AL016 / 30APR19			
SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 30 - 04 - 2019	TIME: 10:58		
LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)	
GOLOMOTI - SOLAR PV	0 672 768	8 403 213	(m)	3.000-4.000	
TYPE OF MATERIAL: MOIST STIFF REDDISH BROWN LATERITE GRAVELLY SANDY SILTY CLAY					
TESTED BY: M. MILANZI		DATE: 08 - 06 - 2019	TIME: 10:00		
CHECKED BY: S. THANGATO		DATE: 10 - 06 - 2019	TIME: 09:35		
APPROVED BY: M. SABELLI		DATE: 10 - 06 - 2019	TIME: 14:18		

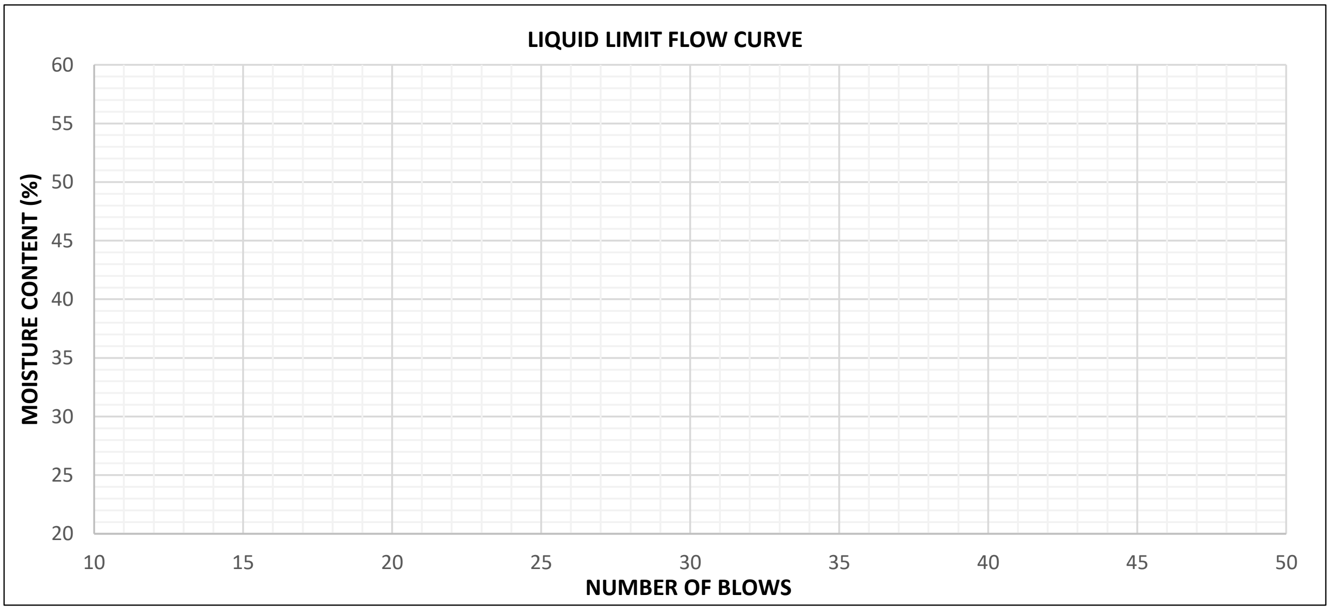
PROJECT: GOLOMOTI SOLAR PV

CLIENT: JCM

ATTERBURG LIMITS STANDARD: BS 1377, 2 (C)

TYPE OF TEST	**LIQUID LIMITS (LL)**				**PLASTIC LIMITS (PL)**		
TEST No.	1	2	3	4	1	2	3
CONTAINER No.	R3		R75		RA1	R19	C3
MASS OF WET SOIL + CONTAINER(g)	59.0		63.0		44.5	44.5	39.0
MASS OF DRY SOIL + CONTAINER(g)	51.0		54.5		41.5	42.5	36.0
MASS OF CONTAINER (g)	30		34		27.5	33	22
MASS OF DRY SOIL (g)	21.0		20.5		14.0	9.5	14.0
MASS OF WATER (g)	8.00		8.50		3.00	2.00	3.00
MOISTURE CONTENT %	38.1	38.9	41.5	41.0	21.4	21.1	21.4
No. BLOWS	32		24			21.3	

LINEAR SHRINKAGE	3
INITIAL LENGTH OF SPECIMEN (cm)	14.0
LENGTH OF OVERN DRY SPECIMEN (cm)	12.5
LINEAR SHRINKAGE %	12.0
LIQUID LIMIT (LL) %	40.0
PLASTIC LIMIT (PL) %	21.3
PLASTICITY INDEX (PI)	**19**
NATURAL MOISTURE CONTENT %	14.5
FINENESS INDEX	1197



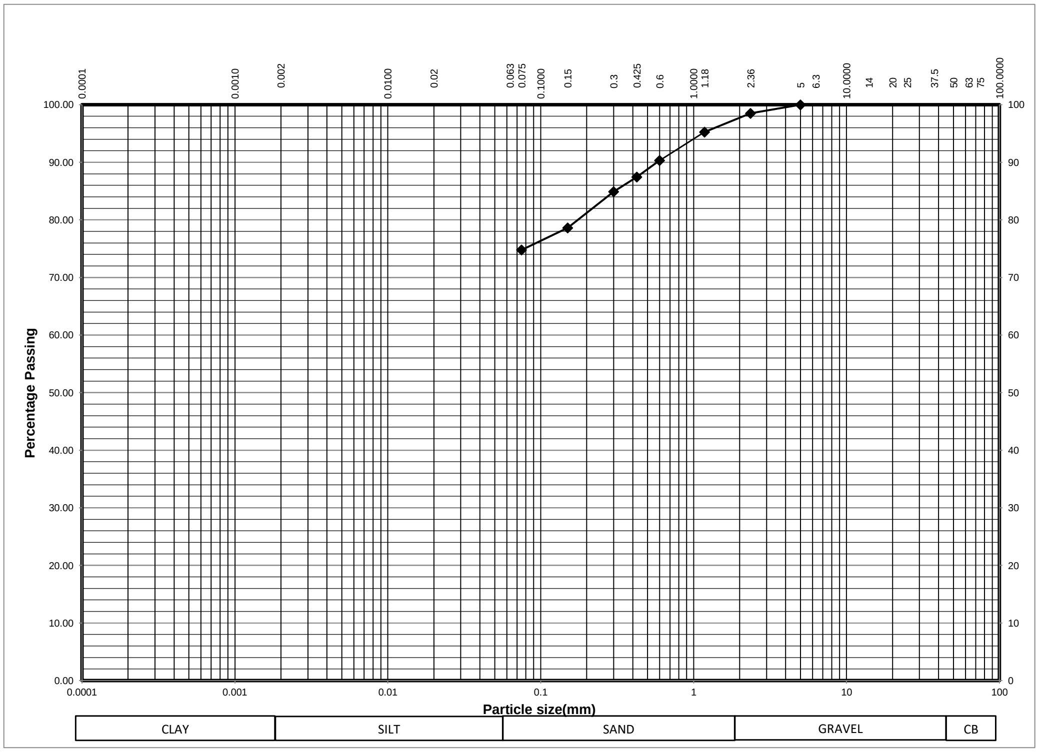
REMARKS: SAMPLED FROM TRIAL PIT 05 @ 3.000-4.000M. SOLAR PV SITE INVESTIGATION

GEOCONSULT	LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP05 / G014 / 30APR19		
	SAMPLED BY: GEOCONSULT LAB TEAM		DATE: 30 / 04 / 2019	TIME: 10:58	
	LOCATION:	EASTING	NORTHING	ELEVATION	DEPTH (m)
	GOLOMOTI - SOLAR PV	0 672 768	8 403 213	(m)	0.100-1.500
	TYPE OF MATERIAL: MOIST LIGHT BROWN SANDY SILTY CLAY				
	TESTED BY: C. NDALAMA		DATE: 03 - 06 - 2019	TIME: 10:43	
+265 0888 846 543	CHECKED BY: G. KACHIWALA		DATE: 04 - 06 - 2019	TIME: 13:30	
sabelli@geoconsult.cc	APPROVED BY: M. SABELLI		DATE: 04 - 06 - 2019	TIME: 15:00	

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

SIEVE ANALYSIS (GRADATION) STANDARD: TRH14:1985

SIEVE	MASS	PERCENTAGE			GRADATION SPECIFICATION			ZONE
(mm)	RETAINED	RETAINED	PASSING		BASE	SUBBASE	SL SEAL	
75.000								
50.000								
37.500								
28.000								
25.000								
20.000								
14.000								
12.500								
10.000								
6.300								
5.000	0.00	0.00	100.00	100				
2.360	10.00	1.50	98.50	98				
1.180	31.50	4.73	95.27	95				
0.600	64.50	9.68	90.32	90				
0.425	83.50	12.54	87.46	87				
0.300	100.50	15.09	84.91	85				
0.150	142.50	21.40	78.60	79				
0.075	168.00	25.23	74.77	75				
0 pan	498.00	74.77						
TOTAL (g)	666.00							



REMARKS: SAMPLED FROM TRIAL PIT 05 @ 0.100-1.500M. **SOLAR PV SITE INVESTIGATION** **PAGE No.**

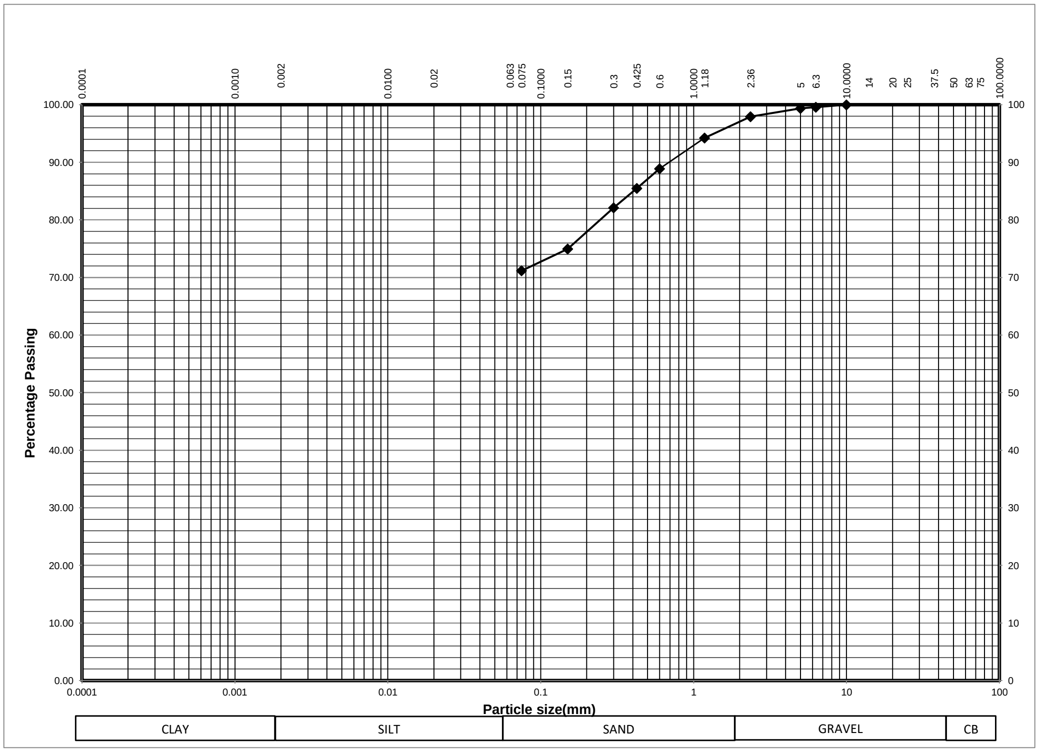
GEOCONSULT	LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP05 / G015 / 30APR19		
	SAMPLED BY: GEOCONSULT LAB TEAM		DATE: 30 / 04 / 2019	TIME: 10:58	
	LOCATION:	EASTING	NORTHING	ELEVATION	DEPTH (m)
	GOLOMOTI - SOLAR PV	0 672 768	8 403 213	(m)	1.500-3.000
	TYPE OF MATERIAL: MOIST BROWN REDDISH GRAVELLY SANDY SILTY CLAY				
	TESTED BY: C. NDALAMA		DATE: 03 - 06 - 2019	TIME: 10:43	
+265 0888 846 543	CHECKED BY: G. KACHIWALA		DATE: 04 - 06 - 2019	TIME: 13:30	
sabelli@geoconsult.cc	APPROVED BY: M. SABELLI		DATE: 04 - 06 - 2019	TIME: 15:00	

PROJECT: GOLOMOTI SOLAR PV

CLIENT: JCM

SIEVE ANALYSIS (GRADATION) STANDARD: TRH14:1985

SIEVE	MASS	PERCENTAGE			GRADATION SPECIFICATION			ZONE
(mm)	RETAINED	RETAINED	PASSING		BASE	SUBBASE	SL SEAL	
75.000								
50.000								
37.500								
28.000								
25.000								
20.000								
14.000								
12.500								
10.000	0.00	0.00	100.00	100				
6.300	4.50	0.43	99.57	100				
5.000	6.50	0.62	99.38	99				
2.360	21.50	2.07	97.93	98				
1.180	60.00	5.77	94.23	94				
0.600	115.50	11.10	88.90	89				
0.425	151.00	14.51	85.49	85				
0.300	186.00	17.88	82.12	82				
0.150	260.50	25.04	74.96	75				
0.075	300.00	28.83	71.17	71				
0 pan	740.50	71.17						
TOTAL (g)	1040.50							



REMARKS: SAMPLED FROM TRIAL PIT 05 @ 1.500-3.000M. **SOLAR PV SITE INVESTIGATION**

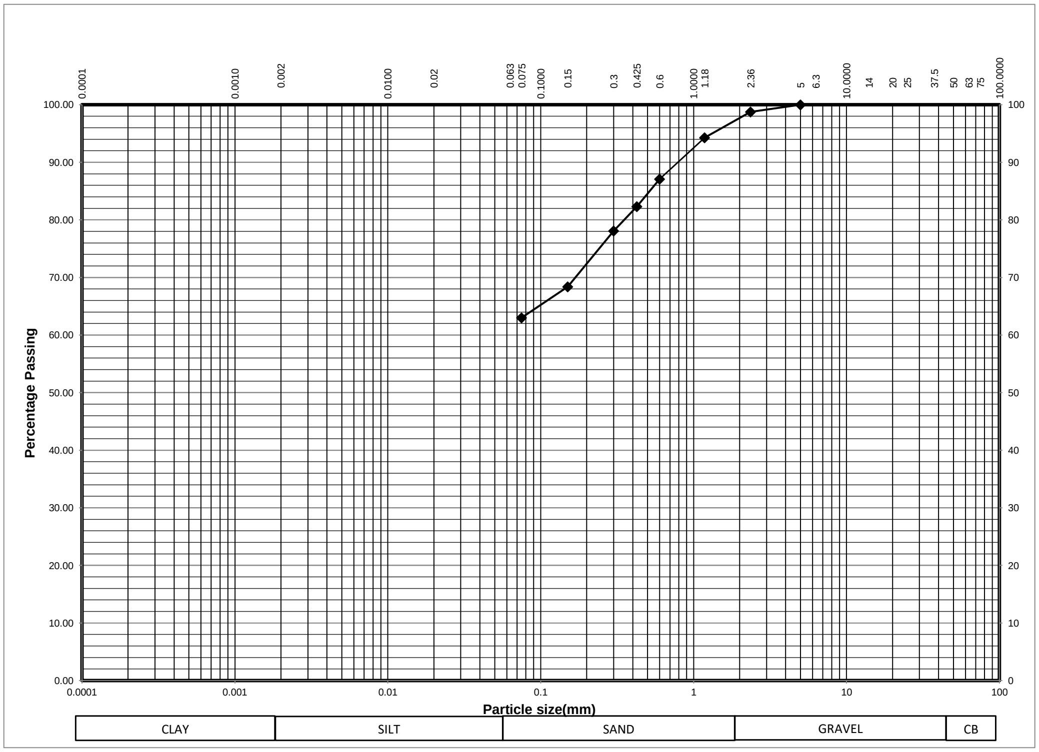
PAGE No.

GEOCONSULT	LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP05 / G016 / 30APR19	
	SAMPLED BY: GEOCONSULT LAB TEAM		DATE: 30 / 04 / 2019	TIME: 10:58
	LOCATION:	EASTING	NORTHING	ELEVATION (m)	DEPTH (m)
	GOLOMOTI - SOLAR PV	0 672 768	8 403 213		3.000-4.000
	TYPE OF MATERIAL: MOIST BROWN REDDISH BROWN LATERITE GRAVELLY SANDY SILTY CLAY			
	TESTED BY: C. NDALAMA		DATE: 03 - 06 - 2019	TIME: 10:43
+265 0888 846 543	CHECKED BY: G. KACHIWALA		DATE: 04 - 06 - 2019	TIME: 13:30
sabelli@geoconsult.cc	APPROVED BY: M. SABELLI		DATE: 04 - 06 - 2019	TIME: 15:00

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

SIEVE ANALYSIS (GRADATION) STANDARD: TRH14:1985

SIEVE	MASS	PERCENTAGE			GRADATION SPECIFICATION			ZONE
(mm)	RETAINED	RETAINED	PASSING		BASE	SUBBASE	SL SEAL	
75.000								
50.000								
37.500								
28.000								
25.000								
20.000								
14.000								
12.500								
10.000								
6.300								
5.000	0.00	0.00	100.00	100				
2.360	8.50	1.27	98.73	99				
1.180	38.50	5.74	94.26	94				
0.600	86.50	12.90	87.10	87				
0.425	118.50	17.67	82.33	82				
0.300	147.00	21.92	78.08	78				
0.150	212.00	31.62	68.38	68				
0.075	248.00	36.99	63.01	63				
0 pan	422.50	63.01						
TOTAL (g)	670.50							



REMARKS: SAMPLED FROM TRIAL PIT 05 @ 3.000-4.000M. **SOLAR PV SITE INVESTIGATION**	**PAGE No.**

	LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP05 / NMC014 / 30APRT19		
	SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 30 - 04 - 2019	TIME: 10:58	
	LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
	GOLOMOTI - SOLAR PV	0 672 768	8 403 213	(m)	0.100-1.500
	TYPE OF MATERIAL: MOIST LIGHT BROWN SANDY SILTY CLAY				
GEOCONSULT	TESTED BY: C. NDALAMA		DATE: 05 - 05 - 2019	TIME: 09:38	
+265 0888 846 543	CHECKED BY: G. KACHIWALA		DATE: 06 - 05 - 2019	TIME: 09:46	
sabelli@geoconsult.cc	APPROVED BY: M. SABELLI		DATE: 06 - 05 - 2019	TIME: 10:00	

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

NATURAL MOISTURE CONTENT - OVEN DRYING METHOD STANDARD: ASTM D7263

MASS OF WET SOIL + CONTAINER (g)		435.0	
MASS OF DRY SOIL AND CONTAINER (g)		401.0	
CONTAINER No.		GCK	
MASS OF CONTAINER (g)		126.5	
MASS OF DRY SOIL (g)		274.5	
MASS OF WATER (g)		34.0	
MOISTURE CONTENT %		12.4	
AVERAGE MOISTURE CONTENT %		**12.4**	

REMARKS: SAMPLED FROM TRIAL PIT 05 @ 0.100-1.500M. **SOLAR PV SITE INVESTIGATION** **PAGE No.**

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LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP05 / NMC015 / 30APR19		
SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 30 - 04 - 2019	TIME: 10:58	
LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 672 768	8 403 213	(m)	1.500-3.000
TYPE OF MATERIAL: MOIST BROWN REDDISH GRAVELLY SANDY SILTY CLAY				
TESTED BY: C. NDALAMA		DATE: 05 - 05 - 2019	TIME: 09:38	
CHECKED BY: G. KACHIWALA		DATE: 06 - 05 - 2019	TIME: 09:46	
APPROVED BY: M. SABELLI		DATE: 06 - 05 - 2019	TIME: 10:00	

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

NATURAL MOISTURE CONTENT - OVEN DRYING METHOD STANDARD: ASTM D7263

MASS OF WET SOIL + CONTAINER (g)		407.0	
MASS OF DRY SOIL AND CONTAINER (g)		376.5	
CONTAINER No.		JJ	
MASS OF CONTAINER (g)		118.0	
MASS OF DRY SOIL (g)		258.5	
MASS OF WATER (g)		30.5	
MOISTURE CONTENT %		11.8	
AVERAGE MOISTURE CONTENT %		**11.8**	

REMARKS: SAMPLED FROM TRIAL PIT 05 @ 1.500-3.500M. **SOLAR PV SITE INVESTIGATION** **PAGE No.**

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LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP05 / NMC016 / 30APR19		
SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 30 - 04 - 2019	TIME: 10:58	
LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 672 768	8 403 213	(m)	3.000-4.000
TYPE OF MATERIAL: MOIST STIFF REDDISH BROWN LATERITE GRAVELLY SANDY SILTY CLAY				
TESTED BY: C. NDALAMA		DATE: 05 - 05 - 2019	TIME: 09:38	
CHECKED BY: G. KACHIWALA		DATE: 06 - 05 - 2019	TIME: 09:46	
APPROVED BY: M. SABELLI		DATE: 06 - 05 - 2019	TIME: 10:00	

PROJECT: GOLOMOTI SOLAR PV

CLIENT: JCM

NATURAL MOISTURE CONTENT - OVEN DRYING METHOD   STANDARD: ASTM D7263

MASS OF WET SOIL + CONTAINER (g)		407.0	
MASS OF DRY SOIL AND CONTAINER (g)		370.5	
CONTAINER No.		JM	
MASS OF CONTAINER (g)		118.0	
MASS OF DRY SOIL (g)		252.5	
MASS OF WATER (g)		36.5	
MOISTURE CONTENT %		14.5	
AVERAGE MOISTURE CONTENT %		**14.5**	

REMARKS: SAMPLED FROM TRIAL PIT 05 @3.000-4.000M. **SOLAR PV SITE INVESTIGATION**

PAGE No.

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LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP05 / AL014 / 30APR19		
SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 30 - 04 - 2019	TIME: 10:58	
LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 672 768	8 403 213	(m)	0.100-1.500
TYPE OF MATERIAL: MOIST LIGHT BROWN SANDY SILTY CLAY				
TESTED BY: M. MILANZI		DATE: 27 - 05 - 2019	TIME: 10:00	
CHECKED BY: S. THANGATO		DATE: 01 - 06 - 2019	TIME: 09:35	
APPROVED BY: M. SABELLI		DATE: 01 - 06 - 2019	TIME: 14:18	

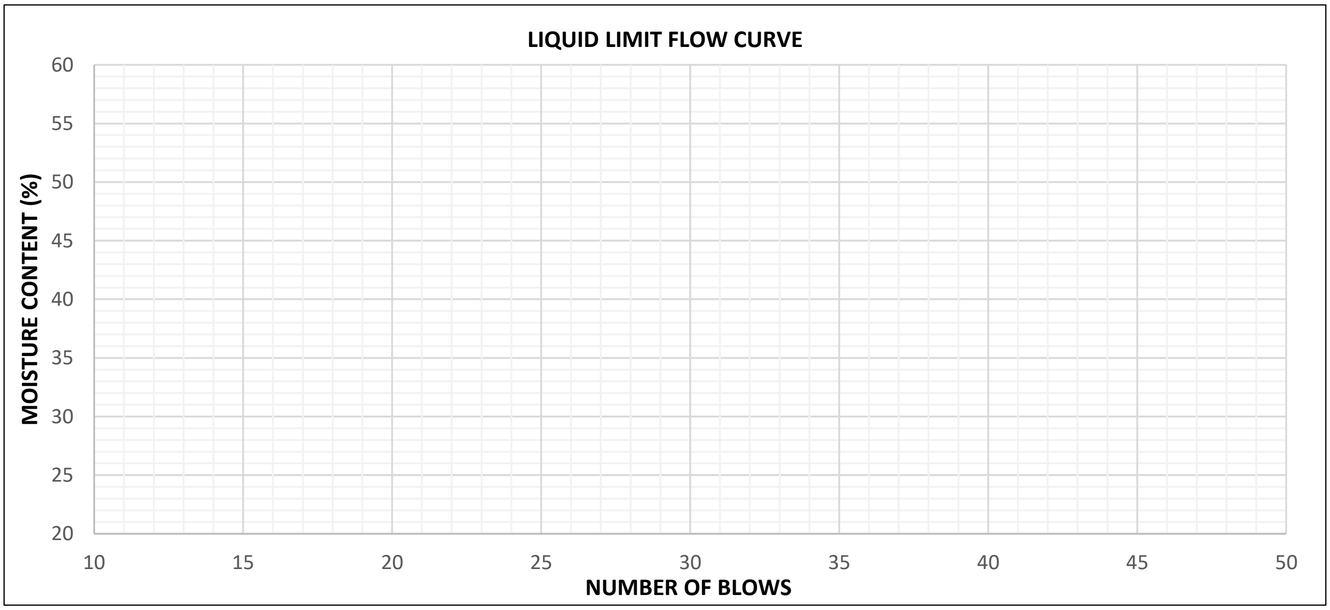
PROJECT: GOLOMOTI SOLAR PV

CLIENT: JCM

ATTERBURG LIMITS STANDARD: BS 1377, 2 (C)

TYPE OF TEST	LIQUID LIMITS (LL)				PLASTIC LIMITS (PL)		
TEST No.	1	2	3	4	1	2	3
CONTAINER No.	C10		R28		R12	R75	R4
MASS OF WET SOIL + CONTAINER(g)	44.0		48.0		43.5	48.0	44.0
MASS OF DRY SOIL + CONTAINER(g)	39.5		42.5		41.5	46.0	42.0
MASS OF CONTAINER (g)	28.5		30		29	34	30
MASS OF DRY SOIL (g)	11.0		12.5		12.5	12.0	12.0
MASS OF WATER (g)	4.50		5.50		2.00	2.00	2.00
MOISTURE CONTENT %	40.9	42.1	44.0	43.6	16.0	16.7	16.7
No. BLOWS	35		24			16.4	

LINEAR SHRINKAGE	3
INITIAL LENGTH OF SPECIMEN (cm)	14.0
LENGTH OF OVERN DRY SPECIMEN (cm)	12.4
LINEAR SHRINKAGE %	12.9
LIQUID LIMIT (LL) %	42.8
PLASTIC LIMIT (PL) %	16.4
PLASTICITY INDEX (PI)	**26**
NATURAL MOISTURE CONTENT %	12.4
FINENESS INDEX	1950



REMARKS: SAMPLED FROM TRIAL PIT 05 @ 0.100-1.500M. SOLAR PV SITE INVESTIGATION

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LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP05 / AL015 / 30APR19		
SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 30 - 04 - 2019	TIME: 10:58	
LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 672 768	8 403 213	(m)	1.500-3.000
TYPE OF MATERIAL: MOIST BROWN REDDISH GRAVELLY SANDY SILTY CLAY				
TESTED BY: S. MATCHADO		DATE: 27 - 05 - 2019	TIME: 10:00	
CHECKED BY: G. KACHIWALA		DATE: 01 - 06 - 2019	TIME: 09:35	
APPROVED BY: M. SABELLI		DATE: 01 - 06 - 2019	TIME: 14:18	

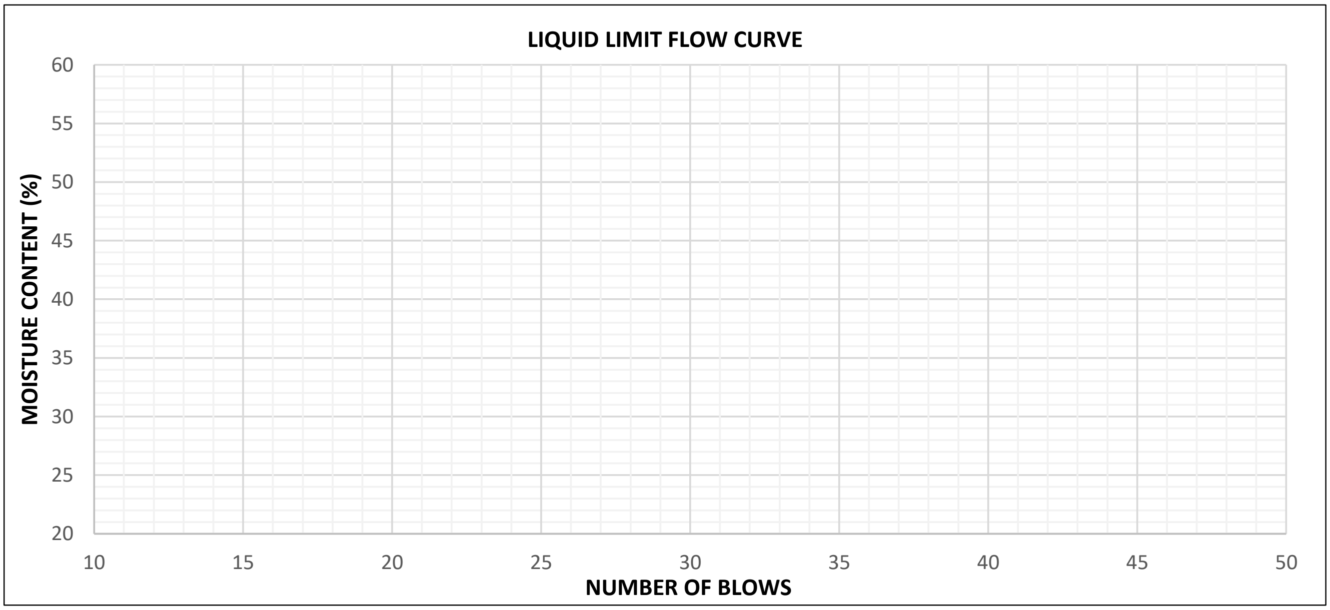
PROJECT: GOLOMOTI SOLAR PV

CLIENT: JCM

ATTERBURG LIMITS STANDARD: BS 1377, 2 (C)

TYPE OF TEST	LIQUID LIMITS (LL)				PLASTIC LIMITS (PL)		
TEST No.	1	2	3	4	1	2	3
CONTAINER No.	R22		R30		E	C7	M
MASS OF WET SOIL + CONTAINER(g)	54.5		50.0		46.0	38.5	44.5
MASS OF DRY SOIL + CONTAINER(g)	47.0		44.0		42.5	37.0	41.5
MASS OF CONTAINER (g)	27.5		30		26	30	27.5
MASS OF DRY SOIL (g)	19.5		14.0		16.5	7.0	14.0
MASS OF WATER (g)	7.50		6.00		3.50	1.50	3.00
MOISTURE CONTENT %	38.5	38.8	42.9	42.4	21.2	21.4	21.4
No. BLOWS	29		23			21.4	

LINEAR SHRINKAGE	1
INITIAL LENGTH OF SPECIMEN (cm)	14.0
LENGTH OF OVERN DRY SPECIMEN (cm)	12.7
LINEAR SHRINKAGE %	10.2
LIQUID LIMIT (LL) %	40.6
PLASTIC LIMIT (PL) %	21.4
PLASTICITY INDEX (PI)	**19**
NATURAL MOISTURE CONTENT %	11.8
FINENESS INDEX	1349



REMARKS: SAMPLED FROM TRIAL PIT 05 @ 1.500-3.000M. SOLAR PV SITE INVESTIGATION

GEOCONSULT LIMITED

P.O. BOX 40 LILONGWE

Triaxial test - UU
BS 1377 part 7, 1377 part 8

Site :	GOLOMOTI SOLAR PV	Levy date :	27-Jun-19
Technicien's name :		Date of test :	27-Jun-19
File N° :	32	Survey depth (m) :	1.000
Survey N° :	TRIAL PIT No. 05	Level of water (m) :	
Kind of soil :			Moist Light Brown Sandy Silty CLAY

Identification of samples :

σvo, Total stress of the soil in situ (kPa) :	0.000	Uo, Pore pressure of the soil in situ (kPa) :	0.000
Category of soil :	Soft/Granular	Kind of drainage :	Without lateral drain
ρs, Grain density (kg/m³) :	0.000		
Sm :	☐	Sd :	☐

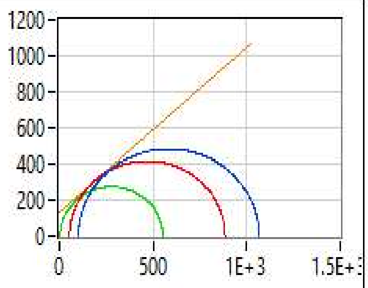
Samples before test : / Samples after saturation :

	N°	Hi (mm)	Di (mm)	mi (g)	ρi (kg/m³)	ρdi (kg/m³)	wi (%)	ei	Sri (%)	Ucp (kPa)	ΔVsat. (mm³)	B (%)
🟦	1	76.00	38	179.0	2077	1781	16.61	-1.000	-0.000		0.000	0.000
🟥	2	76.00	38	160.0	1856	1589	16.79	-1.000	-0.000		0.000	0.000
🟩	3	76.00	38	165.5	1920	1624	18.21	-1.000	-0.000		0.000	0.000

Samples after consolidation : / Samples after shearing

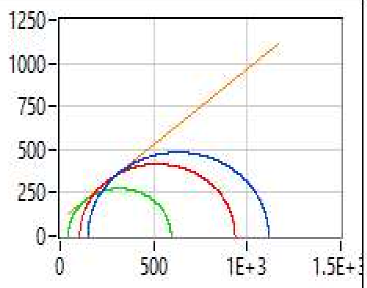
	N°	Hs (mm)	Ds (mm)	ΔVs (mm³)	T100 (min)	Vmax (µm/min)	σ'c (kPa)	Hf (mm)	Df (mm)	mf (g)	md (g)	wf (%)	ρdf (kg/m³)	ef	Srf (%)
🟦	1	76.00	38.00	0.000	0.000	0.000	0.000	76.00	38.00	179.0	153.5	16.61	1781	-1.000	-0.000
🟥	2	76.00	38.00	0.000	0.000	0.000	0.000	76.00	38.00	160.0	137.0	16.79	1589	-1.000	-0.000
🟩	3	76.00	38.00	0.000	0.000	0.000	0.000	76.00	38.00	166.0	140.0	18.57	1624	-1.000	-0.000

Total stress :



	Mohr
C (kPa)	131.7
φ (°)	42.40

Effective stress :



	Mohr	Lambe
C' (kPa)	95.82	64.15
φ' (°)	41.20	33.78

Comments :

Visa :

	Triaxial test - UU **BS 1377 part 7, 1377 part 8**			
	Site :	GOLOMOTI SOLAR PV	Levy date :	27-Jun-19
	Technicien's name :		Date of test :	27-Jun-19
GEOCONSULT LIMITED P.O. BOX 40 LILONGWE	File N° :	34	Survey depth (m) :	2.000
	Survey N° :	TRIAL PIT No. 05	Level of water (m) :	
	Kind of soil :			Moist Brown Reddish Gravelley Sandy Silty CLAY

Identification of samples :

σvo, Total stress of the soil in situ (kPa) :	0.000	Uo, Pore pressure of the soil in situ (kPa) :	0.000
Category of soil :	Soft/Granular	Kind of drainage :	Without lateral drain
ρs, Grain density (kg/m^3) :	0.000		
Sm :	☐	Sd :	☐

Samples before test :

Samples after saturation :

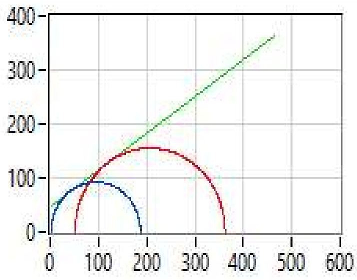
	N°	Hi (mm)	Di (mm)	mi (g)	ρi (kg/m^3)	ρdi (kg/m^3)	wi (%)	ei	Sri (%)	Ucp (kPa)	ΔVsat. (mm^3)	B (%)
🟦	1	76.00	38	149.0	1729	1450	19.20	-1.000	-0.000		0.000	0.000
🟥	2	76.00	38	161.5	1874	1584	18.32	-1.000	-0.000		0.000	0.000

Samples after consolidation :

Samples after shearing

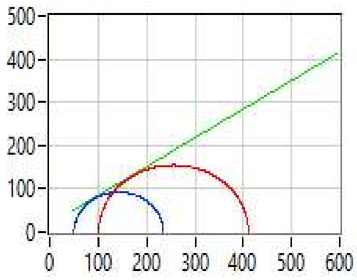
	N°	Hs (mm)	Ds (mm)	ΔVs (mm^3)	T100 (min)	Vmax (μm/min)	σ'c (kPa)	Hf (mm)	Df (mm)	mf (g)	md (g)	wf (%)	ρdf (kg/m^3)	ef	Srf (%)
🟦	1	76.00	38.00	0.000	0.000	0.000	0.000	76.00	38.00	148.5	125.0	18.80	1450	-1.000	-0.000
🟥	2	76.00	38.00	0.000	0.000	0.000	0.000	76.00	38.00	163.0	136.5	19.41	1584	-1.000	-0.000

Total stress :



	Mohr
C (kPa)	47.36
φ (°)	34.12

Effective stress :



	Mohr	Lambe
C' (kPa)	16.34	13.61
φ' (°)	33.58	28.95

Comments :

Visa :

p.1/3

3.9 Trial Pit 06

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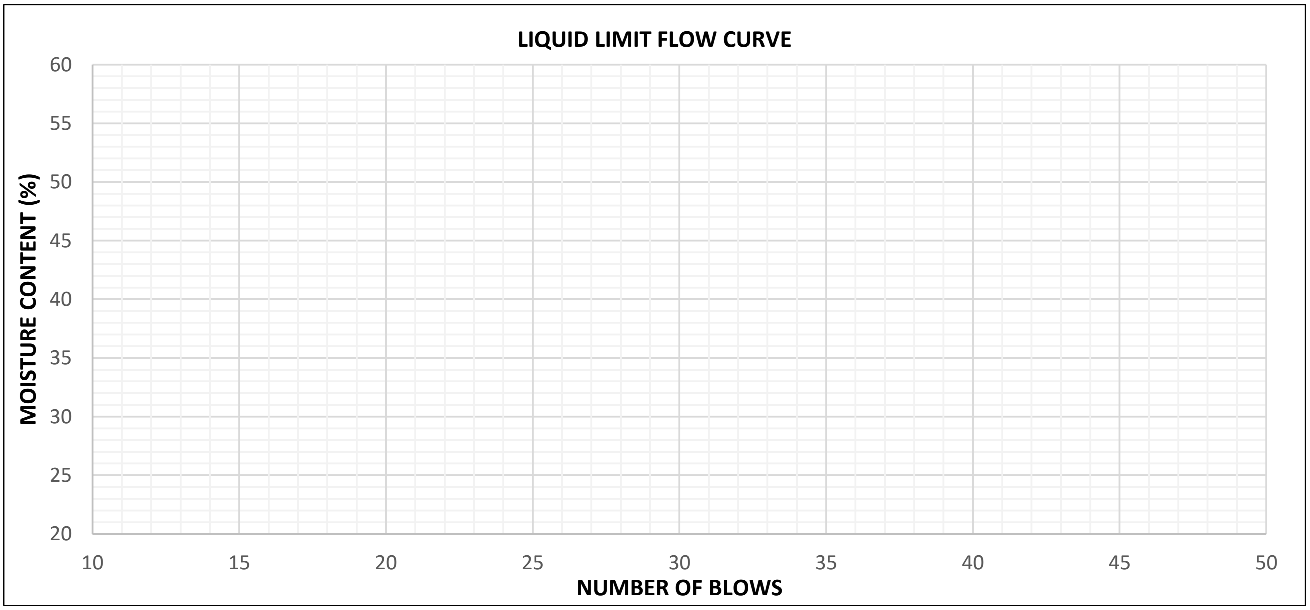
LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP06 / AL019 / 30APR19		
SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 30 - 04 - 2019	TIME: 11:53	
LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 672 663	8 402 947	(m)	3.000-4.000
TYPE OF MATERIAL: MOIST BROWN REDDISH SANDY SILTY CLAYEY LATERITE GRAVEL				
TESTED BY: M. MILANZI		DATE: 28-08-2019	TIME: 15:21	
CHECKED BY: S. THANGATO		DATE: 31 - 05 - 2019	TIME: 09:35	
APPROVED BY: M. SABELLI		DATE: 31 - 05 - 2019	TIME: 14:18	

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

ATTERBURG LIMITS STANDARD: BS 1377, 2 (C)

TYPE OF TEST	**LIQUID LIMITS (LL)**				**PLASTIC LIMITS (PL)**		
TEST No.	1	2	3	4	1	2	3
CONTAINER No.	R12		C18		R11	K4	C18
MASS OF WET SOIL + CONTAINER(g)	46.0		47.0		41.0	38.0	39.5
MASS OF DRY SOIL + CONTAINER(g)	41.0		42.0		39.5	36.5	38.0
MASS OF CONTAINER (g)	28.5		30.5		30.5	27.5	29
MASS OF DRY SOIL (g)	12.5		11.5		9.0	9.0	9.0
MASS OF WATER (g)	5.00		5.00		1.50	1.50	1.50
MOISTURE CONTENT %	40.0	40.4	43.5	41.7	16.7	16.7	16.7
No. BLOWS	28		17			16.7	

LINEAR SHRINKAGE	4
INITIAL LENGTH OF SPECIMEN (cm)	14.0
LENGTH OF OVERN DRY SPECIMEN (cm)	12.5
LINEAR SHRINKAGE %	12.0
LIQUID LIMIT (LL) %	41.1
PLASTIC LIMIT (PL) %	16.7
PLASTICITY INDEX (PI)	**24**
NATURAL MOISTURE CONTENT %	9.1
FINENESS INDEX	1248



REMARKS: SAMPLED FROM TRIAL PIT 06 @ 3.000-4.000M. SOLAR PV SITE INVESTIGATION

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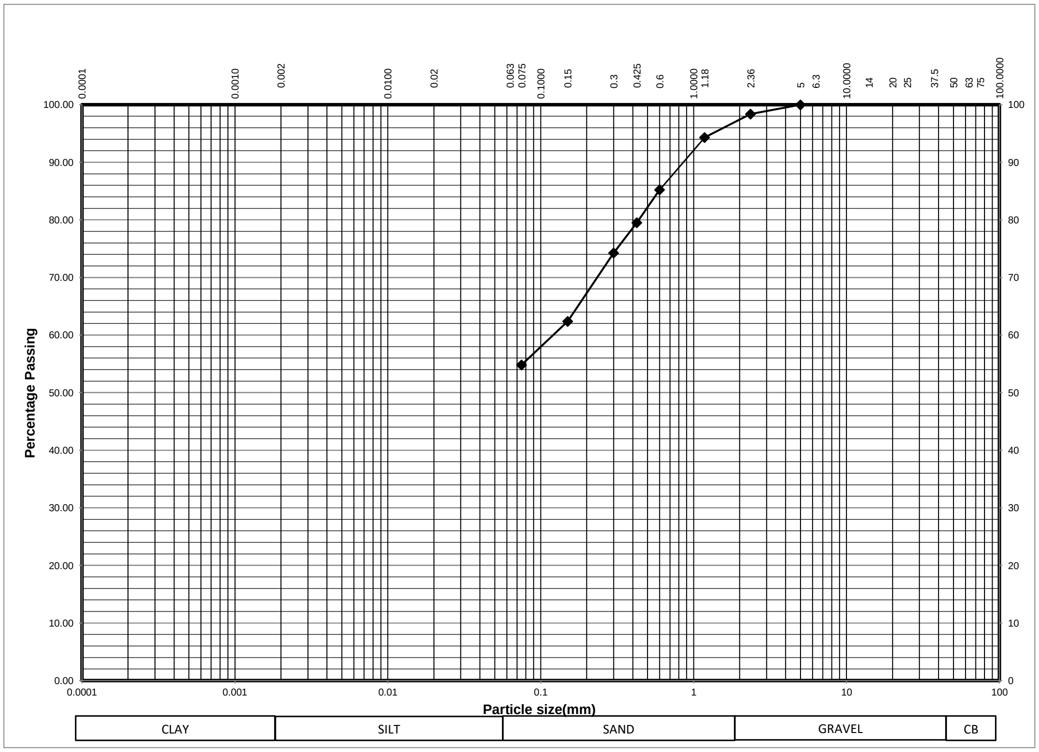
LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP06 / G017 / 30APR19		
SAMPLED BY: GEOCONSULT LAB TEAM		DATE: 30 / 04 / 2019	TIME: 10:18	
LOCATION:	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 672 663	8 402 947	(m)	0.200-1.000
TYPE OF MATERIAL: MOIST LIGHT GREY SANDY SILTY CLAY				
TESTED BY: C. NDALAMA		DATE: 03 - 06 - 2019	TIME: 14:50	
CHECKED BY: G. KACHIWALA		DATE: 04 - 06 - 2019	TIME: 13:30	
APPROVED BY: M. SABELLI		DATE: 04 - 06 - 2019	TIME: 15:00	

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

SIEVE ANALYSIS (GRADATION) STANDARD: TRH14:1985

SIEVE	MASS	PERCENTAGE			GRADATION SPECIFICATION			ZONE
(mm)	RETAINED	RETAINED	PASSING		BASE	SUBBASE	SL SEAL	
75.000								
50.000								
37.500								
28.000								
25.000								
20.000								
14.000								
12.500								
10.000								
6.300								
5.000	0.00	0.00	100.00	100				
2.360	7.00	1.63	98.37	98				
1.180	24.50	5.70	94.30	94				
0.600	63.50	14.78	85.22	85				
0.425	88.00	20.49	79.51	80				
0.300	110.50	25.73	74.27	74				
0.150	161.50	37.60	62.40	62				
0.075	194.00	45.17	54.83	55				
0 pan	235.50	54.83						
TOTAL (g)	429.50							



REMARKS: SAMPLED FROM TRIAL PIT 06 @ 0.200-1.000M. **SOLAR PV SITE INVESTIGATION**

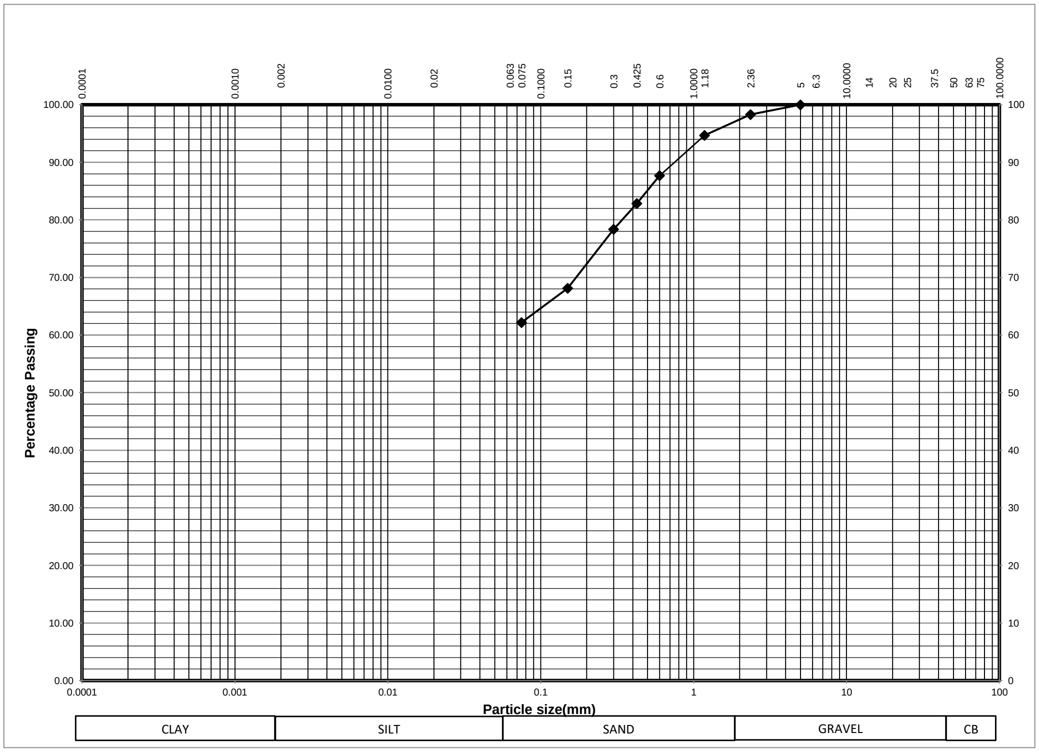
PAGE No.

	LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP06 / G018 / 30APR19		
	SAMPLED BY: GEOCONSULT LAB TEAM		DATE: 30 / 04 / 2019	TIME: 10:18	
	LOCATION:	EASTING	NORTHING	ELEVATION	DEPTH (m)
	GOLOMOTI - SOLAR PV	0 672 663	8 402 947	(m)	1.000-3.000
	TYPE OF MATERIAL: MOIST LIGHT BROWN SANDY SILTY CLAY				
	TESTED BY: C. NDALAMA		DATE: 03 - 06 - 2019	TIME: 15:00	
+265 0888 846 543	CHECKED BY: G. KACHIWALA		DATE: 04 - 06 - 2019	TIME: 13:30	
sabelli@geoconsult.cc	APPROVED BY: M. SABELLI		DATE: 04 - 06 - 2019	TIME: 15:00	

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

SIEVE ANALYSIS (GRADATION) STANDARD: TRH14:1985

SIEVE	MASS	PERCENTAGE			GRADATION SPECIFICATION			ZONE
(mm)	RETAINED	RETAINED	PASSING		BASE	SUBBASE	SL SEAL	
75.000								
50.000								
37.500								
28.000								
25.000								
20.000								
14.000								
12.500								
10.000								
6.300								
5.000	0.00	0.00	100.00	100				
2.360	7.00	1.69	98.31	98				
1.180	22.00	5.31	94.69	95				
0.600	51.00	12.32	87.68	88				
0.425	71.00	17.15	82.85	83				
0.300	89.50	21.62	78.38	78				
0.150	132.00	31.88	68.12	68				
0.075	156.50	37.80	62.20	62				
0 pan	257.50	62.20						
TOTAL (g)	414.00							



REMARKS: SAMPLED FROM TRIAL PIT 06 @ 1.000-3.000M. **SOLAR PV SITE INVESTIGATION**	**PAGE No.**

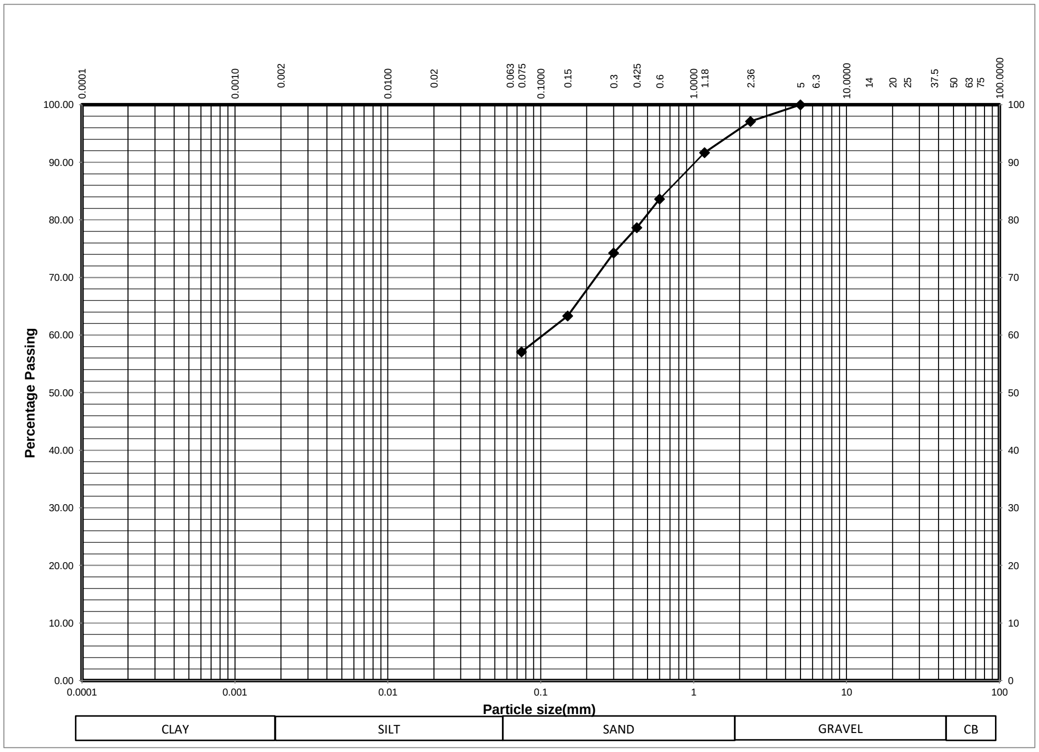
GEOCONSULT	LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP06 / G019 / 30APR19		
	SAMPLED BY: GEOCONSULT LAB TEAM		DATE: 30 / 04 / 2019	TIME: 10:18	
	LOCATION:	EASTING	NORTHING	ELEVATION	DEPTH (m)
	GOLOMOTI - SOLAR PV	0 672 663	8 402 947	(m)	3.000-4.000
	TYPE OF MATERIAL: MOIST BROWN REDDISH SANDY SILTY CLAYEY LATERITE GRAVEL				
	TESTED BY: C. NDALAMA		DATE: 03 - 06 - 2019	TIME: 15:10	
+265 0888 846 543	CHECKED BY: G. KACHIWALA		DATE: 04 - 06 - 2019	TIME: 13:30	
sabelli@geoconsult.cc	APPROVED BY: M. SABELLI		DATE: 04 - 06 - 2019	TIME: 15:00	

PROJECT: GOLOMOTI SOLAR PV

CLIENT: JCM

SIEVE ANALYSIS (GRADATION)   STANDARD: TRH14:1985

SIEVE	MASS	PERCENTAGE			GRADATION SPECIFICATION			ZONE
(mm)	RETAINED	RETAINED	PASSING		BASE	SUBBASE	SL SEAL	
75.000								
50.000								
37.500								
28.000								
25.000								
20.000								
14.000								
12.500								
10.000								
6.300								
5.000	0.00	0.00	100.00	100				
2.360	12.50	2.88	97.12	97				
1.180	36.00	8.30	91.70	92				
0.600	71.00	16.38	83.62	84				
0.425	92.50	21.34	78.66	79				
0.300	111.50	25.72	74.28	74				
0.150	159.00	36.68	63.32	63				
0.075	186.00	42.91	57.09	57				
0 pan	247.50	57.09						
TOTAL (g)	433.50							



REMARKS: SAMPLED FROM TRIAL PIT 06 @ 3.000-4.000M. **SOLAR PV SITE INVESTIGATION**

PAGE No.

GEOCONSULT +265 0888 846 543 sabelli@geoconsult.cc	LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP06 / NMC017 / 30APR19		
	SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 30 - 04 - 2019	TIME: 11:53	
	LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
	GOLOMOTI - SOLAR PV	0 672 663	8 402 947	(m)	0.200-1.000
	TYPE OF MATERIAL: MOIST LIGHT GREY SANDY SILTY CLAY				
	TESTED BY: C. NDALAMA		DATE: 05 - 05 - 2019	TIME: 09:38	
	CHECKED BY: G. KACHIWALA		DATE: 06 - 05 - 2019	TIME: 09:46	
	APPROVED BY: M. SABELLI		DATE: 06 - 05 - 2019	TIME: 10:00	

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

NATURAL MOISTURE CONTENT - OVEN DRYING METHOD   STANDARD: ASTM D7263

MASS OF WET SOIL + CONTAINER (g)		363.5	
MASS OF DRY SOIL AND CONTAINER (g)		345.0	
CONTAINER No.		GC3	
MASS OF CONTAINER (g)		74.0	
MASS OF DRY SOIL (g)		271.0	
MASS OF WATER (g)		18.5	
MOISTURE CONTENT %		6.8	
AVERAGE MOISTURE CONTENT %	**6.8**		

REMARKS: SAMPLED FROM TRIAL PIT 06 @0.200-1.000M. **SOLAR PV SITE INVESTIGATION** | **PAGE No.**

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LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP06 / NMC018 / 30APR19		
SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 30 - 04 - 2019	TIME: 11:53	
LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 672 663	8 402 947	(m)	1.000-3.000
TYPE OF MATERIAL: MOIST LIGHT BROWN SANDY SILTY CLAY				
TESTED BY: C. NDALAMA		DATE: 05 - 05 - 2019	TIME: 11:38	
CHECKED BY: G. KACHIWALA		DATE: 06 - 05 - 2019	TIME: 09:46	
APPROVED BY: M. SABELLI		DATE: 06 - 05 - 2019	TIME: 10:00	

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

NATURAL MOISTURE CONTENT - OVEN DRYING METHOD STANDARD: ASTM D7263

MASS OF WET SOIL + CONTAINER (g)		294.5	
MASS OF DRY SOIL AND CONTAINER (g)		272.0	
CONTAINER No.		GC21	
MASS OF CONTAINER (g)		49.0	
MASS OF DRY SOIL (g)		223.0	
MASS OF WATER (g)		22.5	
MOISTURE CONTENT %		10.1	
AVERAGE MOISTURE CONTENT %		**10.1**	

REMARKS: SAMPLED FROM TRIAL PIT 06 @1.000-3.000M. **SOLAR PV SITE INVESTIGATION** **PAGE No.**

GEOCONSULT +265 0888 846 543 sabelli@geoconsult.cc	LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP06 / NMC019 / 30APR19	
	SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 30 - 04 - 2019	TIME: 11:53
	LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
	GOLOMOTI - SOLAR PV	0 672 663	8 402 947	(m)	3.000-4.000
	TYPE OF MATERIAL: MOIST BROWN REDDISH SANDY SILTY CLAYEY LATERITE GRAVEL				
	TESTED BY: C. NDALAMA		DATE: 05 - 05 - 2019	TIME: 11:38
	CHECKED BY: G. KACHIWALA		DATE: 06 - 05 - 2019	TIME: 09:46
	APPROVED BY: M. SABELLI		DATE: 06 - 05 - 2019	TIME: 10:00

PROJECT: GOLOMOTI SOLAR PV

CLIENT: JCM

NATURAL MOISTURE CONTENT - OVEN DRYING METHOD STANDARD: ASTM D7263

MASS OF WET SOIL + CONTAINER (g)		312.0	
MASS OF DRY SOIL AND CONTAINER (g)		290.5	
CONTAINER No.		GC15	
MASS OF CONTAINER (g)		54.0	
MASS OF DRY SOIL (g)		236.5	
MASS OF WATER (g)		21.5	
MOISTURE CONTENT %		9.1	
AVERAGE MOISTURE CONTENT %	**9.1**		

REMARKS: SAMPLED FROM TRIAL PIT 06 @3.000-4.000M. **SOLAR PV SITE INVESTIGATION**

PAGE No.

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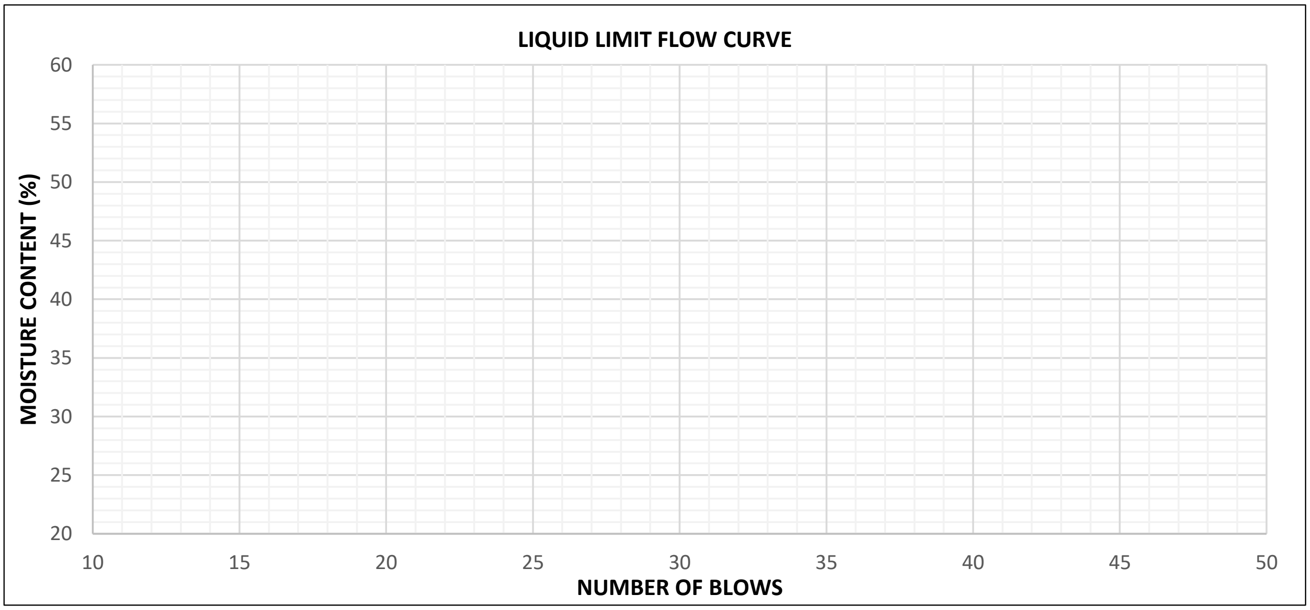
LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP06 / AL017 / 30APR19		
SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 30 - 04 - 2019	TIME: 11:53	
LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 672 663	8 402 947	(m)	0.200-1.000
TYPE OF MATERIAL: MOIST LIGHT GREY SANDY SILTY CLAY				
TESTED BY: M. MILANZI		DATE: 08 - 06 - 2019	TIME: 15:21	
CHECKED BY: G. KACHIWALA		DATE: 10 - 06 - 2019	TIME: 09:35	
APPROVED BY: M. SABELLI		DATE: 10 - 06 - 2019	TIME: 14:18	

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

ATTERBURG LIMITS STANDARD: BS 1377, 2 (C)

TYPE OF TEST	**LIQUID LIMITS (LL)**				**PLASTIC LIMITS (PL)**		
TEST No.	1	2	3	4	1	2	3
CONTAINER No.	C5		C9		R13	K2	C15
MASS OF WET SOIL + CONTAINER(g)	46.0		47.0		41.0	38.0	39.5
MASS OF DRY SOIL + CONTAINER(g)	41.0		42.0		39.5	36.5	38.0
MASS OF CONTAINER (g)	28.5		30.5		31	28	29.5
MASS OF DRY SOIL (g)	12.5		11.5		8.5	8.5	8.5
MASS OF WATER (g)	5.00		5.00		1.50	1.50	1.50
MOISTURE CONTENT %	40.0	40.4	43.5	41.7	17.6	17.6	17.6
No. BLOWS	28		17			17.6	

LINEAR SHRINKAGE	2
INITIAL LENGTH OF SPECIMEN (cm)	14.0
LENGTH OF OVERN DRY SPECIMEN (cm)	12.6
LINEAR SHRINKAGE %	11.1
LIQUID LIMIT (LL) %	41.1
PLASTIC LIMIT (PL) %	17.6
PLASTICITY INDEX (PI)	**23**
NATURAL MOISTURE CONTENT %	6.8
FINENESS INDEX	1265



REMARKS: SAMPLED FROM TRIAL PIT 06 @ 0.200-1.000M. SOLAR PV SITE INVESTIGATION

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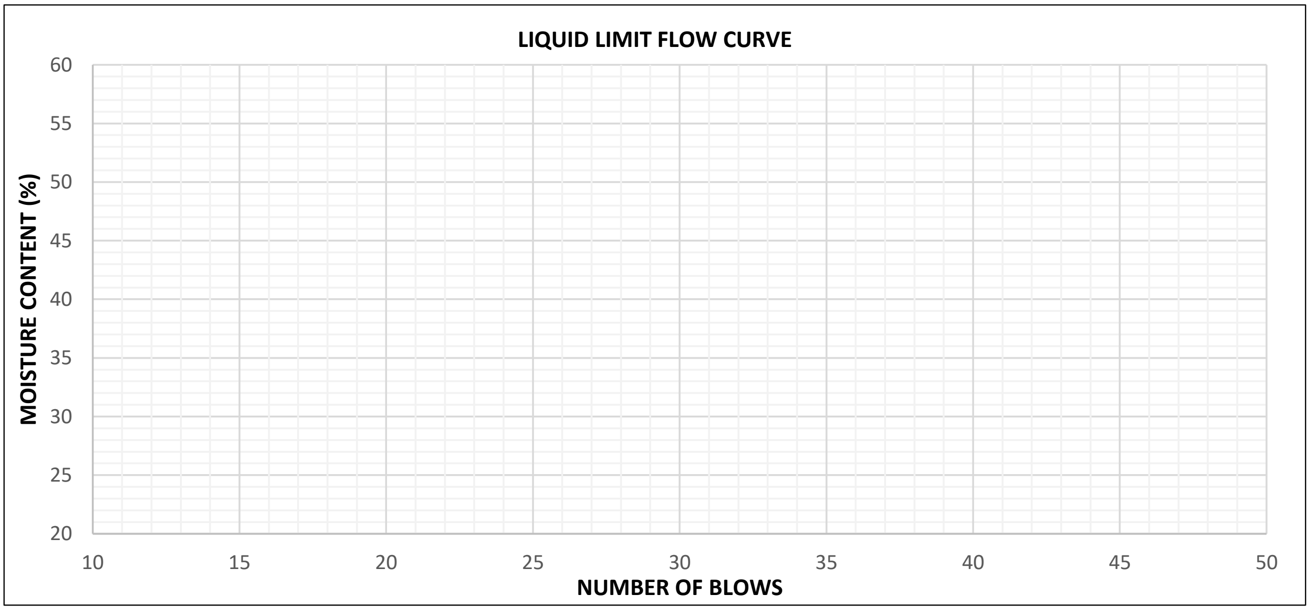
LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP06 / AL018 / 30APR19		
SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 30 - 04 - 2019	TIME: 11:53	
LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 672 663	8 402 947	(m)	1.000-3.000
TYPE OF MATERIAL: MOIST LIGHT BROWN SANDY SILTY CLAY				
TESTED BY: M. MILANZI		DATE: 10 - 06 - 2019	TIME: 15:21	
CHECKED BY: G. KACHIWALA		DATE: 11 - 05 - 2019	TIME: 09:35	
APPROVED BY: M. SABELLI		DATE: 11 - 05 - 2019	TIME: 14:18	

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

ATTERBURG LIMITS STANDARD: BS 1377, 2 (C)

TYPE OF TEST	**LIQUID LIMITS (LL)**				**PLASTIC LIMITS (PL)**		
TEST No.	1	2	3	4	1	2	3
CONTAINER No.	C6		C8		R13	K2	C15
MASS OF WET SOIL + CONTAINER(g)	46.0		47.0		41.0	38.0	39.5
MASS OF DRY SOIL + CONTAINER(g)	41.5		42.0		39.5	36.5	38.0
MASS OF CONTAINER (g)	28.5		30.5		30	27	28.5
MASS OF DRY SOIL (g)	13.0		11.5		9.5	9.5	9.5
MASS OF WATER (g)	4.50		5.00		1.50	1.50	1.50
MOISTURE CONTENT %	34.6	35.0	43.5	41.7	15.8	15.8	15.8
No. BLOWS	27		17			15.8	

LINEAR SHRINKAGE	4
INITIAL LENGTH OF SPECIMEN (cm)	14.0
LENGTH OF OVERN DRY SPECIMEN (cm)	12.6
LINEAR SHRINKAGE %	11.1
LIQUID LIMIT (LL) %	38.4
PLASTIC LIMIT (PL) %	15.8
PLASTICITY INDEX (PI)	**23**
NATURAL MOISTURE CONTENT %	10.1
FINENESS INDEX	1426



REMARKS: SAMPLED FROM TRIAL PIT 06 @ 1.000-3.000M. SOLAR PV SITE INVESTIGATION

	Triaxial test - UU BS 1377 part 7, 1377 part 8			
	Site :	GOLOMOTI SOLAR PV	Levy date :	17-Jun-19
	Technicien's name :		Date of test :	17-Jun-19
GEOCONSULT LIMITED	File N° :	14	Survey depth (m) :	2.000
P.O. BOX 40 LILONGWE	Survey N° :	06	Level of water (m) :	
	Kind of soil :			MOIST LIGHT BROWN SANDY SILTY CLAY

Identification of samples :

σvo, Total stress of the soil in situ (kPa) :	0.000	Uo, Pore pressure of the soil in situ (kPa) :	0.000
Category of soil :	Steep/Strongly overconsolidated	Kind of drainage :	Without lateral drain
ρs, Grain density (kg/m³) :	0.000		
Sm :	☐	Sd :	☐

Samples before test :

	N°	Hi (mm)	Di (mm)	mi (g)	ρi (kg/m³)	ρdi (kg/m³)	wi (%)	ei	Sri (%)
🟦	1	75.00	38	167.0	1963	1652	18.86	-1.000	-0.000
🟥	2	76.00	38	174.0	2019	1665	21.25	-1.000	-0.000

Samples after saturation :

Ucp (kPa)	ΔVsat. (mm³)	B (%)
	0.000	0.000
	0.000	-0.024

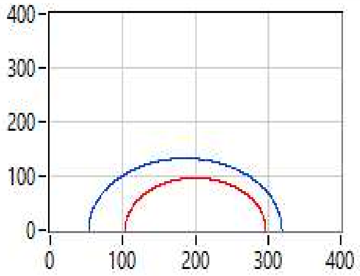
Samples after consolidation :

	N°	Hs (mm)	Ds (mm)	ΔVs (mm³)	T100 (min)	Vmax (µm/min)	σ'c (kPa)
🟦	1	75.00	38.00	0.000	0.000	0.000	0.000
🟥	2	76.00	38.00	0.000	0.000	0.000	0.000

Samples after shearing

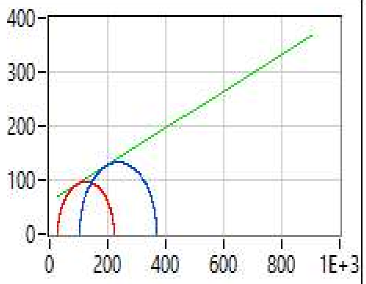
Hf (mm)	Df (mm)	mf (g)	md (g)	wf (%)	ρdf (kg/m³)	ef	Srf (%)
75.00	38.00	167.0	140.5	18.86	1652	-1.000	-0.000
76.00	38.00	174.5	143.5	21.60	1665	-1.000	-0.000

Total stress :



	Mohr
C (kPa)	NaN
φ (°)	NaN

Effective stress :



	Mohr	Lambe
C' (kPa)	59.91	56.69
φ' (°)	18.87	17.92

Comments :

Visa : p.1/3

3.10 Trial Pit 07

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LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP07 / AL022 / 30APR19		
SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 30 - 04 - 2019	TIME: 15:28	
LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 672 863	8 402 795	(m)	2.500-4.000
TYPE OF MATERIAL: MOIST BROWN REDDISH SANDY SILTY CLAYEY LATERITE GRAVEL				
TESTED BY: M. MILANZI		DATE: 28 - 04 - 2019	TIME: 07:30	
CHECKED BY: G. KACHIWALA		DATE: 31 - 05 - 2019	TIME: 09:35	
APPROVED BY: M. SABELLI		DATE: 31 - 05 - 2019	TIME: 14:18	

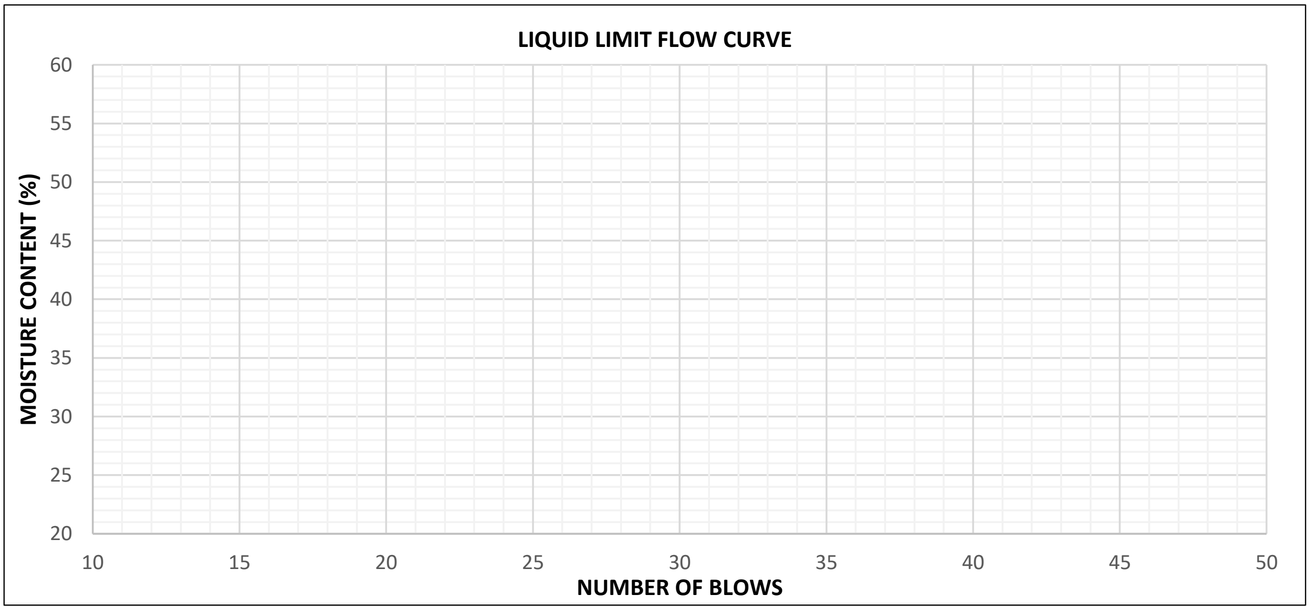
PROJECT: GOLOMOTI SOLAR PV

CLIENT: JCM

ATTERBURG LIMITS STANDARD: BS 1377, 2 (C)

TYPE OF TEST	LIQUID LIMITS (LL)				PLASTIC LIMITS (PL)		
TEST No.	1	2	3	4	1	2	3
CONTAINER No.	C6		R20		R22	C25	C7
MASS OF WET SOIL + CONTAINER(g)	47.5		49.5		44.0	41.0	40.0
MASS OF DRY SOIL + CONTAINER(g)	43.5		44.0		41.0	39.0	38.0
MASS OF CONTAINER (g)	29.5		28.5		26.5	29.5	28.5
MASS OF DRY SOIL (g)	14.0		15.5		14.5	9.5	9.5
MASS OF WATER (g)	4.00		5.50		3.00	2.00	2.00
MOISTURE CONTENT %	28.6	29.4	35.5	35.1	20.7	21.1	21.1
No. BLOWS	35		24			20.9	

LINEAR SHRINKAGE	8
INITIAL LENGTH OF SPECIMEN (cm)	14.0
LENGTH OF OVERN DRY SPECIMEN (cm)	13.2
LINEAR SHRINKAGE %	6.1
LIQUID LIMIT (LL) %	32.3
PLASTIC LIMIT (PL) %	20.9
PLASTICITY INDEX (PI)	**11**
NATURAL MOISTURE CONTENT %	7.1
FINENESS INDEX	583



REMARKS: SAMPLED FROM TRIAL PIT 07 @ 2.500-4.000M. SOLAR PV SITE INVESTIGATION

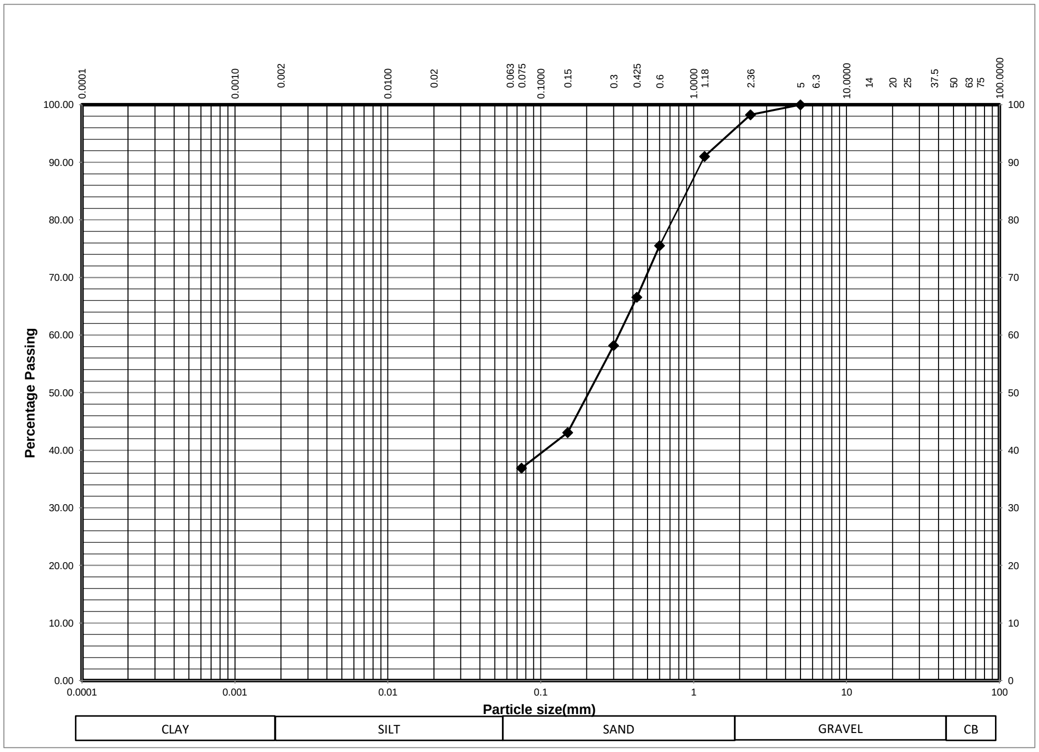
GEOCONSULT	LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP07 / G020 / 30APR19		
	SAMPLED BY: GEOCONSULT LAB TEAM		DATE: 30 / 04 / 2019	TIME: 10:20	
	LOCATION:	EASTING	NORTHING	ELEVATION	DEPTH (m)
	GOLOMOTI - SOLAR PV	0 672 863	8 402 795	(m)	0.200-1.000
	TYPE OF MATERIAL: MOIST REDDISH GREY SANDY SILTY CLAY				
	TESTED BY: C. NDALAMA		DATE: 03 - 06 - 2019	TIME: 10:15	
+265 0888 846 543	CHECKED BY: G. KACHIWALA		DATE: 04 - 06 - 2019	TIME: 13:30	
sabelli@geoconsult.cc	APPROVED BY: M. SABELLI		DATE: 04 - 06 - 2019	TIME: 15:00	

PROJECT: GOLOMOTI SOLAR PV

CLIENT: JCM

SIEVE ANALYSIS (GRADATION) STANDARD: TRH14:1985

SIEVE	MASS	PERCENTAGE			GRADATION SPECIFICATION			ZONE
(mm)	RETAINED	RETAINED	PASSING		BASE	SUBBASE	SL SEAL	
75.000								
50.000								
37.500								
28.000								
25.000								
20.000								
14.000								
12.500								
10.000								
6.300								
5.000	0.00	0.00	100.00	100				
2.360	7.50	1.75	98.25	98				
1.180	38.50	8.96	91.04	91				
0.600	105.00	24.45	75.55	76				
0.425	143.50	33.41	66.59	67				
0.300	179.50	41.79	58.21	58				
0.150	244.50	56.93	43.07	43				
0.075	271.00	63.10	36.90	37				
0 pan	158.50	36.90						
TOTAL (g)	429.50							



REMARKS: SAMPLED FROM TRIAL PIT 07 @ 0.200-1.000M. **SOLAR PV SITE INVESTIGATION**

PAGE No.

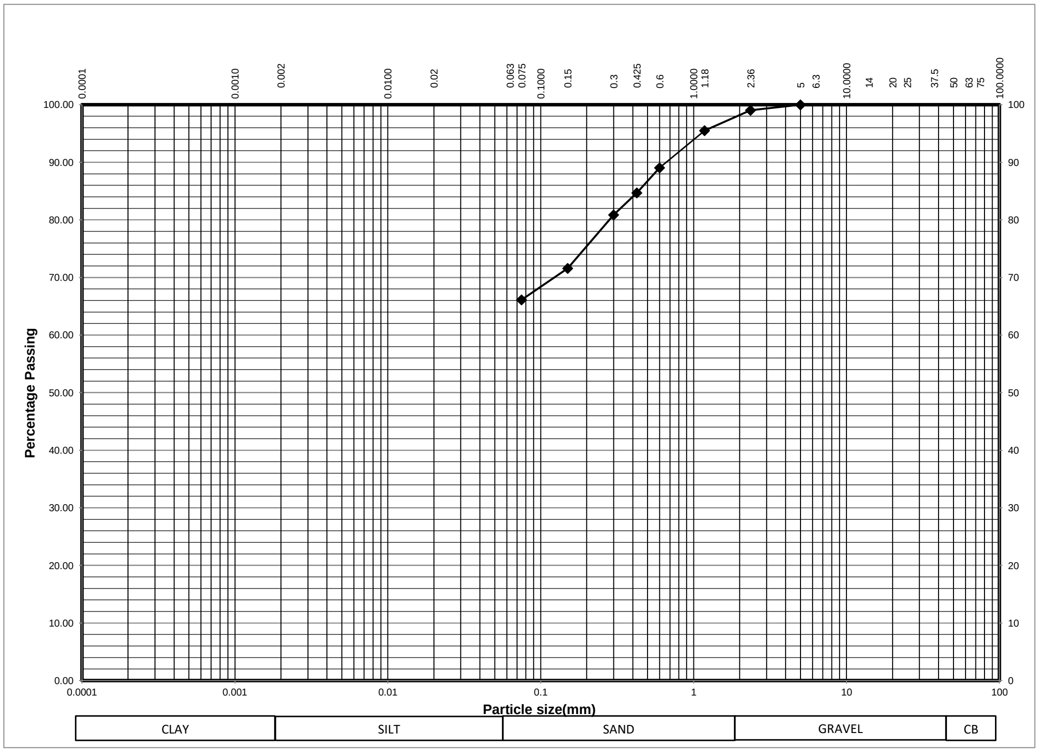
GEOCONSULT	LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP07 / G021 / 30APR19	
	SAMPLED BY: GEOCONSULT LAB TEAM		DATE: 30 / 04 / 2019	TIME: 10:20
	LOCATION:	EASTING	NORTHING	ELEVATION (m) / DEPTH (m)
	GOLOMOTI - SOLAR PV	0 672 863	8 402 795	1.000-2.500
	TYPE OF MATERIAL: MOIST STIFF BROWN GRAVELLY SANDY SILTY CLAY			
	TESTED BY: C. NDALAMA		DATE: 03 - 06 - 2019	TIME: 10:25
+265 0888 846 543	CHECKED BY: G. KACHIWALA		DATE: 04 - 06 - 2019	TIME: 13:30
sabelli@geoconsult.cc	APPROVED BY: M. SABELLI		DATE: 04 - 06 - 2019	TIME: 15:00

PROJECT: GOLOMOTI SOLAR PV

CLIENT: JCM

SIEVE ANALYSIS (GRADATION) STANDARD: TRH14:1985

SIEVE	MASS	PERCENTAGE			GRADATION SPECIFICATION			ZONE
(mm)	RETAINED	RETAINED	PASSING		BASE	SUBBASE	SL SEAL	
75.000								
50.000								
37.500								
28.000								
25.000								
20.000								
14.000								
12.500								
10.000								
6.300								
5.000	0.00	0.00	100.00	100				
2.360	3.50	0.96	99.04	99				
1.180	16.50	4.51	95.49	95				
0.600	40.00	10.93	89.07	89				
0.425	56.00	15.30	84.70	85				
0.300	70.00	19.13	80.87	81				
0.150	104.00	28.42	71.58	72				
0.075	124.00	33.88	66.12	66				
0 pan	242.00	66.12						
TOTAL (g)	366.00							



REMARKS: SAMPLED FROM TRIAL PIT 07 @ 1.000-2.500M. **SOLAR PV SITE INVESTIGATION**

PAGE No.

LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP07 / G022 / 30APR19		
SAMPLED BY: GEOCONSULT LAB TEAM		DATE: 30 / 04 / 2019	TIME: 10:20	
LOCATION:	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 672 863	8 402 795	(m)	2.500-4.000
TYPE OF MATERIAL: MOIST BROWN REDDISH SANDY SILTY CLAYEY LATERITE GRAVEL				
TESTED BY: C. NDALAMA		DATE: 03 - 06 - 2019	TIME: 10:25	
CHECKED BY: G. KACHIWALA		DATE: 04 - 06 - 2019	TIME: 13:30	
APPROVED BY: M. SABELLI		DATE: 04 - 06 - 2019	TIME: 15:00	

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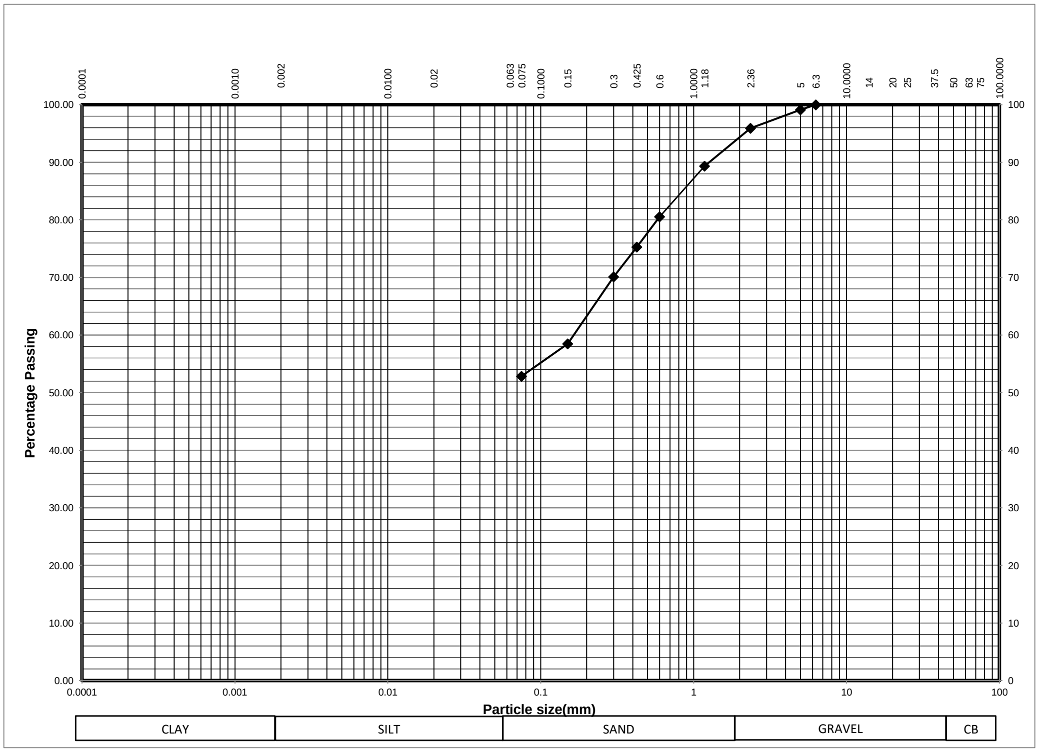
PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

SIEVE ANALYSIS (GRADATION) STANDARD: TRH14:1985

SIEVE	MASS	PERCENTAGE			GRADATION SPECIFICATION			ZONE
(mm)	RETAINED	RETAINED	PASSING		BASE	SUBBASE	SL SEAL	
75.000								
50.000								
37.500								
28.000								
25.000								
20.000								
14.000								
12.500								
10.000								
6.300	0.00	0.00	100.00	100				
5.000	4.00	0.88	99.12	99				
2.360	18.50	4.07	95.93	96				
1.180	48.50	10.66	89.34	89				
0.600	88.50	19.45	80.55	81				
0.425	112.50	24.73	75.27	75				
0.300	136.00	29.89	70.11	70				
0.150	189.00	41.54	58.46	58				
0.075	214.50	47.14	52.86	53				
0 pan	240.50	52.86						
TOTAL (g)	455.00							



REMARKS: SAMPLED FROM TRIAL PIT 07 @ 2.500-4.000M. **SOLAR PV SITE INVESTIGATION**

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LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP07 / NMC020 / 30APR19		
SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 30 - 04 - 2019	TIME: 15:28	
LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 672 863	8 402 795	(m)	0.200-1.000
TYPE OF MATERIAL: MOIST REDDISH GREY SAND SILTY CLAY				
TESTED BY: C. NDALAMA		DATE: 05 - 05 - 2019	TIME: 13:38	
CHECKED BY: G. KACHIWALA		DATE: 06 - 05 - 2019	TIME: 09:46	
APPROVED BY: M. SABELLI		DATE: 06 - 05 - 2019	TIME: 10:00	

PROJECT: GOLOMOTI SOLAR PV

CLIENT: JCM

NATURAL MOISTURE CONTENT - OVEN DRYING METHOD   STANDARD: ASTM D7263

MASS OF WET SOIL + CONTAINER (g)		281.0	
MASS OF DRY SOIL AND CONTAINER (g)		258.0	
CONTAINER No.		GC111	
MASS OF CONTAINER (g)		51.5	
MASS OF DRY SOIL (g)		206.5	
MASS OF WATER (g)		23.0	
MOISTURE CONTENT %		11.1	
AVERAGE MOISTURE CONTENT %		**11.1**	

REMARKS: SAMPLED FROM TRIAL PIT 07 @0.200-1.000M. **SOLAR PV SITE INVESTIGATION**

PAGE No.

GEOCONSULT	LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP07 / NMC021 / 30APR19		
	SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 30 - 04 - 2019	TIME: 15:28	
	LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
	GOLOMOTI - SOLAR PV	0 672 863	8 402 795	(m)	1.000-2.500
	TYPE OF MATERIAL: MOIST STIFF BROWN GRAVELLY SAND SILTY CLAY				
	TESTED BY: C. NDALAMA		DATE: 05 - 05 - 2019	TIME: 13:38	
+265 0888 846 543	CHECKED BY: G. KACHIWALA		DATE: 06 - 05 - 2019	TIME: 09:46	
sabelli@geoconsult.cc	APPROVED BY: M. SABELLI		DATE: 06 - 05 - 2019	TIME: 10:00	

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

NATURAL MOISTURE CONTENT - OVEN DRYING METHOD STANDARD: ASTM D7263

MASS OF WET SOIL + CONTAINER (g)		350.5	
MASS OF DRY SOIL AND CONTAINER (g)		323.0	
CONTAINER No.		GC18	
MASS OF CONTAINER (g)		67.5	
MASS OF DRY SOIL (g)		255.5	
MASS OF WATER (g)		27.5	
MOISTURE CONTENT %		10.8	
AVERAGE MOISTURE CONTENT %		**10.8**	

REMARKS: SAMPLED FROM TRIAL PIT 07 @1.000-2.500M. **SOLAR PV SITE INVESTIGATION** **PAGE No.**

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LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP07 / NMC022 / 30APR19		
SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 30 - 04 - 2019	TIME: 15:28	
LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 672 863	8 402 795	(m)	2.500-4.000
TYPE OF MATERIAL: MOIST BROWN REDDISH SANDY SILTY CLAYEY LATERITE GRAVEL				
TESTED BY: C. NDALAMA		DATE: 05 - 05 - 2019	TIME: 13:38	
CHECKED BY: G. KACHIWALA		DATE: 06 - 05 - 2019	TIME: 09:46	
APPROVED BY: M. SABELLI		DATE: 06 - 05 - 2019	TIME: 10:00	

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

NATURAL MOISTURE CONTENT - OVEN DRYING METHOD STANDARD: ASTM D7263

MASS OF WET SOIL + CONTAINER (g)		371.5	
MASS OF DRY SOIL AND CONTAINER (g)		350.0	
CONTAINER No.		GC13	
MASS OF CONTAINER (g)		47.0	
MASS OF DRY SOIL (g)		303.0	
MASS OF WATER (g)		21.5	
MOISTURE CONTENT %		7.1	
AVERAGE MOISTURE CONTENT %		**7.1**	

REMARKS: SAMPLED FROM TRIAL PIT 07 @2.500-4.000M. **SOLAR PV SITE INVESTIGATION** **PAGE No.**

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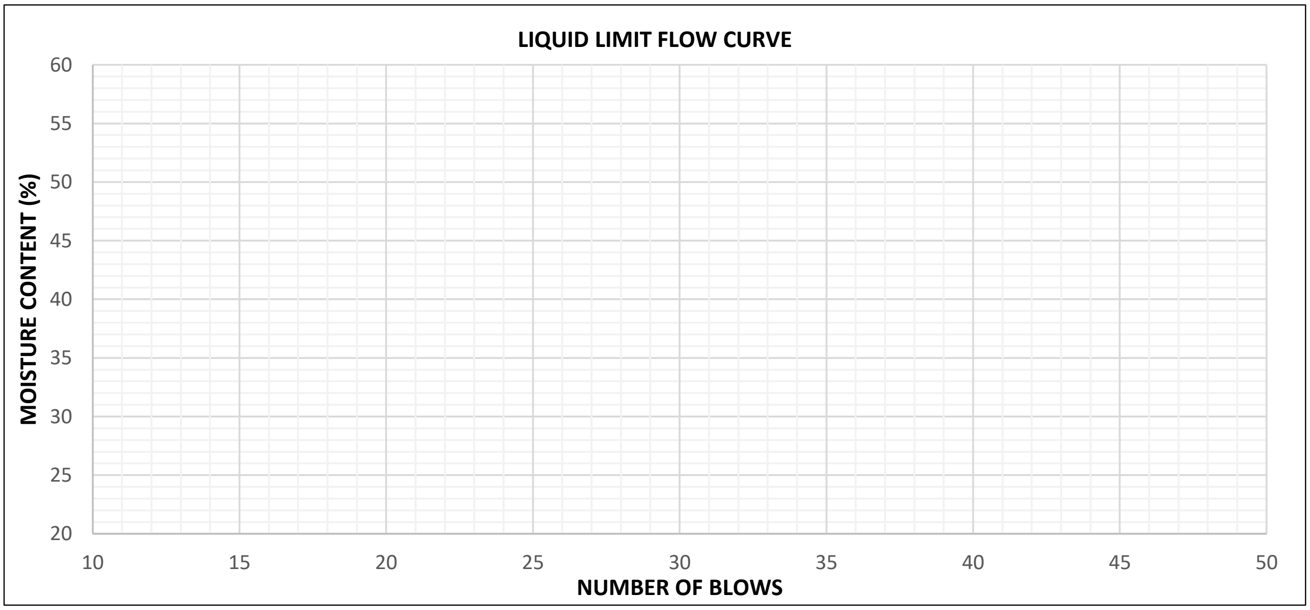
LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP07 / AL020 / 30APR19		
SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 30 - 04 - 2019	TIME: 13:50	
LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 672 863	8 402 795	(m)	0.200-1.000
TYPE OF MATERIAL: MOIST REDDISH GREY SAND SILTY CLAY				
TESTED BY: M. MILANZI		DATE: 10 - 06 - 2019	TIME: 09:30	
CHECKED BY: G. KACHIWALA		DATE: 15 - 06 - 2019	TIME: 09:35	
APPROVED BY: M. SABELLI		DATE: 15 - 06 - 2019	TIME: 14:18	

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

ATTERBURG LIMITS STANDARD: BS 1377, 2 (C)

TYPE OF TEST	**LIQUID LIMITS (LL)**				**PLASTIC LIMITS (PL)**		
TEST No.	1	2	3	4	1	2	3
CONTAINER No.	R14		C23		C11	R18	C4
MASS OF WET SOIL + CONTAINER(g)	50.0		48.0		41.0	39.0	39.5
MASS OF DRY SOIL + CONTAINER(g)	43.5		40.5		39.0	37.5	37.0
MASS OF CONTAINER (g)	28		22		28.5	29.5	24
MASS OF DRY SOIL (g)	15.5		18.5		10.5	8.0	13.0
MASS OF WATER (g)	6.50		7.50		2.00	1.50	2.50
MOISTURE CONTENT %	41.9	42.8	40.5	38.9	19.0	18.8	19.2
No. BLOWS	30		16			19.0	

LINEAR SHRINKAGE	5
INITIAL LENGTH OF SPECIMEN (cm)	14.0
LENGTH OF OVERN DRY SPECIMEN (cm)	12.6
LINEAR SHRINKAGE %	11.1
LIQUID LIMIT (LL) %	40.8
PLASTIC LIMIT (PL) %	19.0
PLASTICITY INDEX (PI)	**22**
NATURAL MOISTURE CONTENT %	11.1
FINENESS INDEX	814.0



REMARKS: SAMPLED FROM TRIAL PIT 07 @ 0.200-1.000M. SOLAR PV SITE INVESTIGATION

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LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP07 / AL021 / 30APR19		
SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 30 - 04 - 2019	TIME: 15:28	
LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 672 863	8 402 795	(m)	1.000-2.500
TYPE OF MATERIAL: MOIST STIFF BROWN GRAVELLY SAND SILTY CLAY				
TESTED BY: M. MILANZI		DATE: 10 - 06 - 2019	TIME: 07:30	
CHECKED BY: G. KACHIWALA		DATE: 11 - 06 - 2019	TIME: 09:35	
APPROVED BY: M. SABELLI		DATE: 11 - 06 - 2019	TIME: 14:18	

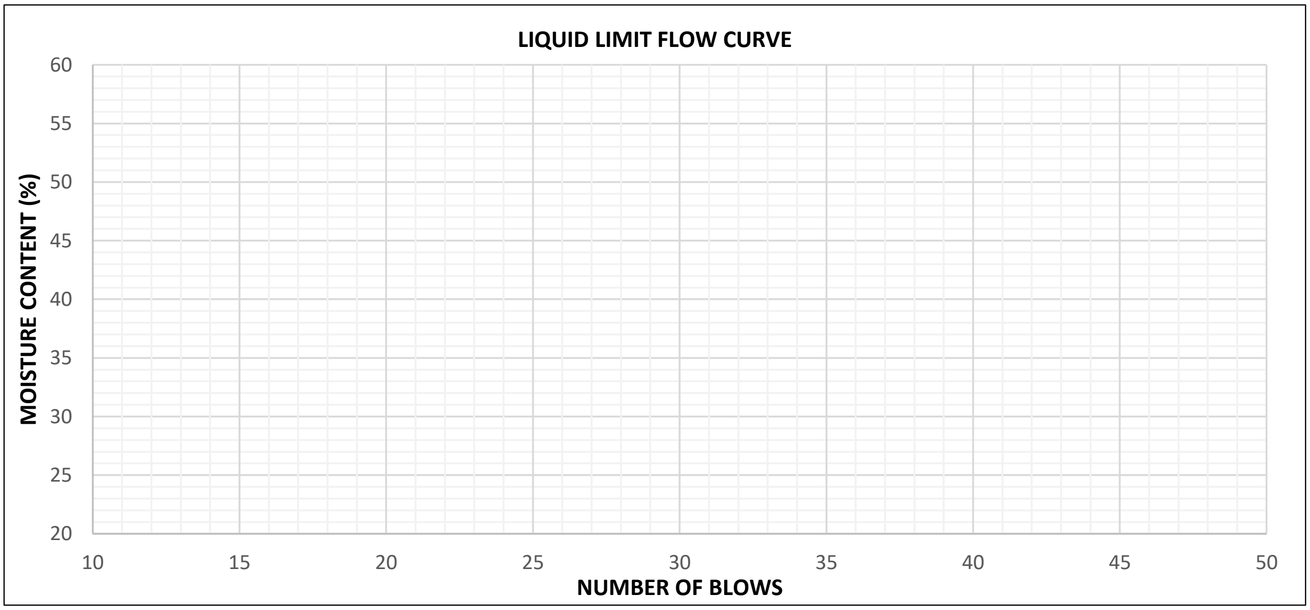
PROJECT: GOLOMOTI SOLAR PV

CLIENT: JCM

ATTERBURG LIMITS STANDARD: BS 1377, 2 (C)

TYPE OF TEST	LIQUID LIMITS (LL)				PLASTIC LIMITS (PL)		
TEST No.	1	2	3	4	1	2	3
CONTAINER No.	R27		R20		R28	C17	C29
MASS OF WET SOIL + CONTAINER(g)	47.5		49.5		44.0	41.0	40.0
MASS OF DRY SOIL + CONTAINER(g)	43.5		44.0		41.5	39.0	38.0
MASS OF CONTAINER (g)	30		28		29	29	28
MASS OF DRY SOIL (g)	13.5		16.0		12.5	10.0	10.0
MASS OF WATER (g)	4.00		5.50		2.50	2.00	2.00
MOISTURE CONTENT %	29.6	30.5	34.4	34.0	20.0	20.0	20.0
No. BLOWS	35		24			20.0	

LINEAR SHRINKAGE	11
INITIAL LENGTH OF SPECIMEN (cm)	14.0
LENGTH OF OVERN DRY SPECIMEN (cm)	13.1
LINEAR SHRINKAGE %	6.9
LIQUID LIMIT (LL) %	32.3
PLASTIC LIMIT (PL) %	20.0
PLASTICITY INDEX (PI)	**12**
NATURAL MOISTURE CONTENT %	10.8
FINENESS INDEX	782



REMARKS: SAMPLED FROM TRIAL PIT 07 @ 1.000-2.500M. SOLAR PV SITE INVESTIGATION

	# Triaxial test - UU BS 1377 part 7, 1377 part 8			
	Site :	GOLOMOTI SOLAR PV	Levy date :	26-Jun-19
	Technicien's name :		Date of test :	26-Jun-19
GEOCONSULT LIMITED	File N° :	28	Survey depth (m) :	1.000
P.O. BOX 40 LILONGWE	Survey N° :	TRIAL PIT No. 07	Level of water (m) :	
	Kind of soil :	Moist Brown Gravelley Sandy Silty CLAY		

Identification of samples :

σvo, Total stress of the soil in situ (kPa) :	0.000	Uo, Pore pressure of the soil in situ (kPa) :	0.000
Category of soil :	Steep/Strongly overconsolidated	Kind of drainage :	Without lateral drain
ρs, Grain density (kg/m³) :	0.000		
Sm :	☐	Sd :	☐

Samples before test :

	N°	Hi (mm)	Di (mm)	mi (g)	ρi (kg/m³)	ρdi (kg/m³)	wi (%)	ei	Sri (%)
🟦	1	76.00	38	147.0	1705	1404	21.49	-1.000	-0.000
🟥	2	76.00	38	155.0	1798	1491	20.62	-1.000	-0.000
🟩	3	76.00	38	154.0	1787	1468	21.74	-1.000	-0.000

Samples after saturation :

Ucp (kPa)	ΔVsat. (mm³)	B (%)
	0.000	0.000
	0.000	0.000
	0.000	0.000

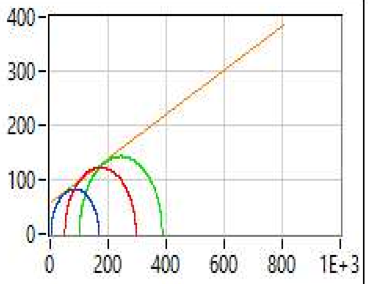
Samples after consolidation :

	N°	Hs (mm)	Ds (mm)	ΔVs (mm³)	T100 (min)	Vmax (µm/min)	σ'c (kPa)
🟦	1	76.00	38.00	0.000	0.000	0.000	0.000
🟥	2	76.00	38.00	0.000	0.000	0.000	0.000
🟩	3	76.00	38.00	0.000	0.000	0.000	0.000

Samples after shearing

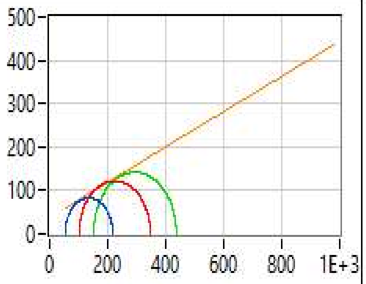
Hf (mm)	Df (mm)	mf (g)	md (g)	wf (%)	ρdf (kg/m³)	ef	Srf (%)
76.00	38.00	146.5	121.0	21.07	1404	-1.000	-0.000
76.00	38.00	154.0	128.5	19.84	1491	-1.000	-0.000
76.00	38.00	153.0	126.5	20.95	1468	-1.000	-0.000

Total stress :



	Mohr
C (kPa)	59.51
φ (°)	22.15

Effective stress :



	Mohr	Lambe
C' (kPa)	39.51	32.72
φ' (°)	22.04	20.91

Comments :

Visa :

p.1/3

	Triaxial test - UU **BS 1377 part 7, 1377 part 8**	
	Site : GOLOMOTI SOLAR PV	Levy date : 28-Jun-19
	Technicien's name :	Date of test : 28-Jun-19
GEOCONSULT LIMITED P.O. BOX 40 LILONGWE	File N° : 36	Survey depth (m) : 2.000
	Survey N° : TRIAL PIT No. 07	Level of water (m) :
	Kind of soil : Moist Brown Gravelley Sandy Silty CLAY	

Identification of samples :

σvo, Total stress of the soil in situ (kPa) : 0.000

Uo, Pore pressure of the soil in situ (kPa) : 0.000

Category of soil : Soft/Granular

Kind of drainage : Without lateral drain

ρs, Grain density (kg/m³) : 0.000

Sm : ☐

Sd : ☐

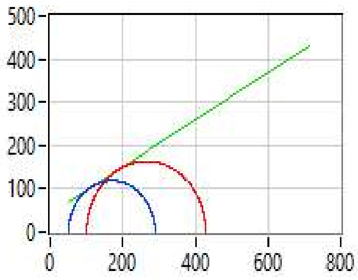
Samples before test : / Samples after saturation :

	N°	Hi (mm)	Di (mm)	mi (g)	ρi (kg/m³)	ρdi (kg/m³)	wi (%)	ei	Sri (%)	Ucp (kPa)	ΔVsat. (mm³)	B (%)
🟦	1	76.00	38	152.0	1763	1497	17.83	-1.000	-0.000		0.000	0.000
🟥	2	76.00	38	160.0	1856	1572	18.08	-1.000	-0.000		0.000	0.000

Samples after consolidation : / Samples after shearing

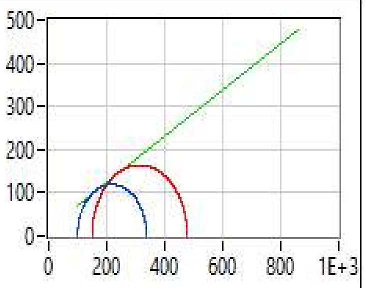
	N°	Hs (mm)	Ds (mm)	ΔVs (mm³)	T100 (min)	Vmax (µm/min)	σ'c (kPa)	Hf (mm)	Df (mm)	mf (g)	md (g)	wf (%)	ρdf (kg/m³)	ef	Srf (%)
🟦	1	76.00	38.00	0.000	0.000	0.000	0.000	76.00	38.00	152.5	129.0	18.22	1497	-1.000	-0.000
🟥	2	76.00	38.00	0.000	0.000	0.000	0.000	76.00	38.00	159.5	135.5	17.71	1572	-1.000	-0.000

Total stress :



	Mohr
C (kPa)	43.78
φ (°)	28.31

Effective stress :



	Mohr	Lambe
C' (kPa)	19.25	16.99
φ' (°)	28.01	25.16

Comments :

Visa :

p.1/3

3.11 Trial Pit 08

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LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP08 / AL025 / 30APR19			
SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 30 - 04 - 2019	TIME: 16:28		
LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)	
GOLOMOTI - SOLAR PV	0 673 025	8 402 675	(m)	2.500-4.000	
TYPE OF MATERIAL: MOIST BROWN REDDISH SANDY SILTY LATERITE GRAVEL					
TESTED BY: M. MILANZI		DATE: 28 - 05 - 2019	TIME: 11:02		
CHECKED BY: S. THANGATO		DATE: 31 - 05 - 2019	TIME: 09:35		
APPROVED BY: M. SABELLI		DATE: 31 - 05 - 2019	TIME: 14:18		

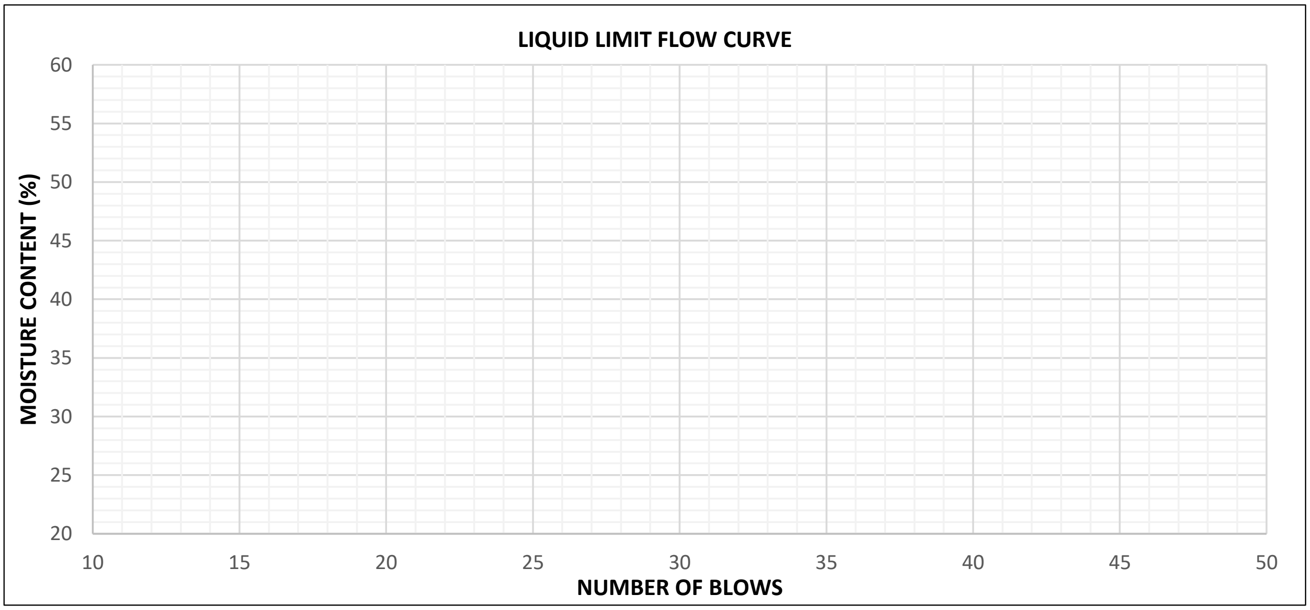
PROJECT: GOLOMOTI SOLAR PV

CLIENT: JCM

ATTERBURG LIMITS STANDARD: BS 1377, 2 (C)

TYPE OF TEST	**LIQUID LIMITS (LL)**				**PLASTIC LIMITS (PL)**		
TEST No.	1	2	3	4	1	2	3
CONTAINER No.	K3		R29		C24	R16	R24
MASS OF WET SOIL + CONTAINER(g)	53.5		51.5		43.0	41.5	42.5
MASS OF DRY SOIL + CONTAINER(g)	47.0		45.0		41.0	39.0	40.5
MASS OF CONTAINER (g)	29.5		29		32.5	28.5	32
MASS OF DRY SOIL (g)	17.5		16.0		8.5	10.5	8.5
MASS OF WATER (g)	6.50		6.50		2.00	2.50	2.00
MOISTURE CONTENT %	37.1	37.9	40.6	39.4	23.5	23.8	23.5
No. BLOWS	30		18			23.6	

LINEAR SHRINKAGE	11
INITIAL LENGTH OF SPECIMEN (cm)	14.0
LENGTH OF OVERN DRY SPECIMEN (cm)	13.2
LINEAR SHRINKAGE %	6.1
LIQUID LIMIT (LL) %	38.6
PLASTIC LIMIT (PL) %	23.6
PLASTICITY INDEX (PI)	**15**
NATURAL MOISTURE CONTENT %	8.3
FINENESS INDEX	750



REMARKS: SAMPLED FROM TRIAL PIT 08 @ 2.500-4.000M. SOLAR PV SITE INVESTIGATION

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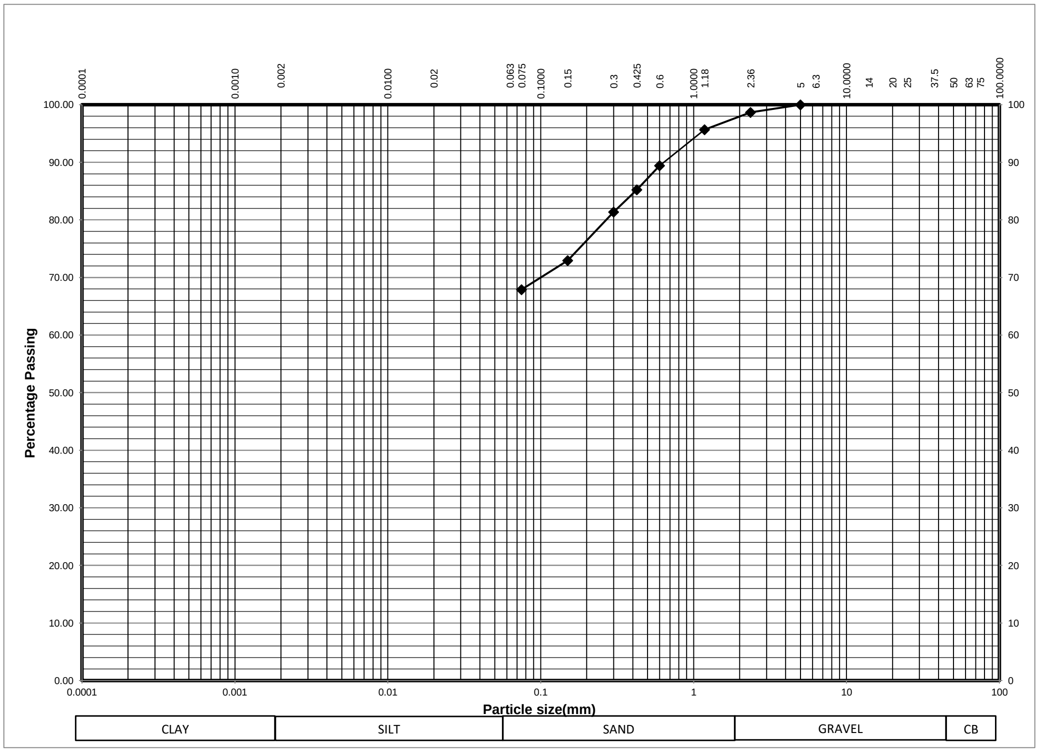
LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP08 / G023 / 30APR19		
SAMPLED BY: GEOCONSULT LAB TEAM		DATE: 30 / 04 / 2019	TIME: 16:28	
LOCATION:	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 673 025	8 402 675	(m)	0.100-0.800
TYPE OF MATERIAL: MOIST DARK BROWN SANDY SILTY CLAY				
TESTED BY: C. NDALAMA		DATE: 07 - 06 - 2019	TIME: 10:25	
CHECKED BY: G. KACHIWALA		DATE: 08 - 06 - 2019	TIME: 13:30	
APPROVED BY: M. SABELLI		DATE: 08 - 06 - 2019	TIME: 15:00	

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

SIEVE ANALYSIS (GRADATION) STANDARD: TRH14:1985

SIEVE	MASS	PERCENTAGE			GRADATION SPECIFICATION			ZONE
(mm)	RETAINED	RETAINED	PASSING		BASE	SUBBASE	SL SEAL	
75.000								
50.000								
37.500								
28.000								
25.000								
20.000								
14.000								
12.500								
10.000								
6.300								
5.000	0.00	0.00	100.00	100				
2.360	5.50	1.32	98.68	99				
1.180	18.00	4.33	95.67	96				
0.600	44.00	10.58	89.42	89				
0.425	61.50	14.78	85.22	85				
0.300	77.50	18.63	81.37	81				
0.150	112.50	27.04	72.96	73				
0.075	133.50	32.09	67.91	68				
0 pan	282.50	67.91						
TOTAL (g)	416.00							



REMARKS: SAMPLED FROM TRIAL PIT 08 @ 0.100-0.800M. **SOLAR PV SITE INVESTIGATION** **PAGE No.**

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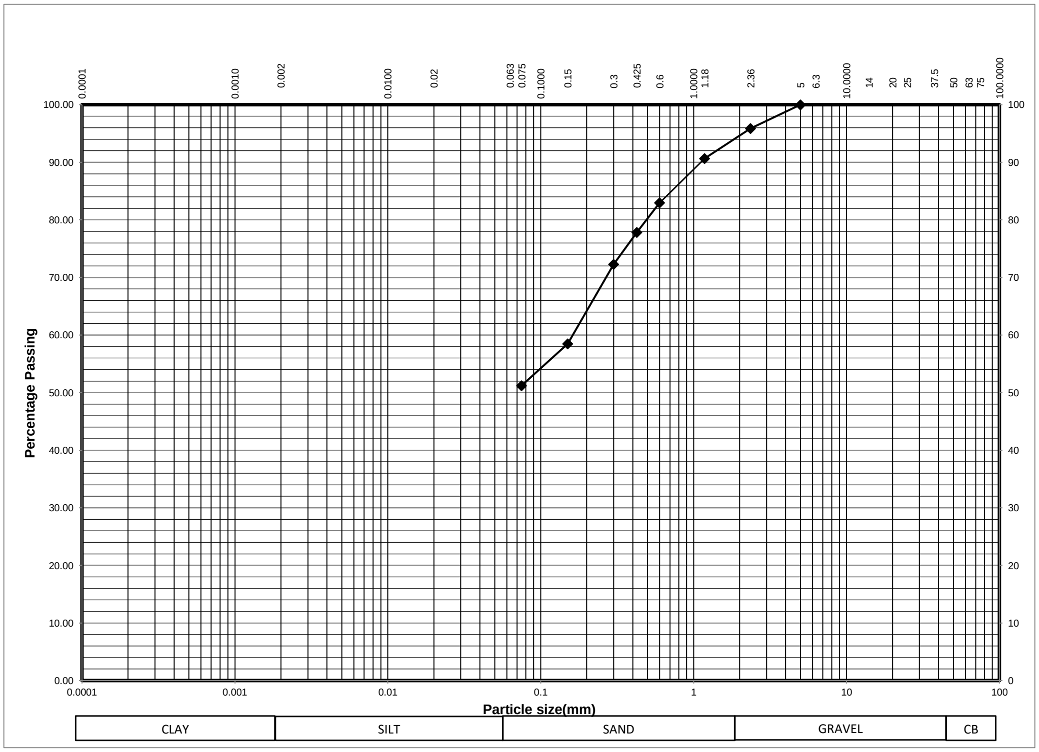
LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP08 / G024 / 30APR19		
SAMPLED BY: GEOCONSULT LAB TEAM		DATE: 30 / 04 / 2019	TIME: 16:28	
LOCATION:	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 673 025	8 402 675	(m)	0.800-2.500
TYPE OF MATERIAL: MOIST BROWN GRAVELLY SANDY SILTY CLAY WITH SPOTS OF HARD AND WHITISH DECOMPOSED ROCK				
TESTED BY: C. NDALAMA		DATE: 07 - 06 - 2019	TIME: 10:55	
CHECKED BY: G. KACHIWALA		DATE: 08 - 06 - 2019	TIME: 13:30	
APPROVED BY: M. SABELLI		DATE: 08 - 06 - 2019	TIME: 15:00	

PROJECT: GOLOMOTI SOLAR PV

CLIENT: JCM

SIEVE ANALYSIS (GRADATION) STANDARD: TRH14:1985

SIEVE	MASS	PERCENTAGE			GRADATION SPECIFICATION			ZONE
(mm)	RETAINED	RETAINED	PASSING		BASE	SUBBASE	SL SEAL	
75.000								
50.000								
37.500								
28.000								
25.000								
20.000								
14.000								
12.500								
10.000								
6.300								
5.000	0.00	0.00	100.00	100				
2.360	18.50	4.12	95.88	96				
1.180	42.00	9.35	90.65	91				
0.600	76.50	17.04	82.96	83				
0.425	99.50	22.16	77.84	78				
0.300	124.50	27.73	72.27	72				
0.150	186.50	41.54	58.46	58				
0.075	219.00	48.78	51.22	51				
0 pan	230.00	51.22						
TOTAL (g)	449.00							



REMARKS: SAMPLED FROM TRIAL PIT 08 @ 0.800-2.500M. **SOLAR PV SITE INVESTIGATION**

PAGE No.

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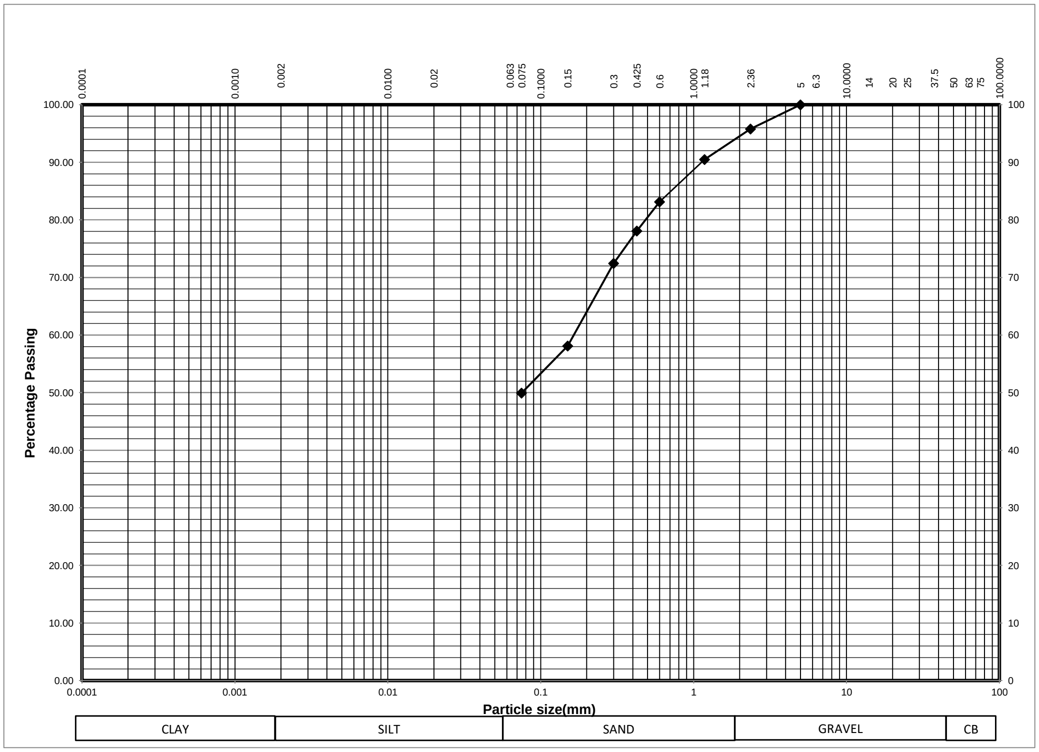
LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP08 / G024 / 30APR19		
SAMPLED BY: GEOCONSULT LAB TEAM		DATE: 30 / 04 / 2019	TIME: 16:28	
LOCATION:	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 673 025	8 402 675	(m)	2.500-4.000
TYPE OF MATERIAL: MOIST BROWN GRAVELLY SANDY SILTY CLAY WITH SPOTS OF HARD AND WHITISH DECOMPOSED ROCK				
TESTED BY: C. NDALAMA		DATE: 07 - 06 - 2019	TIME: 14:25	
CHECKED BY: G. KACHIWALA		DATE: 08 - 06 - 2019	TIME: 13:30	
APPROVED BY: M. SABELLI		DATE: 08 - 06 - 2019	TIME: 15:00	

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

SIEVE ANALYSIS (GRADATION) STANDARD: TRH14:1985

SIEVE	MASS	PERCENTAGE			GRADATION SPECIFICATION			ZONE
(mm)	RETAINED	RETAINED	PASSING		BASE	SUBBASE	SL SEAL	
75.000								
50.000								
37.500								
28.000								
25.000								
20.000								
14.000								
12.500								
10.000								
6.300								
5.000	0.00	0.00	100.00	100				
2.360	17.50	4.21	95.79	96				
1.180	39.50	9.51	90.49	90				
0.600	70.00	16.85	83.15	83				
0.425	91.00	21.90	78.10	78				
0.300	114.50	27.56	72.44	72				
0.150	174.00	41.88	58.12	58				
0.075	208.00	50.06	49.94	50				
0 pan	207.50	49.94						
TOTAL (g)	415.50							



REMARKS: SAMPLED FROM TRIAL PIT 08 @ 2.500-4.000M. **SOLAR PV SITE INVESTIGATION**

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LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP08 / NMC023 / 30APR19		
SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 30 - 04 - 2019	TIME: 16:28	
LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 673 025	8 402 675	(m)	0.100-0.800
TYPE OF MATERIAL: MOIST DARK BROWN SANDY SILTY CLAY				
TESTED BY: C. NDALAMA		DATE: 05 - 05 - 2019	TIME: 13:38	
CHECKED BY: G. KACHIWALA		DATE: 06 - 05 - 2019	TIME: 09:46	
APPROVED BY: M. SABELLI		DATE: 06 - 05 - 2019	TIME: 10:00	

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

NATURAL MOISTURE CONTENT - OVEN DRYING METHOD STANDARD: ASTM D7263

MASS OF WET SOIL + CONTAINER (g)		370.5	
MASS OF DRY SOIL AND CONTAINER (g)		340.5	
CONTAINER No.		GC12	
MASS OF CONTAINER (g)		69.5	
MASS OF DRY SOIL (g)		271.0	
MASS OF WATER (g)		30.0	
MOISTURE CONTENT %		11.1	
AVERAGE MOISTURE CONTENT %		**11.1**	

REMARKS: SAMPLED FROM TRIAL PIT 07 @0.100-0.800M. **SOLAR PV SITE INVESTIGATION**

PAGE No.

GEOCONSULT +265 0888 846 543 sabelli@geoconsult.cc	LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP08 / NMC024 / 30APR19	
	SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 30 - 04 - 2019	TIME: 16:28
	LOCATION: 36 L UTM GOLOMOTI - SOLAR PV	EASTING 0 673 025	NORTHING 8 402 675	ELEVATION (m)	DEPTH (m) 0.800-2.500
	TYPE OF MATERIAL: MOIST BROWN GRAVELLY SANDY SILTY CLAY WITH SPOTS OF HARD AND WHITISH DECOMPOSED ROCK			
	TESTED BY: C. NDALAMA		DATE: 05 - 05 - 2019	TIME: 13:38
	CHECKED BY: G. KACHIWALA		DATE: 06 - 05 - 2019	TIME: 09:46
	APPROVED BY: M. SABELLI		DATE: 06 - 05 - 2019	TIME: 10:00

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

NATURAL MOISTURE CONTENT - OVEN DRYING METHOD STANDARD: ASTM D7263

MASS OF WET SOIL + CONTAINER (g)		386.5	
MASS OF DRY SOIL AND CONTAINER (g)		360.0	
CONTAINER No.		GC2B	
MASS OF CONTAINER (g)		73.0	
MASS OF DRY SOIL (g)		287.0	
MASS OF WATER (g)		26.5	
MOISTURE CONTENT %		9.2	
AVERAGE MOISTURE CONTENT %		**9.2**	

REMARKS: SAMPLED FROM TRIAL PIT 07 @0.800-2.500M. **SOLAR PV SITE INVESTIGATION** **PAGE No.**

GEOCONSULT	LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP08 / NMC025 / 30APR19	
	SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 30 - 04 - 2019	TIME: 16:28
	LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
	GOLOMOTI - SOLAR PV	0 673 025	8 402 675	(m)	2.500-4.000
	TYPE OF MATERIAL: MOIST BROWN REDDISH SANDY SILTY LATERITE GRAVEL				
	TESTED BY: C. NDALAMA		DATE: 05 - 05 - 2019	TIME: 13:38
+265 0888 846 543	CHECKED BY: G. KACHIWALA		DATE: 06 - 05 - 2019	TIME: 09:46
sabelli@geoconsult.cc	APPROVED BY: M. SABELLI		DATE: 06 - 05 - 2019	TIME: 10:00

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

NATURAL MOISTURE CONTENT - OVEN DRYING METHOD STANDARD: ASTM D7263

MASS OF WET SOIL + CONTAINER (g)		347.5	
MASS OF DRY SOIL AND CONTAINER (g)		326.5	
CONTAINER No.		GC1	
MASS OF CONTAINER (g)		74.0	
MASS OF DRY SOIL (g)		252.5	
MASS OF WATER (g)		21.0	
MOISTURE CONTENT %		8.3	
AVERAGE MOISTURE CONTENT %		**8.3**	

REMARKS: SAMPLED FROM TRIAL PIT 07 @2.500-4.000M. **SOLAR PV SITE INVESTIGATION** **PAGE No.**

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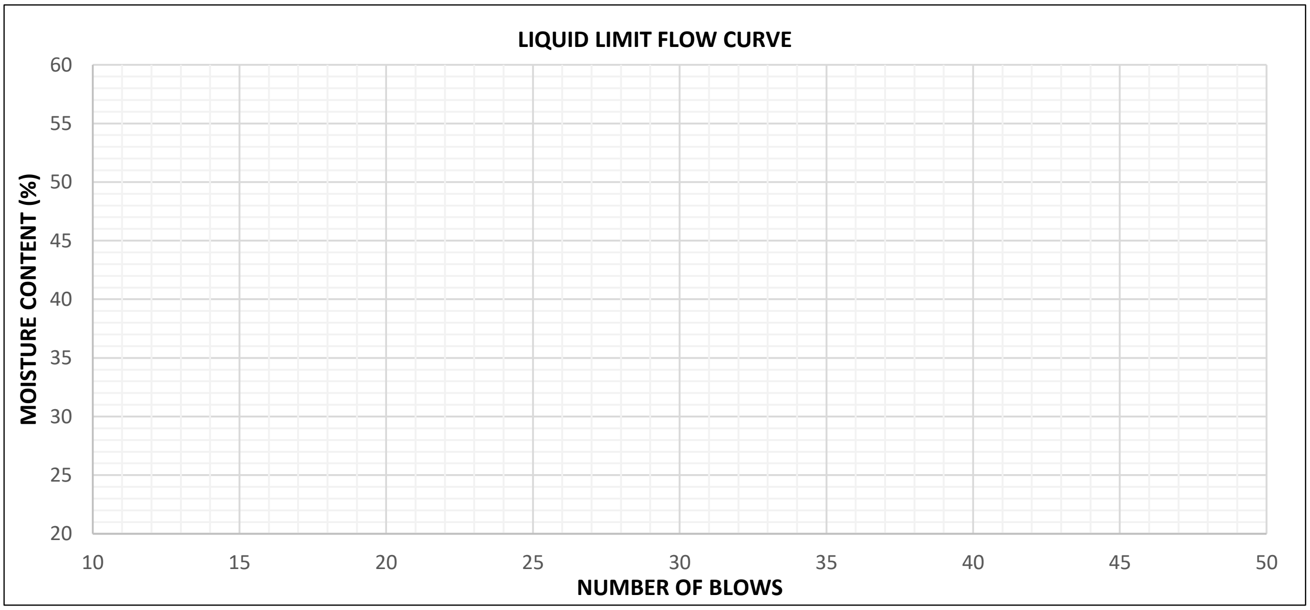
LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP08 / AL023 / 30APR19		
SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 30 - 04 - 2019	TIME: 16:28	
LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 673 025	8 402 675	(m)	0.100-0.800
TYPE OF MATERIAL: MOIST DARK BROWN SANDY SILTY CLAY				
TESTED BY: M. MILANZI		DATE: 28 - 05 - 2019	TIME: 11:52	
CHECKED BY: G. KACHIWALA		DATE: 31 - 05 - 2019	TIME: 09:35	
APPROVED BY: M. SABELLI		DATE: 31 - 05 - 2019	TIME: 14:18	

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

ATTERBURG LIMITS STANDARD: BS 1377, 2 (C)

TYPE OF TEST	**LIQUID LIMITS (LL)**				**PLASTIC LIMITS (PL)**		
TEST No.	1	2	3	4	1	2	3
CONTAINER No.	R20		C13		C1	R10	R17
MASS OF WET SOIL + CONTAINER(g)	44.5		41.5		46.0	42.0	44.0
MASS OF DRY SOIL + CONTAINER(g)	39.5		37.0		44.0	40.0	41.0
MASS OF CONTAINER (g)	28		28		35	31.5	27.5
MASS OF DRY SOIL (g)	11.5		9.0		9.0	8.5	13.5
MASS OF WATER (g)	5.00		4.50		2.00	2.00	3.00
MOISTURE CONTENT %	43.5	43.5	50.0	49.5	22.2	23.5	22.2
No. BLOWS	26		23			22.7	

LINEAR SHRINKAGE	14
INITIAL LENGTH OF SPECIMEN (cm)	14.0
LENGTH OF OVERN DRY SPECIMEN (cm)	12.4
LINEAR SHRINKAGE %	12.9
LIQUID LIMIT (LL) %	46.5
PLASTIC LIMIT (PL) %	22.7
PLASTICITY INDEX (PI)	**24**
NATURAL MOISTURE CONTENT %	11.1
FINENESS INDEX	1632



REMARKS: SAMPLED FROM TRIAL PIT 08 @ 0.100-0.800M. SOLAR PV SITE INVESTIGATION

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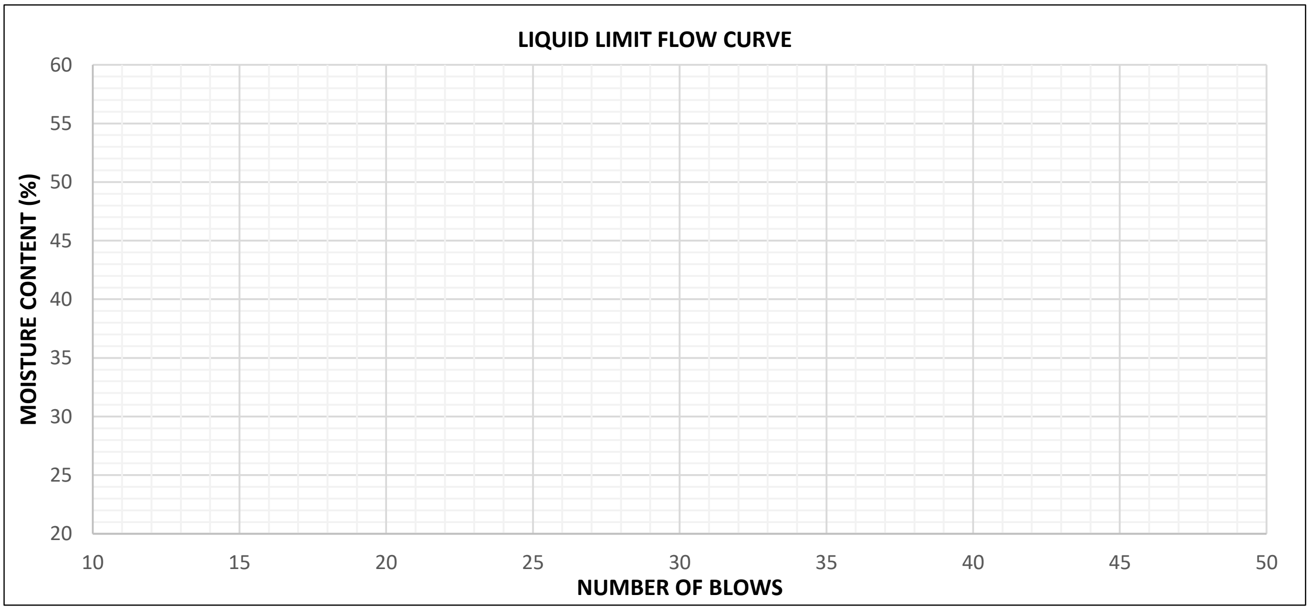
LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP08 / AL024 / 30APR19		
SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 30 - 04 - 2019	TIME: 16:28	
LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 673 025	8 402 675	(m)	0.800-2.500
TYPE OF MATERIAL: MOIST BROWN GRAVELLY SANDY SILTY CLAY WITH SPOTS OF HARD AND WHITISH DECOMPOSED ROCK				
TESTED BY: M. MILANZI		DATE: 28 - 05 - 2019	TIME: 08:18	
CHECKED BY: S. THANGATO		DATE: 31 - 05 - 2019	TIME: 09:35	
APPROVED BY: M. SABELLI		DATE: 31 - 05 - 2019	TIME: 14:18	

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

ATTERBURG LIMITS STANDARD: BS 1377, 2 (C)

TYPE OF TEST	**LIQUID LIMITS (LL)**				**PLASTIC LIMITS (PL)**		
TEST No.	1	2	3	4	1	2	3
CONTAINER No.	R27		C14		C31	C8	R4
MASS OF WET SOIL + CONTAINER(g)	44.0		46.5		42.5	41.5	43.5
MASS OF DRY SOIL + CONTAINER(g)	40.0		42.0		40.5	39.5	41.5
MASS OF CONTAINER (g)	29.5		31		30	29	31
MASS OF DRY SOIL (g)	10.5		11.0		10.5	10.5	10.5
MASS OF WATER (g)	4.00		4.50		2.00	2.00	2.00
MOISTURE CONTENT %	38.1	38.1	40.9	39.3	19.0	19.0	19.0
No. BLOWS	26		16			19.0	

LINEAR SHRINKAGE	5
INITIAL LENGTH OF SPECIMEN (cm)	14.0
LENGTH OF OVERN DRY SPECIMEN (cm)	12.8
LINEAR SHRINKAGE %	9.4
LIQUID LIMIT (LL) %	38.7
PLASTIC LIMIT (PL) %	19.0
PLASTICITY INDEX (PI)	**20**
NATURAL MOISTURE CONTENT %	9.2
FINENESS INDEX	1020



REMARKS: SAMPLED FROM TRIAL PIT 08 @ 0.800-2.500M. SOLAR PV SITE INVESTIGATION

	Triaxial test - UU BS 1377 part 7, 1377 part 8			
	Site :	GOLOMOTI SOLAR PV	Levy date :	24-Jun-19
	Technicien's name :		Date of test :	24-Jun-19
GEOCONSULT LIMITED	File N° :	23	Survey depth (m) :	1.000
P.O. BOX 40 LILONGWE	Survey N° :	TRIAL PIT No. 8	Level of water (m) :	
	Kind of soil :	MOIST BROWN REDDISH SANDY SILTY LATERITE GRAVEL		

Identification of samples :

σvo, Total stress of the soil in situ (kPa) : 0.000

Uo, Pore pressure of the soil in situ (kPa) : 0.000

Category of soil : Steep/Strongly overconsolidated

Kind of drainage : Without lateral drain

ρs, Grain density (kg/m³) : 0.000

Sm : ☐

Sd : ☐

Samples before test :

	N°	Hi (mm)	Di (mm)	mi (g)	ρi (kg/m³)	ρdi (kg/m³)	wi (%)	ei	Sri (%)
🟦	1	76.00	38	177.0	2054	1700	20.82	-1.000	-0.000
🟥	2	76.00	38	172.5	2001	1659	20.63	-1.000	-0.000

Samples after saturation :

Ucp (kPa)	ΔVsat. (mm³)	B (%)
	0.000	0.000
	0.000	0.000

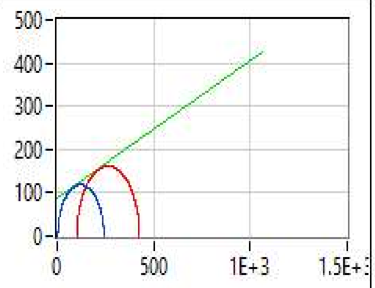
Samples after consolidation :

	N°	Hs (mm)	Ds (mm)	ΔVs (mm³)	T100 (min)	Vmax (µm/min)	σ'c (kPa)
🟦	1	76.00	38.00	0.000	0.000	0.000	0.000
🟥	2	76.00	38.00	0.000	0.000	0.000	0.000

Samples after shearing

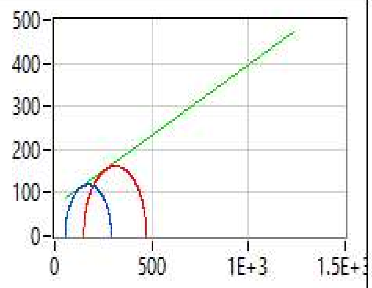
Hf (mm)	Df (mm)	mf (g)	md (g)	wf (%)	ρdf (kg/m³)	ef	Srf (%)
76.00	38.00	176.5	146.5	20.48	1700	-1.000	-0.000
76.00	38.00	171.5	143.0	19.93	1659	-1.000	-0.000

Total stress :



	Mohr
C (kPa)	85.55
φ (°)	17.75

Effective stress :



	Mohr	Lambe
C' (kPa)	68.34	64.93
φ' (°)	18.18	17.33

Comments :

Visa :

p.1/3

3.12 Trial Pit 09

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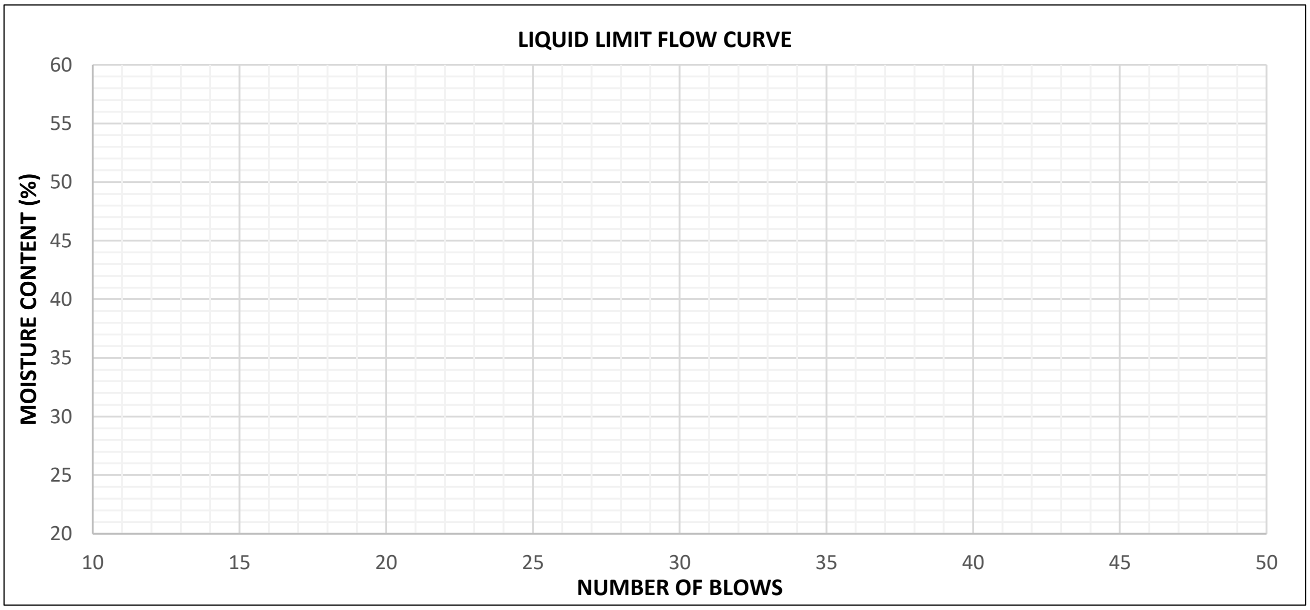
LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP09 / AL028 / 01MAY19		
SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 01 - 05 - 2019	TIME: 09:59	
LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 673 013	8 402 587	(m)	2.500-4.000
TYPE OF MATERIAL: MOIST BROWN REDDISH STIFF LATERITE GRAVELLEY SANDY SILTY CLAY				
TESTED BY: M. MILANZI		DATE: 24 - 05 - 2019	TIME: 11:52	
CHECKED BY: G. KACHIWALA		DATE: 31 - 05 - 2019	TIME: 09:35	
APPROVED BY: M. SABELLI		DATE: 31 - 05 - 2019	TIME: 14:18	

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

ATTERBURG LIMITS STANDARD: BS 1377, 2 (C)

TYPE OF TEST	**LIQUID LIMITS (LL)**				**PLASTIC LIMITS (PL)**		
TEST No.	1	2	3	4	1	2	3
CONTAINER No.	R30		C11		R24	K2	C15
MASS OF WET SOIL + CONTAINER(g)	57.0		57.0		45.5	40.5	46.5
MASS OF DRY SOIL + CONTAINER(g)	49.5		48.5		43.5	38.5	44.0
MASS OF CONTAINER (g)	29		29		32.5	27.5	30.5
MASS OF DRY SOIL (g)	20.5		19.5		11.0	11.0	13.5
MASS OF WATER (g)	7.50		8.50		2.00	2.00	2.50
MOISTURE CONTENT %	36.6	36.2	43.6	41.8	18.2	18.2	18.5
No. BLOWS	23		16			18.3	

LINEAR SHRINKAGE	1
INITIAL LENGTH OF SPECIMEN (cm)	14.0
LENGTH OF OVERN DRY SPECIMEN (cm)	12.5
LINEAR SHRINKAGE %	12.0
LIQUID LIMIT (LL) %	39.0
PLASTIC LIMIT (PL) %	18.3
PLASTICITY INDEX (PI)	**21**
NATURAL MOISTURE CONTENT %	9.9
FINENESS INDEX	1344



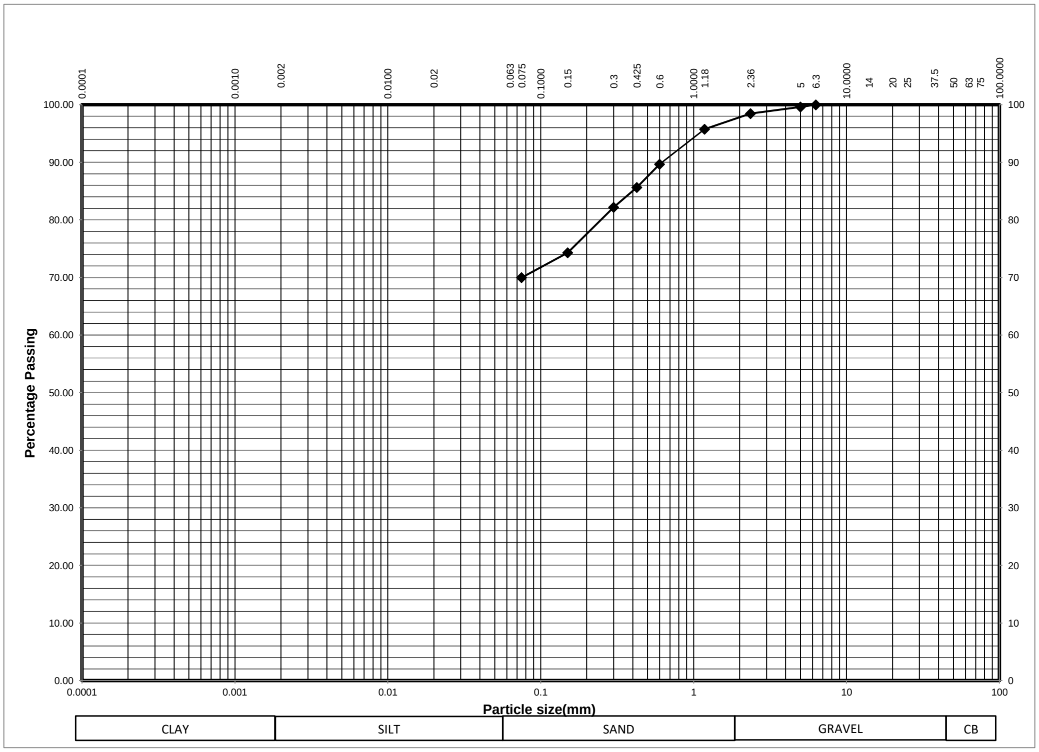
REMARKS: SAMPLED FROM TRIAL PIT 09 @ 2.500-4.000M. SOLAR PV SITE INVESTIGATION

GEOCONSULT	LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP09 / G026 / 01MAY19		
	SAMPLED BY: GEOCONSULT LAB TEAM		DATE: 01 / 05 / 2019	TIME: 09:10	
	LOCATION:	EASTING	NORTHING	ELEVATION	DEPTH (m)
	GOLOMOTI - SOLAR PV	0 673 013	8 402 587	(m)	0.100-1.000
	TYPE OF MATERIAL: MOIST DARK GREY SANDY SILTY CLAY				
	TESTED BY:G. KONDE		DATE: 25 - 05 - 2019	TIME: 11:20	
+265 0888 846 543	CHECKED BY: E. NKHUKU		DATE: 29 - 05 - 2019	TIME: 13:30	
sabelli@geoconsult.cc	APPROVED BY: M. SABELLI		DATE: 29 - 05 - 2019	TIME: 15:00	

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

SIEVE ANALYSIS (GRADATION) STANDARD: TRH14:1985

SIEVE	MASS	PERCENTAGE			GRADATION SPECIFICATION			ZONE
(mm)	RETAINED	RETAINED	PASSING		BASE	SUBBASE	SL SEAL	
75.000								
50.000								
37.500								
28.000								
25.000								
20.000								
14.000								
12.500								
10.000								
6.300	0.00	0.00	100.00	100				
5.000	2.00	0.40	99.60	100				
2.360	7.50	1.52	98.48	98				
1.180	21.00	4.25	95.75	96				
0.600	51.00	10.31	89.69	90				
0.425	71.00	14.36	85.64	86				
0.300	88.00	17.80	82.20	82				
0.150	127.00	25.68	74.32	74				
0.075	148.50	30.03	69.97	70				
0 pan	346.00	69.97						
TOTAL (g)	494.50							



REMARKS: SAMPLED FROM TRIAL PIT 09 @ 0.100-1.000M. **SOLAR PV SITE INVESTIGATION**

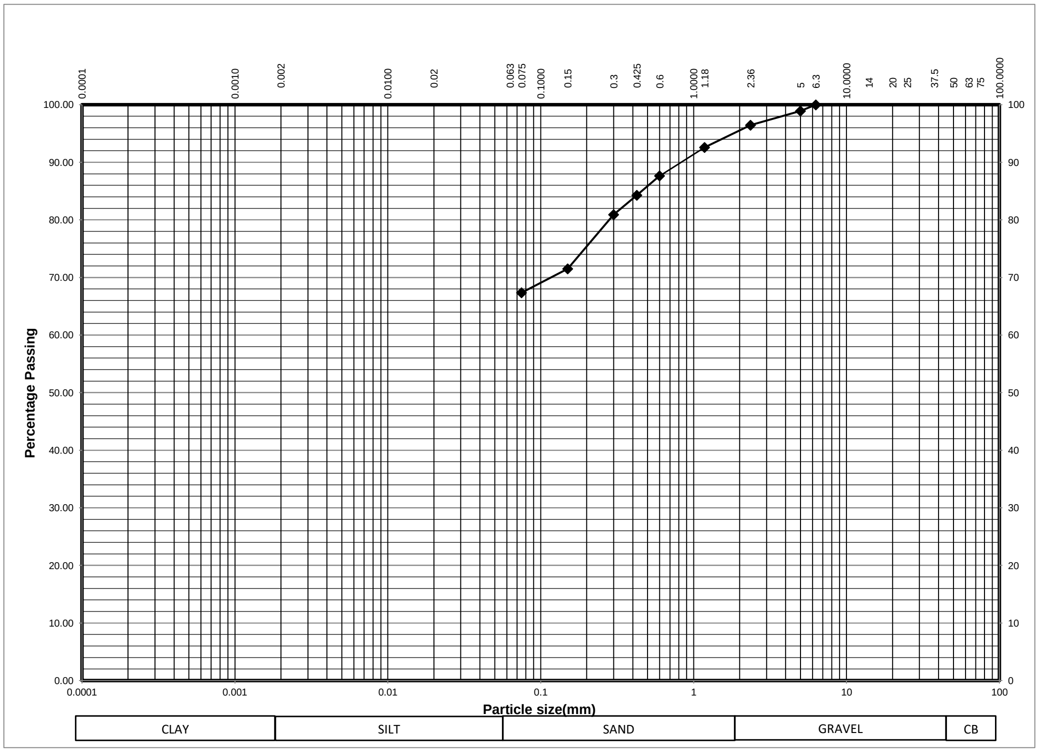
PAGE No.

GEOCONSULT	LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP09 / G027 / 01MAY19		
	SAMPLED BY: GEOCONSULT LAB TEAM		DATE: 01 / 05 / 2019	TIME: 09:42	
	LOCATION:	EASTING	NORTHING	ELEVATION	DEPTH (m)
	GOLOMOTI - SOLAR PV	0 673 013	8 402 587	(m)	1.000-2.500
	TYPE OF MATERIAL: MOIST BROWN STIFF GRAVELLEY SANDY SILTY CLAY CONTAINS SPOTS OF WHITISH DECOMPOSED ROCK				
	TESTED BY:G. KONDE		DATE: 25 - 05 - 2019	TIME: 11:20	
+265 0888 846 543	CHECKED BY: E. NKHUKU		DATE: 29 - 05 - 2019	TIME: 13:30	
sabelli@geoconsult.cc	APPROVED BY: M. SABELLI		DATE: 29 - 05 - 2019	TIME: 15:00	

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

SIEVE ANALYSIS (GRADATION) STANDARD: TRH14:1985

SIEVE	MASS	PERCENTAGE			GRADATION SPECIFICATION			ZONE
(mm)	RETAINED	RETAINED	PASSING		BASE	SUBBASE	SL SEAL	
75.000								
50.000								
37.500								
28.000								
25.000								
20.000								
14.000								
12.500								
10.000								
6.300	0.00	0.00	100.00	100				
5.000	5.50	1.09	98.91	99				
2.360	18.00	3.56	96.44	96				
1.180	37.50	7.42	92.58	93				
0.600	62.50	12.36	87.64	88				
0.425	79.50	15.73	84.27	84				
0.300	96.50	19.09	80.91	81				
0.150	144.00	28.49	71.51	72				
0.075	165.00	32.64	67.36	67				
0 pan	340.50	67.36						
TOTAL (g)	505.50							



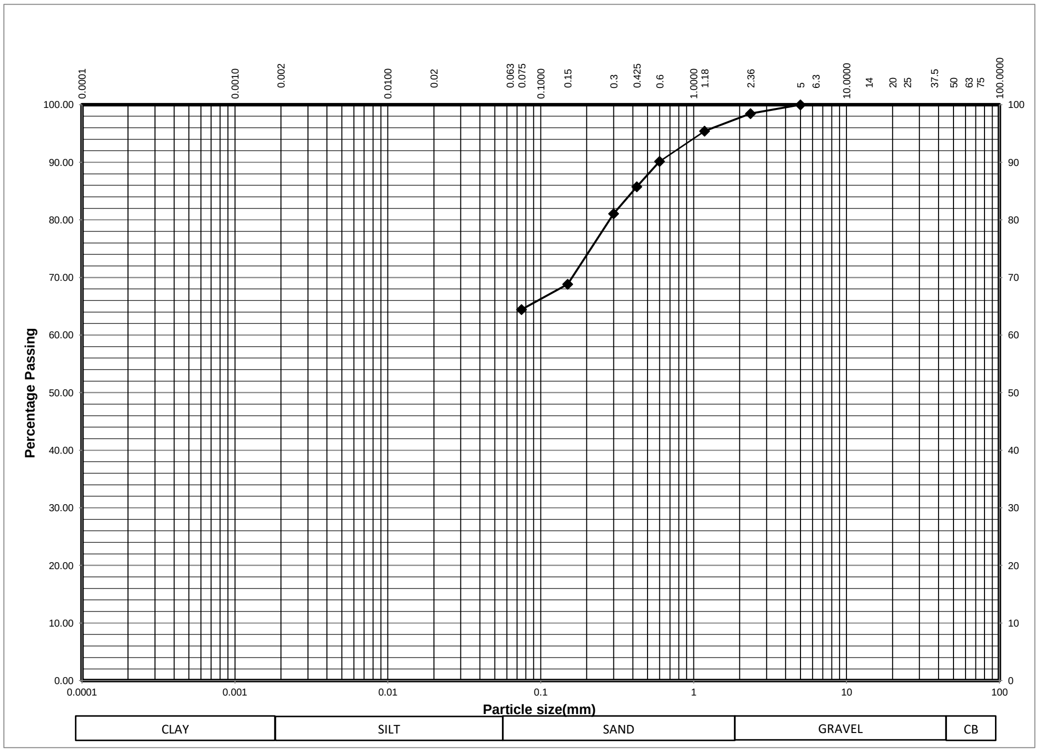
REMARKS: SAMPLED FROM TRIAL PIT 09 @ 1.000-2.500M. **SOLAR PV SITE INVESTIGATION**	**PAGE No.**

GEOCONSULT	LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP09 / G028 / 01MAY19		
	SAMPLED BY: GEOCONSULT LAB TEAM		DATE: 01 / 05 / 2019	TIME: 09:59	
	LOCATION:	EASTING	NORTHING	ELEVATION	DEPTH (m)
	GOLOMOTI - SOLAR PV	0 673 013	8 402 587	(m)	2.500-3.700
	TYPE OF MATERIAL: MOIST BROWN REDDISH STIFF LATERITE GRAVELLEY SANDY SILTY CLAY				
	TESTED BY:G. KONDE		DATE: 25 - 05 - 2019	TIME: 11:20	
+265 0888 846 543	CHECKED BY: E. NKHUKU		DATE: 29 - 05 - 2019	TIME: 13:30	
sabelli@geoconsult.cc	APPROVED BY: M. SABELLI		DATE: 29 - 05 - 2019	TIME: 15:00	

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

SIEVE ANALYSIS (GRADATION) STANDARD: TRH14:1985

SIEVE	MASS	PERCENTAGE			GRADATION SPECIFICATION			ZONE
(mm)	RETAINED	RETAINED	PASSING		BASE	SUBBASE	SL SEAL	
75.000								
50.000								
37.500								
28.000								
25.000								
20.000								
14.000								
12.500								
10.000								
6.300								
5.000	0.00	0.00	100.00	100				
2.360	7.00	1.53	98.47	98				
1.180	21.00	4.60	95.40	95				
0.600	45.00	9.85	90.15	90				
0.425	65.00	14.22	85.78	86				
0.300	86.50	18.93	81.07	81				
0.150	142.50	31.18	68.82	69				
0.075	162.50	35.56	64.44	64				
0 pan	294.50	64.44						
TOTAL (g)	457.00							



REMARKS: SAMPLED FROM TRIAL PIT 09 @ 2.500-3.700M. **SOLAR PV SITE INVESTIGATION**

PAGE No.

GEOCONSULT +265 0888 846 543 sabelli@geoconsult.cc	LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP09 / NMC026 / 01MAY19	
	SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 01 - 05 - 2019	TIME: 09:10
	LOCATION: 36 L UTM GOLOMOTI - SOLAR PV	EASTING 0 673 013	NORTHING 8 402 587	ELEVATION (m)	DEPTH (m) 0.200-1.000
	TYPE OF MATERIAL: MOIST DARK GREY SANDY SILTY CLAY			
	TESTED BY: C. NDALAMA		DATE: 05 - 05 - 2019	TIME: 13:38
	CHECKED BY: G. KACHIWALA		DATE: 06 - 05 - 2019	TIME: 09:46
	APPROVED BY: M. SABELLI		DATE: 06 - 05 - 2019	TIME: 10:00

PROJECT: GOLOMOTI SOLAR PV

CLIENT: JCM

NATURAL MOISTURE CONTENT - OVEN DRYING METHOD STANDARD: ASTM D7263

MASS OF WET SOIL + CONTAINER (g)		342.5	
MASS OF DRY SOIL AND CONTAINER (g)		318.0	
CONTAINER No.		GCC	
MASS OF CONTAINER (g)		96.0	
MASS OF DRY SOIL (g)		222.0	
MASS OF WATER (g)		24.5	
MOISTURE CONTENT %		11.0	
AVERAGE MOISTURE CONTENT %		**11.0**	

REMARKS: SAMPLED FROM TRIAL PIT 09 @0.200-1.000M. **SOLAR PV SITE INVESTIGATION**

PAGE No.

GEOCONSULT +265 0888 846 543 sabelli@geoconsult.cc	LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP09 / NMC027 / 01MAY19	
	SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 01 - 05 - 2019	TIME: 09:10
	LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
	GOLOMOTI - SOLAR PV	0 673 013	8 402 587	(m)	1.000-2.500
	TYPE OF MATERIAL: MOIST BROWN STIFF GRAVELLY SANDY SILTY CLAY CONTAINS SPOTS OF WHITISH DECOMPOSED ROCK			
	TESTED BY: C. NDALAMA		DATE: 05 - 05 - 2019	TIME: 13:38
	CHECKED BY: G. KACHIWALA		DATE: 06 - 05 - 2019	TIME: 09:46
	APPROVED BY: M. SABELLI		DATE: 06 - 05 - 2019	TIME: 10:00

PROJECT: GOLOMOTI SOLAR PV

CLIENT: JCM

NATURAL MOISTURE CONTENT - OVEN DRYING METHOD STANDARD: ASTM D7263

MASS OF WET SOIL + CONTAINER (g)		384.5	
MASS OF DRY SOIL AND CONTAINER (g)		354.5	
CONTAINER No.		GC65	
MASS OF CONTAINER (g)		104.0	
MASS OF DRY SOIL (g)		250.5	
MASS OF WATER (g)		30.0	
MOISTURE CONTENT %		12.0	
AVERAGE MOISTURE CONTENT %		**12.0**	

REMARKS: SAMPLED FROM TRIAL PIT 09 @1.000-2.500M. **SOLAR PV SITE INVESTIGATION**

PAGE No.

GEOCONSULT	LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP09 / NMC028 / 01MAY19		
	SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 01 - 05 - 2019	TIME: 09:59	
	LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
	GOLOMOTI - SOLAR PV	0 673 013	8 402 587	(m)	2.500-4.000
	TYPE OF MATERIAL: MOIST BROWN REDDISH STIFF LATERITE GRAVELLY SANDY SILTY CLAY				
	TESTED BY: C. NDALAMA		DATE: 05 - 05 - 2019	TIME: 13:38	
+265 0888 846 543	CHECKED BY: G. KACHIWALA		DATE: 06 - 05 - 2019	TIME: 09:46	
sabelli@geoconsult.cc	APPROVED BY: M. SABELLI		DATE: 06 - 05 - 2019	TIME: 10:00	

PROJECT: GOLOMOTI SOLAR PV

CLIENT: JCM

NATURAL MOISTURE CONTENT - OVEN DRYING METHOD STANDARD: ASTM D7263

MASS OF WET SOIL + CONTAINER (g)		385.5	
MASS OF DRY SOIL AND CONTAINER (g)		358.5	
CONTAINER No.		GCV	
MASS OF CONTAINER (g)		84.5	
MASS OF DRY SOIL (g)		274.0	
MASS OF WATER (g)		27.0	
MOISTURE CONTENT %		9.9	
AVERAGE MOISTURE CONTENT %		**9.9**	

REMARKS: SAMPLED FROM TRIAL PIT 09 @2.500-4.000M. **SOLAR PV SITE INVESTIGATION**

PAGE No.

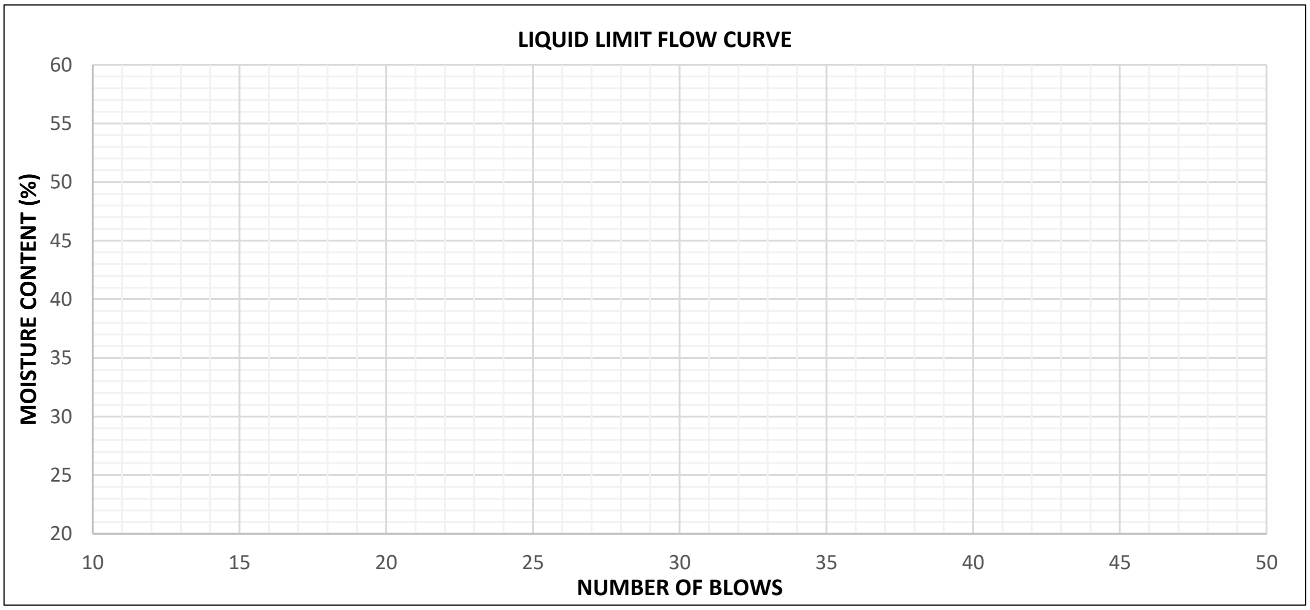
GEOCONSULT	LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP09 / AL026 / 01MAY19		
	SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 01 - 05 - 2019	TIME: 09:10	
	LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
	GOLOMOTI - SOLAR PV	0 673 013	8 402 587	(m)	0.200-1.000
	TYPE OF MATERIAL: MOIST DARK GREY SANDY SILTY CLAY				
	TESTED BY: M. MILANZI		DATE: 24 - 05 - 2019	TIME: 14:05	
+265 0888 846 543	CHECKED BY: G. KACHIWALA		DATE: 31 - 05 - 2019	TIME: 09:35	
sabelli@geoconsult.cc	APPROVED BY: M. SABELLI		DATE: 31 - 05 - 2019	TIME: 14:18	

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

ATTERBURG LIMITS STANDARD: BS 1377, 2 (C)

TYPE OF TEST	**LIQUID LIMITS (LL)**				**PLASTIC LIMITS (PL)**		
TEST No.	1	2	3	4	1	2	3
CONTAINER No.	R7		C8		C18	C25	C4
MASS OF WET SOIL + CONTAINER(g)	53.0		59.5		36.0	35.0	35.5
MASS OF DRY SOIL + CONTAINER(g)	46.5		50.5		34.5	33.0	34.0
MASS OF CONTAINER (g)	29.5		29		26.5	22	25.5
MASS OF DRY SOIL (g)	17.0		21.5		8.0	11.0	8.5
MASS OF WATER (g)	6.50		9.00		1.50	2.00	1.50
MOISTURE CONTENT %	38.2	39.0	41.9	40.2	18.8	18.2	17.6
No. BLOWS	30		16			18.2	

LINEAR SHRINKAGE	8
INITIAL LENGTH OF SPECIMEN (cm)	14.0
LENGTH OF OVERN DRY SPECIMEN (cm)	12.3
LINEAR SHRINKAGE %	13.8
LIQUID LIMIT (LL) %	39.6
PLASTIC LIMIT (PL) %	18.2
PLASTICITY INDEX (PI)	**21**
NATURAL MOISTURE CONTENT %	11.0
FINENESS INDEX	1470



REMARKS: SAMPLED FROM TRIAL PIT 09 @ 0.200-1.000M. SOLAR PV SITE INVESTIGATION

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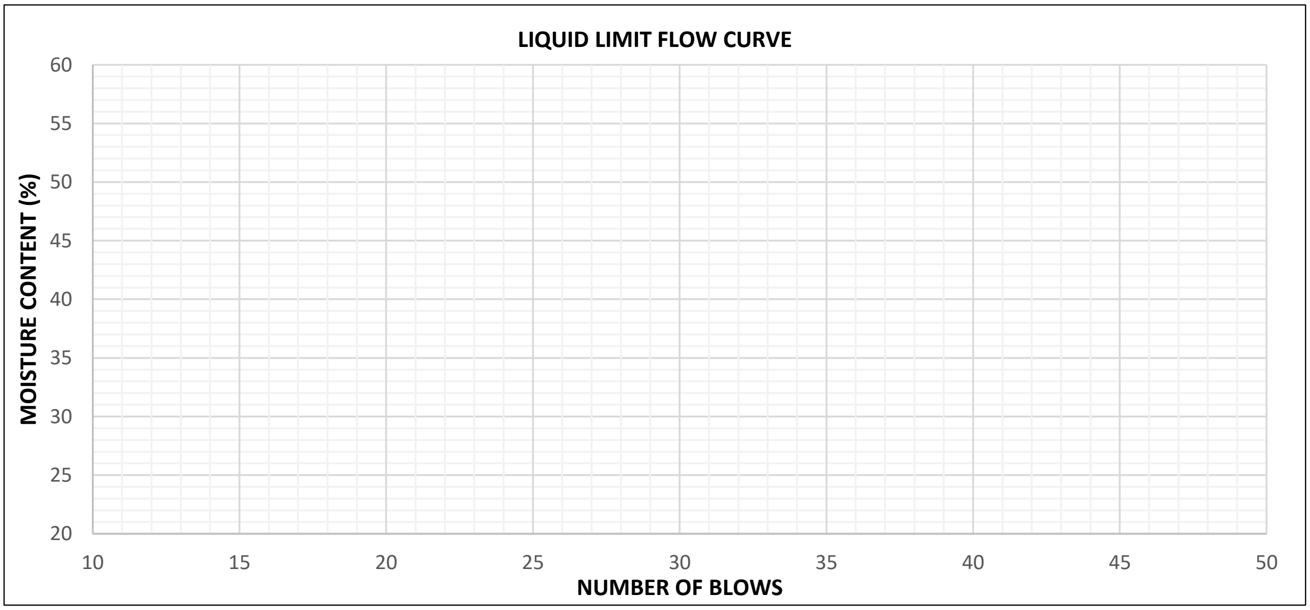
LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP09 / AL027 / 01MAY19		
SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 01 - 05 - 2019	TIME: 09:42	
LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 673 013	8 402 587	(m)	1.000-2.500
TYPE OF MATERIAL: MOIST BROWN STIFF GRAVELLEY SANDY SILTY CLAY CONTAINS SPOTS OF WHITISH DECOMPOSED ROCK				
TESTED BY: M. MILANZI		DATE: 24 - 05 - 2019	TIME: 11:52	
CHECKED BY: G. KACHIWALA		DATE: 31 - 05 - 2019	TIME: 09:35	
APPROVED BY: M. SABELLI		DATE: 31 - 05 - 2019	TIME: 14:18	

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

ATTERBURG LIMITS STANDARD: BS 1377, 2 (C)

TYPE OF TEST	**LIQUID LIMITS (LL)**				**PLASTIC LIMITS (PL)**		
TEST No.	1	2	3	4	1	2	3
CONTAINER No.	C31		C2		C26	R13	K29
MASS OF WET SOIL + CONTAINER(g)	46.5		55.5		36.5	38.5	36.5
MASS OF DRY SOIL + CONTAINER(g)	41.5		46.5		35.5	37.5	35.5
MASS OF CONTAINER (g)	30		26		29	31	29
MASS OF DRY SOIL (g)	11.5		20.5		6.5	6.5	6.5
MASS OF WATER (g)	5.00		9.00		1.00	1.00	1.00
MOISTURE CONTENT %	43.5	43.5	43.9	41.7	15.4	15.4	15.4
No. BLOWS	25		15			15.4	

LINEAR SHRINKAGE	6
INITIAL LENGTH OF SPECIMEN (cm)	14.0
LENGTH OF OVERN DRY SPECIMEN (cm)	12.4
LINEAR SHRINKAGE %	12.9
LIQUID LIMIT (LL) %	42.6
PLASTIC LIMIT (PL) %	15.4
PLASTICITY INDEX (PI)	**27**
NATURAL MOISTURE CONTENT %	12.0
FINENESS INDEX	1809



REMARKS: SAMPLED FROM TRIAL PIT 09 @ 1.000-2.500M. SOLAR PV SITE INVESTIGATION

Triaxial test - UU
BS 1377 part 7, 1377 part 8

GEOCONSULT LIMITED
P.O. BOX 40 LILONGWE

Site :	GOLOMOTI SOLAR PV	Levy date :	24-Jun-19
Technicien's name :		Date of test :	24-Jun-19
File N° :	22	Survey depth (m) :	
Survey N° :	TRIAL PIT No. 09	Level of water (m) :	
Kind of soil :	MOIST BROWN STIFF GRAVELLY SANDY SILTY CLAY CONTAINS SPOTS OF WHITISH		

Identification of samples :

σvo, Total stress of the soil in situ (kPa) : 0.000

Uo, Pore pressure of the soil in situ (kPa) : 0.000

Category of soil : Steep/Strongly overconsolidated

Kind of drainage : Without lateral drain

ρs, Grain density (kg/m³) : 0.000

Sm : ☐

Sd : ☐

Samples before test :

	N°	Hi (mm)	Di (mm)	mi (g)	ρi (kg/m³)	ρdi (kg/m³)	wi (%)	ei	Sri (%)
🟦	1	75.00	38	160.0	1881	1593	18.08	-1.000	-0.000
🟥	2	75.00	38	165.0	1940	1646	17.86	-1.000	-0.000

Samples after saturation :

Ucp (kPa)	ΔVsat. (mm³)	B (%)
	0.000	0.000
	0.000	0.000

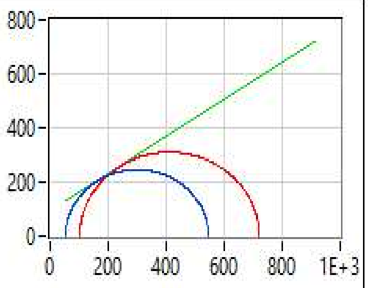
Samples after consolidation :

	N°	Hs (mm)	Ds (mm)	ΔVs (mm³)	T100 (min)	Vmax (µm/min)	σ'c (kPa)
🟦	1	75.00	38.00	0.000	0.000	0.000	0.000
🟥	2	75.00	38.00	0.000	0.000	0.000	0.000

Samples after shearing

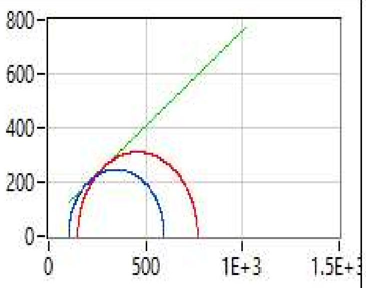
Hf (mm)	Df (mm)	mf (g)	md (g)	wf (%)	ρdf (kg/m³)	ef	Srf (%)
75.00	38.00	160.0	135.5	18.08	1593	-1.000	-0.000
75.00	38.00	165.0	140.0	17.86	1646	-1.000	-0.000

Total stress :



	Mohr
C (kPa)	92.88
φ (°)	34.49

Effective stress :



	Mohr	Lambe
C' (kPa)	55.97	45.76
φ' (°)	35.16	29.94

Comments :

Visa :

p.1/3

Triaxial test - UU
BS 1377 part 7, 1377 part 8

GEOCONSULT LIMITED

P.O. BOX 40 LILONGWE

Site :	GOLOMOTI SOLAR PV	Levy date :	14-Jun-19
Technicien's name :		Date of test :	14-Jun-19
File N° :	13	Survey depth (m) :	2.000
Survey N° :	TRIAL PIT No. 09	Level of water (m) :	
Kind of soil :	Moist Stiff Gravelley Sandy Silty CLAY contains spots of Whitish Decomposed Rock		

Identification of samples :

σvo, Total stress of the soil in situ (kPa) :	0.000	Uo, Pore pressure of the soil in situ (kPa) :	0.000
Category of soil :	Steep/Strongly overconsolidated	Kind of drainage :	Without lateral drain
ρs, Grain density (kg/m³) :	0.000		
Sm :	☐	Sd :	☐

Samples before test :

	N°	Hi (mm)	Di (mm)	mi (g)	ρi (kg/m³)	ρdi (kg/m³)	wi (%)	ei	Sri (%)
🟦	1	72.00	38	156.5	1917	1653	15.93	-1.000	-0.000
🟥	2	72.00	38	169.0	2070	1757	17.77	-1.000	-0.000

Samples after saturation :

Ucp (kPa)	ΔVsat. (mm³)	B (%)
	0.000	0.000
	0.000	0.000

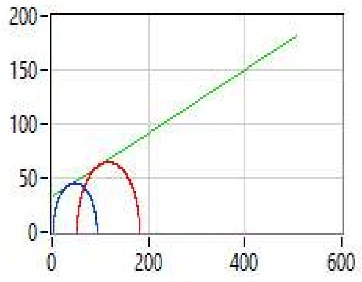
Samples after consolidation :

	N°	Hs (mm)	Ds (mm)	ΔVs (mm³)	T100 (min)	Vmax (µm/min)	σ'c (kPa)
🟦	1	72.00	38.00	0.000	0.000	0.000	0.000
🟥	2	72.00	38.00	0.000	0.000	0.000	0.000

Samples after shearing

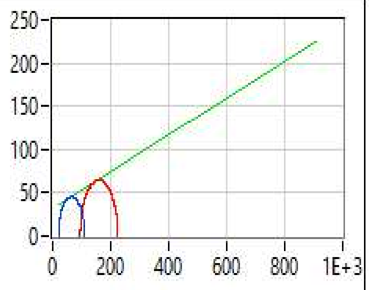
Hf (mm)	Df (mm)	mf (g)	md (g)	wf (%)	ρdf (kg/m³)	ef	Srf (%)
72.00	38.00	160.0	135.0	18.52	1653	-1.000	-0.000
72.00	38.00	168.5	143.5	17.42	1757	-1.000	-0.000

Total stress :



	Mohr
C (kPa)	33.36
φ (°)	16.32

Effective stress :



	Mohr	Lambe
C' (kPa)	32.88	32.18
φ' (°)	11.84	11.60

Comments :

Visa :

p.1/3

3.13 Trial Pit 10

LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP10 / AL031 / 01MAY19		
SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 01 - 05 - 2019	TIME: 11:23	
LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 673 006	8 402 499	548 (m)	3.000-4.000
TYPE OF MATERIAL: MOIST BROWN GRAVELLEY SANDY SILTY CLAY				
TESTED BY: M. MILANZI		DATE: 24 - 05 - 2019	TIME: 11:02	
CHECKED BY: S. THANGATO		DATE: 31 - 05 - 2019	TIME: 09:35	
APPROVED BY: M. SABELLI		DATE: 31 - 05 - 2019	TIME: 14:18	

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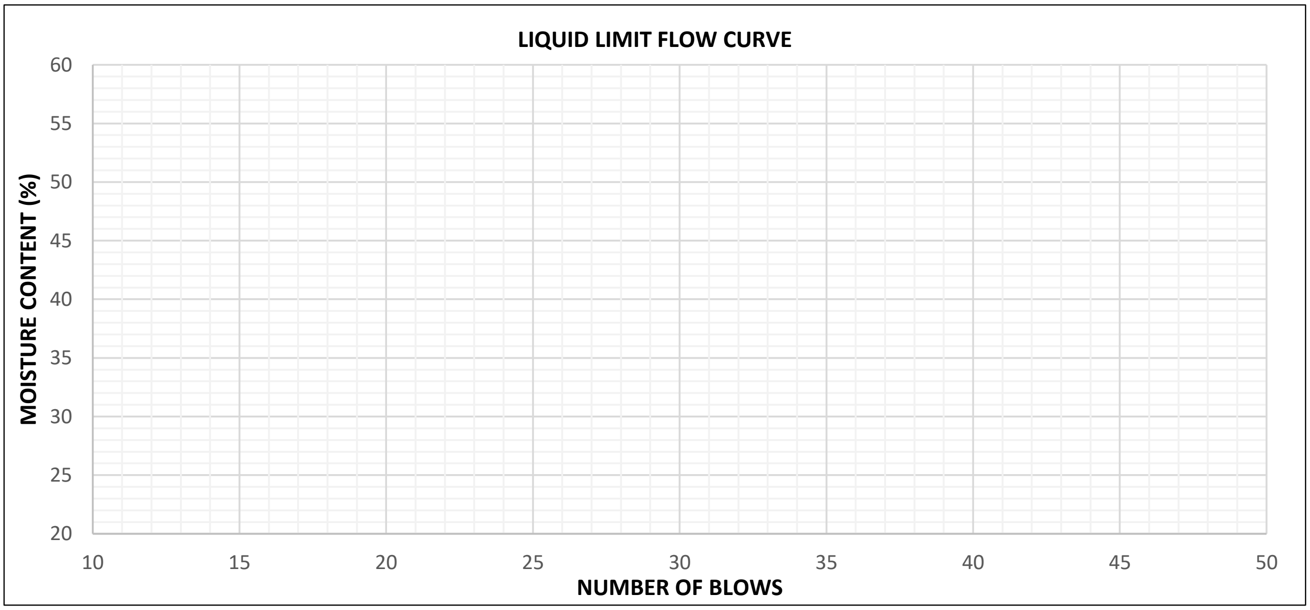
PROJECT: GOLOMOTI SOLAR PV

CLIENT: JCM

ATTERBURG LIMITS STANDARD: BS 1377, 2 (C)

TYPE OF TEST	LIQUID LIMITS (LL)				PLASTIC LIMITS (PL)		
TEST No.	1	2	3	4	1	2	3
CONTAINER No.	C13		R14		R22	RA1	R3
MASS OF WET SOIL + CONTAINER(g)	56.5		59.0		36.5	36.5	39.0
MASS OF DRY SOIL + CONTAINER(g)	49.0		50.5		35.5	35.5	37.5
MASS OF CONTAINER (g)	28		29		30	30	29.5
MASS OF DRY SOIL (g)	21.0		21.5		5.5	5.5	8.0
MASS OF WATER (g)	7.50		8.50		1.00	1.00	1.50
MOISTURE CONTENT %	35.7	36.1	39.5	38.0	18.2	18.2	18.8
No. BLOWS	28		17			18.4	

LINEAR SHRINKAGE	3
INITIAL LENGTH OF SPECIMEN (cm)	14.0
LENGTH OF OVERN DRY SPECIMEN (cm)	12.8
LINEAR SHRINKAGE %	9.4
LIQUID LIMIT (LL) %	37.0
PLASTIC LIMIT (PL) %	18.4
PLASTICITY INDEX (PI)	**19**
NATURAL MOISTURE CONTENT %	12.4
FINENESS INDEX	893



REMARKS: SAMPLED FROM TRIAL PIT 10 @ 3.000-4.000M. SOLAR PV SITE INVESTIGATION

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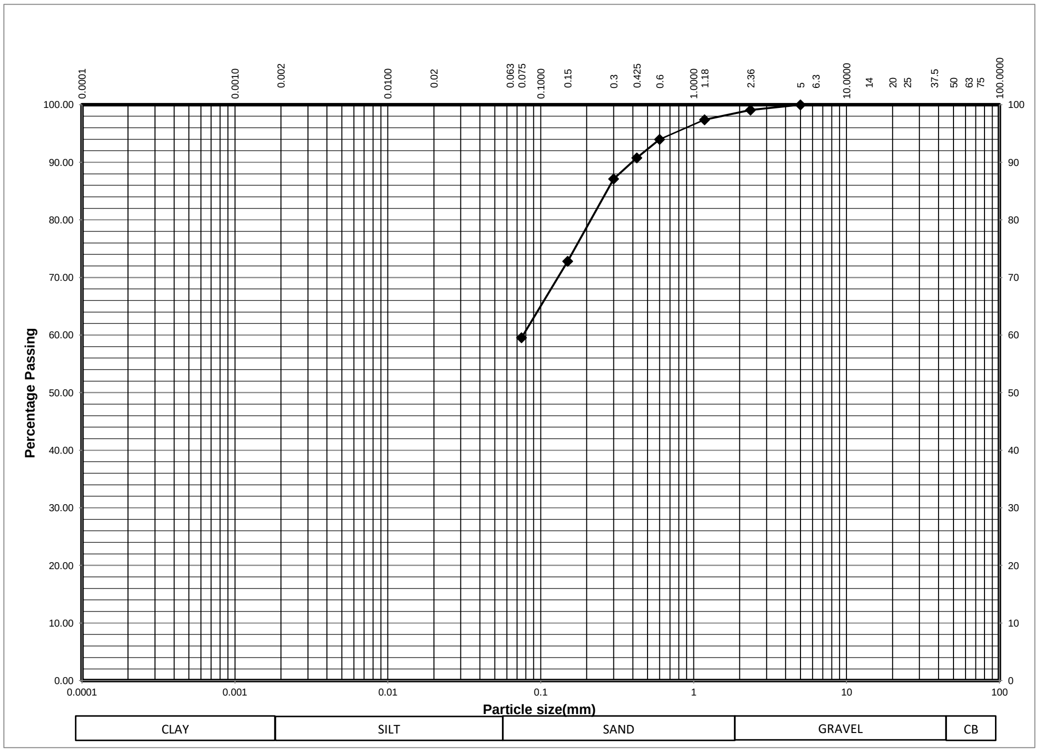
LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP10 / G029 / 01MAY19		
SAMPLED BY: GEOCONSULT LAB TEAM		DATE: 01 / 05 / 2019	TIME: 11:23	
LOCATION:	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 673 006	8 402 499	(m)	0.100-2.000
TYPE OF MATERIAL: MOIST DARK BROWN SANDY SILTY CLAY				
TESTED BY: G. KONDE		DATE: 28 - 05 - 2019	TIME: 11:20	
CHECKED BY: E. NKHUKU		DATE: 29 - 05 - 2019	TIME: 13:30	
APPROVED BY: M. SABELLI		DATE: 29 - 05 - 2019	TIME: 15:00	

PROJECT: GOLOMOTI SOLAR PV

CLIENT: JCM

SIEVE ANALYSIS (GRADATION) STANDARD: TRH14:1985

SIEVE	MASS	PERCENTAGE			GRADATION SPECIFICATION			ZONE
(mm)	RETAINED	RETAINED	PASSING		BASE	SUBBASE	SL SEAL	
75.000								
50.000								
37.500								
28.000								
25.000								
20.000								
14.000								
12.500								
10.000								
6.300								
5.000	0.00	0.00	100.00	100				
2.360	4.50	0.93	99.07	99				
1.180	12.50	2.59	97.41	97				
0.600	29.00	6.02	93.98	94				
0.425	44.50	9.23	90.77	91				
0.300	62.00	12.86	87.14	87				
0.150	131.00	27.18	72.82	73				
0.075	195.00	40.46	59.54	60				
0 pan	287.00	59.54						
TOTAL (g)	482.00							



REMARKS: SAMPLED FROM TRIAL PIT 10 @ 0.100-2.000M. **SOLAR PV SITE INVESTIGATION**

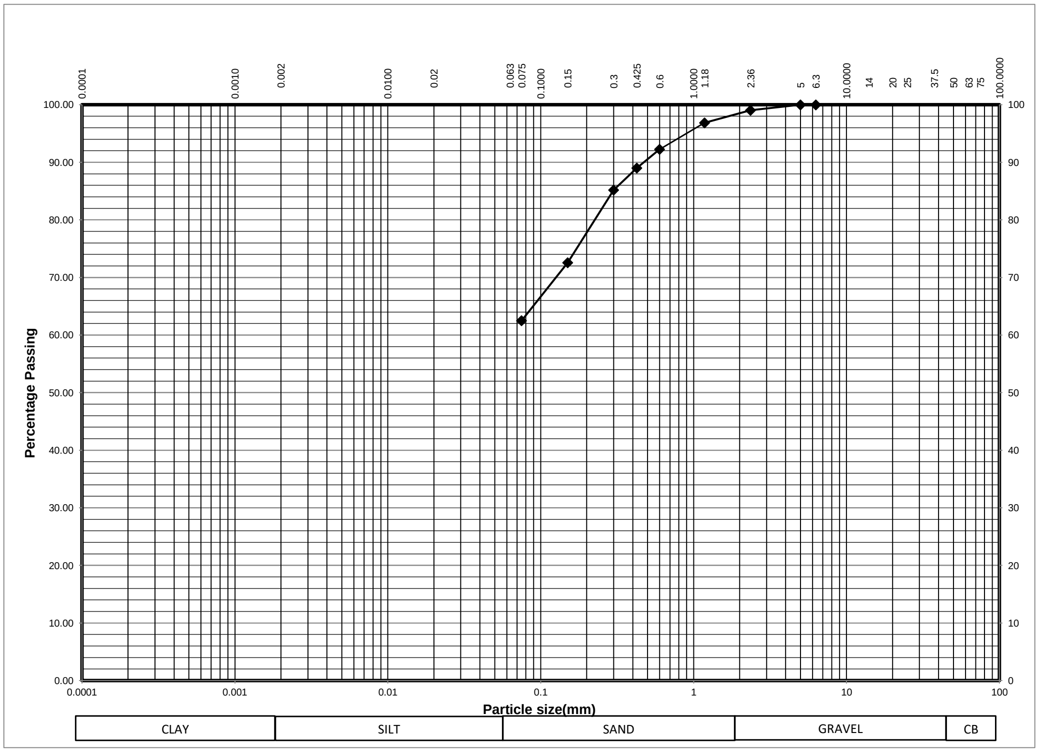
PAGE No.

GEOCONSULT	LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP10 / G030 / 01MAY19		
	SAMPLED BY: GEOCONSULT LAB TEAM		DATE: 01 / 05 / 2019	TIME: 11:23	
	LOCATION:	EASTING	NORTHING	ELEVATION	DEPTH (m)
	GOLOMOTI - SOLAR PV	0 673 006	8 402 499	(m)	2.000-3.000
	TYPE OF MATERIAL: MOIST DARK BROWN STIFF SANDY SILTY CLAY				
	TESTED BY: C. NDALAMA		DATE: 28 - 05 - 2019	TIME: 08:17	
+265 0888 846 543	CHECKED BY: G. KACHIWALA		DATE: 29 - 05 - 2019	TIME: 13:30	
sabelli@geoconsult.cc	APPROVED BY: M. SABELLI		DATE: 29 - 05 - 2019	TIME: 15:00	

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

SIEVE ANALYSIS (GRADATION) STANDARD: TRH14:1985

SIEVE	MASS	PERCENTAGE			GRADATION SPECIFICATION			ZONE
(mm)	RETAINED	RETAINED	PASSING		BASE	SUBBASE	SL SEAL	
75.000								
50.000								
37.500								
28.000								
25.000								
20.000								
14.000								
12.500								
10.000								
6.300	0.00	0.00	100.00	100				
5.000	0.00	0.00	100.00	100				
2.360	3.50	0.95	99.05	99				
1.180	11.50	3.13	96.88	97				
0.600	28.50	7.74	92.26	92				
0.425	40.50	11.01	88.99	89				
0.300	54.50	14.81	85.19	85				
0.150	101.00	27.45	72.55	73				
0.075	138.00	37.50	62.50	63				
0 pan	230.00	62.50						
TOTAL (g)	368.00							



REMARKS: SAMPLED FROM TRIAL PIT 10 @ 2.000-3.000M. **SOLAR PV SITE INVESTIGATION** **PAGE No.**

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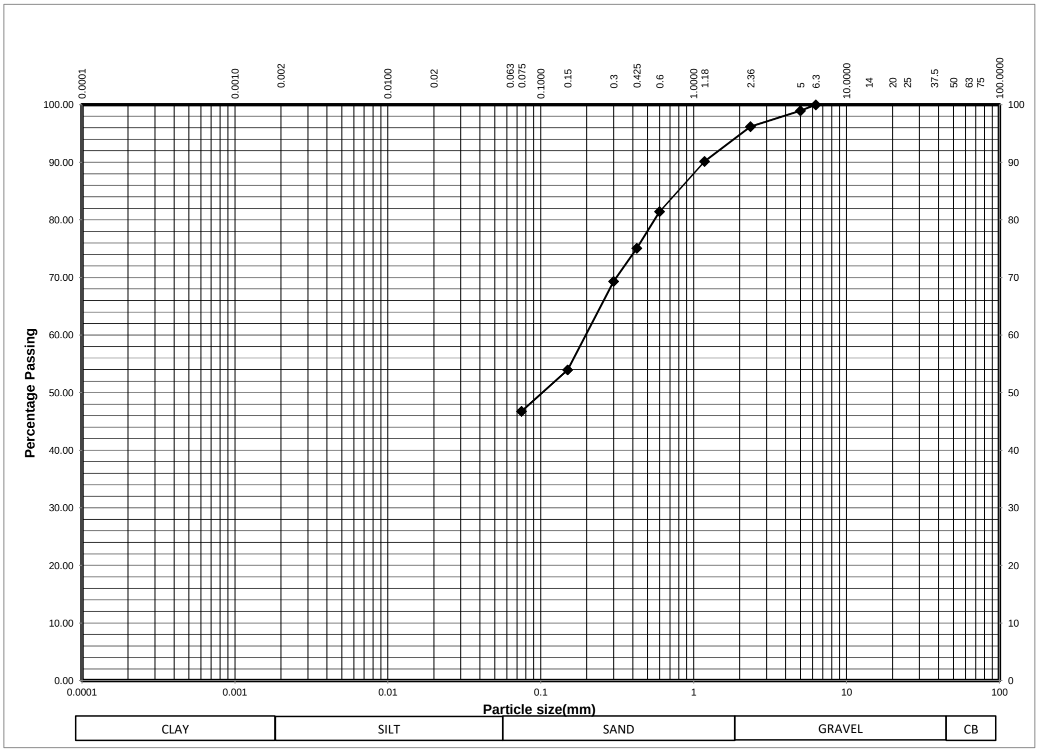
LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP10 / G031 / 01MAY19		
SAMPLED BY: GEOCONSULT LAB TEAM		DATE: 01 / 05 / 2019	TIME: 11:23	
LOCATION:	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 673 006	8 402 499	(m)	3.000-4.000
TYPE OF MATERIAL: MOIST BROWN GRAVELLY SANDY SILTY CLAY				
TESTED BY: G. KONDE		DATE: 28 - 05 - 2019	TIME: 11:20	
CHECKED BY: G. KACHIWALA		DATE: 29 - 05 - 2019	TIME: 13:30	
APPROVED BY: M. SABELLI		DATE: 29 - 05 - 2019	TIME: 15:00	

PROJECT: GOLOMOTI SOLAR PV

CLIENT: JCM

SIEVE ANALYSIS (GRADATION) STANDARD: TRH14:1985

SIEVE (mm)	MASS RETAINED	PERCENTAGE RETAINED	PASSING		GRADATION SPECIFICATION BASE	SUBBASE	SL SEAL	ZONE
75.000								
50.000								
37.500								
28.000								
25.000								
20.000								
14.000								
12.500								
10.000								
6.300	0.00	0.00	100.00	100				
5.000	5.00	1.03	98.97	99				
2.360	18.50	3.79	96.21	96				
1.180	48.00	9.85	90.15	90				
0.600	90.50	18.56	81.44	81				
0.425	121.50	24.92	75.08	75				
0.300	149.50	30.67	69.33	69				
0.150	224.50	46.05	53.95	54				
0.075	259.50	53.23	46.77	47				
0 pan	228.00	46.77						
TOTAL (g)	487.50							



REMARKS: SAMPLED FROM TRIAL PIT 10 @ 3.000-4.000M. **SOLAR PV SITE INVESTIGATION**

PAGE No.

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LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP010 / NMC029 / 01MAY19		
SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 01 - 05 - 2019	TIME: 11:23	
LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 673 006	8 402 499	(m)	0.100-2.000
TYPE OF MATERIAL: MOIST DARK BROWN SANDY SILTY CLAY				
TESTED BY: C. NDALAMA		DATE: 05 - 05 - 2019	TIME: 13:38	
CHECKED BY: G. KACHIWALA		DATE: 06 - 05 - 2019	TIME: 09:46	
APPROVED BY: M. SABELLI		DATE: 06 - 05 - 2019	TIME: 10:00	

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

NATURAL MOISTURE CONTENT - OVEN DRYING METHOD STANDARD: ASTM D7263

MASS OF WET SOIL + CONTAINER (g)		336.0	
MASS OF DRY SOIL AND CONTAINER (g)		299.0	
CONTAINER No.		GC7	
MASS OF CONTAINER (g)		73.5	
MASS OF DRY SOIL (g)		225.5	
MASS OF WATER (g)		37.0	
MOISTURE CONTENT %		16.4	
AVERAGE MOISTURE CONTENT %		**16.4**	

REMARKS: SAMPLED FROM TRIAL PIT 09 @0.100-2.000M. **SOLAR PV SITE INVESTIGATION** **PAGE No.**

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LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP010 / NMC030 / 01MAY19		
SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 01 - 05 - 2019	TIME: 11:23	
LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 673 006	8 402 499	(m)	2.000-3.000
TYPE OF MATERIAL: MOIST DARK BROWN STIFF SANDY SILTY CLAY				
TESTED BY: C. NDALAMA		DATE: 05 - 05 - 2019	TIME: 13:38	
CHECKED BY: G. KACHIWALA		DATE: 06 - 05 - 2019	TIME: 09:46	
APPROVED BY: M. SABELLI		DATE: 06 - 05 - 2019	TIME: 10:00	

PROJECT: GOLOMOTI SOLAR PV

CLIENT: JCM

NATURAL MOISTURE CONTENT - OVEN DRYING METHOD STANDARD: ASTM D7263

MASS OF WET SOIL + CONTAINER (g)		376.0	
MASS OF DRY SOIL AND CONTAINER (g)		344.0	
CONTAINER No.		GC28C	
MASS OF CONTAINER (g)		89.0	
MASS OF DRY SOIL (g)		255.0	
MASS OF WATER (g)		32.0	
MOISTURE CONTENT %		12.5	
AVERAGE MOISTURE CONTENT %		**12.5**	

REMARKS: SAMPLED FROM TRIAL PIT 09 @2.000-3.000M. **SOLAR PV SITE INVESTIGATION**

PAGE No.

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LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP010 / NMC031 / 01MAY19		
SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 01 - 05 - 2019	TIME: 11:23	
LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 673 006	8 402 499	(m)	3.000-4.000
TYPE OF MATERIAL: MOIST BROWN GEAVELLY SANDY SILTY CLAY				
TESTED BY: C. NDALAMA		DATE: 05 - 05 - 2019	TIME: 13:38	
CHECKED BY: G. KACHIWALA		DATE: 06 - 05 - 2019	TIME: 09:46	
APPROVED BY: M. SABELLI		DATE: 06 - 05 - 2019	TIME: 10:00	

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

NATURAL MOISTURE CONTENT - OVEN DRYING METHOD STANDARD: ASTM D7263

MASS OF WET SOIL + CONTAINER (g)		292.0	
MASS OF DRY SOIL AND CONTAINER (g)		265.5	
CONTAINER No.		GC14B	
MASS OF CONTAINER (g)		52.0	
MASS OF DRY SOIL (g)		213.5	
MASS OF WATER (g)		26.5	
MOISTURE CONTENT %		12.4	
AVERAGE MOISTURE CONTENT %		**12.4**	

REMARKS: SAMPLED FROM TRIAL PIT 10@3.000-4.000M. **SOLAR PV SITE INVESTIGATION** **PAGE No.**

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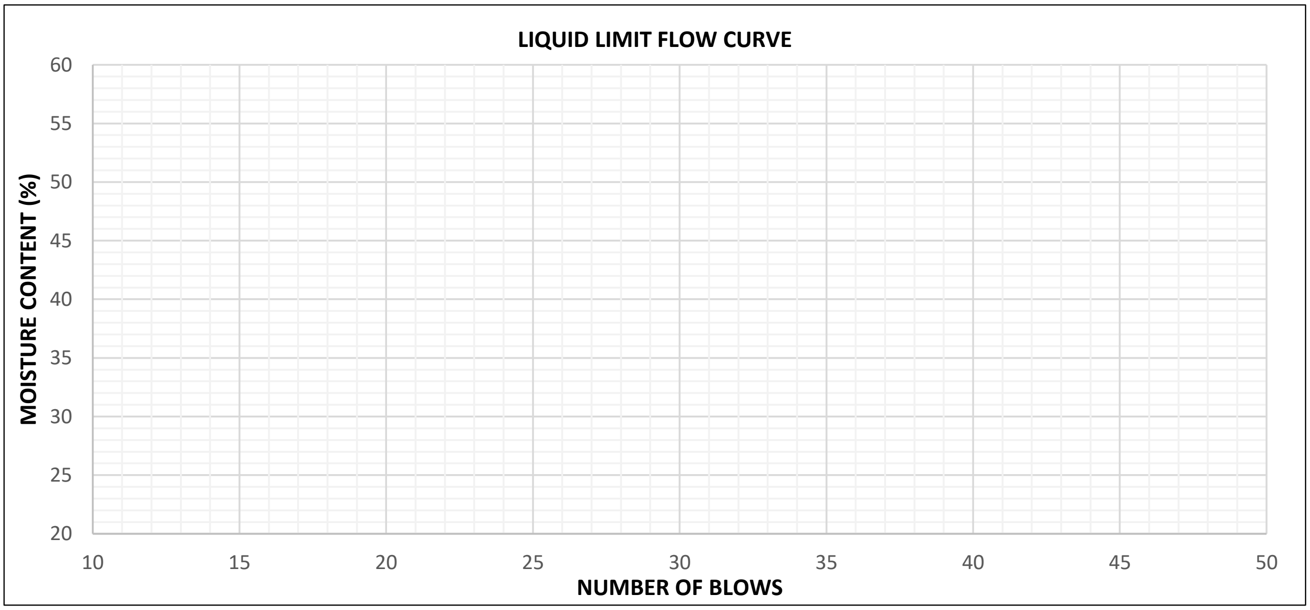
LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP10 / AL029 / 01MAY19		
SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 01 - 05 - 2019	TIME: 11:23	
LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 643 006	8 402 499	(m)	0.100-2.000
TYPE OF MATERIAL: MOIST DARK BROWN SANDY SILTY CLAY				
TESTED BY: M. MILANZI		DATE: 27 - 05 - 2019	TIME: 15:41	
CHECKED BY: G. KACHIWALA		DATE: 31 - 05 - 2019	TIME: 09:35	
APPROVED BY: M. SABELLI		DATE: 31 - 05 - 2019	TIME: 14:18	

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

ATTERBURG LIMITS STANDARD: BS 1377, 2 (C)

TYPE OF TEST	LIQUID LIMITS (LL)				PLASTIC LIMITS (PL)		
TEST No.	1	2	3	4	1	2	3
CONTAINER No.	R18		C17		C19	R20	R17
MASS OF WET SOIL + CONTAINER(g)	48.5		52.5		39.5	37.0	40.0
MASS OF DRY SOIL + CONTAINER(g)	44.0		46.0		37.0	35.5	38.0
MASS OF CONTAINER (g)	29		26		25	28	28
MASS OF DRY SOIL (g)	15.0		20.0		12.0	7.5	10.0
MASS OF WATER (g)	4.50		6.50		2.50	1.50	2.00
MOISTURE CONTENT %	30.0	30.6	32.5	32.2	20.8	20.0	20.0
No. BLOWS	34		22			20.3	

LINEAR SHRINKAGE	19
INITIAL LENGTH OF SPECIMEN (cm)	14.0
LENGTH OF OVERN DRY SPECIMEN (cm)	13.5
LINEAR SHRINKAGE %	3.7
LIQUID LIMIT (LL) %	31.4
PLASTIC LIMIT (PL) %	20.3
PLASTICITY INDEX (PI)	**11**
NATURAL MOISTURE CONTENT %	11.0
FINENESS INDEX	660



REMARKS: SAMPLED FROM TRIAL PIT 10 @ 0.100-2.000M. SOLAR PV SITE INVESTIGATION

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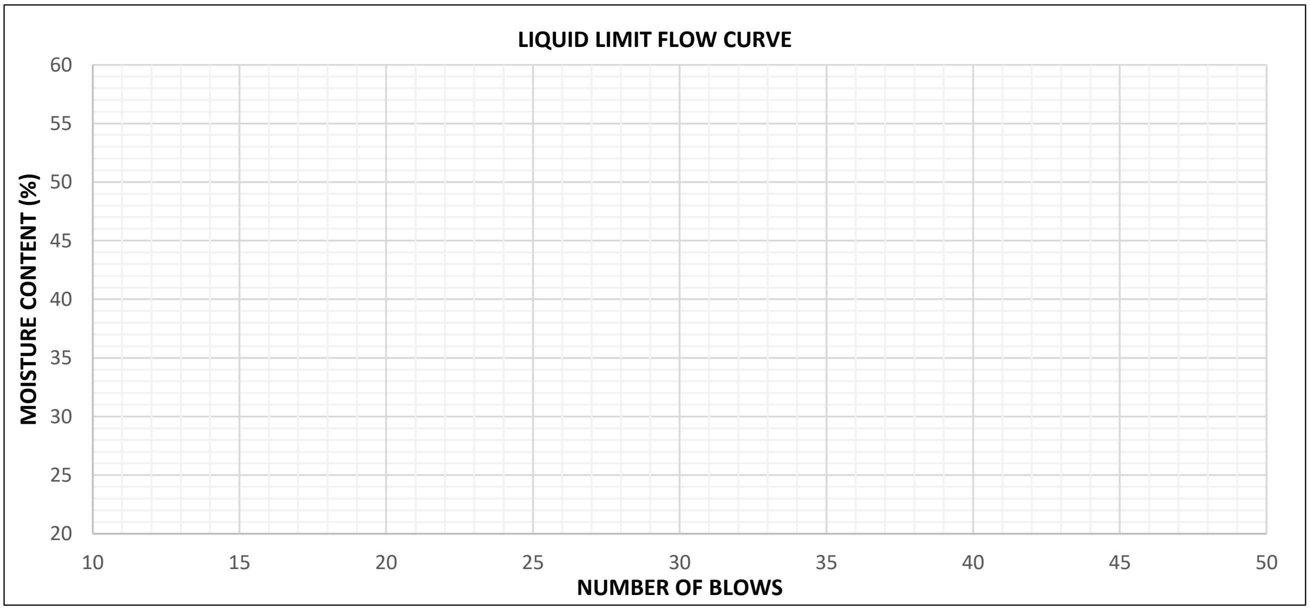
LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP10 / AL030 / 01MAY19		
SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 01 - 05 - 2019	TIME: 11:23	
LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 643 006	8 402 499	(m)	2.000-3.000
TYPE OF MATERIAL: MOIST DARK BROWN STIFF SANDY SILTY CLAY				
TESTED BY: M. MILANZI		DATE: 27 - 05 - 2019	TIME: 15:41	
CHECKED BY: G. KACHIWALA		DATE: 31 - 05 - 2019	TIME: 09:35	
APPROVED BY: M. SABELLI		DATE: 31 - 05 - 2019	TIME: 14:18	

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

ATTERBURG LIMITS STANDARD: BS 1377, 2 (C)

TYPE OF TEST	LIQUID LIMITS (LL)				PLASTIC LIMITS (PL)		
TEST No.	1	2	3	4	1	2	3
CONTAINER No.	R18		C17		C19	R20	R17
MASS OF WET SOIL + CONTAINER(g)	48.5		52.5		39.5	37.0	40.0
MASS OF DRY SOIL + CONTAINER(g)	44.0		46.0		37.0	35.5	38.0
MASS OF CONTAINER (g)	30.5		29.5		25	28	28
MASS OF DRY SOIL (g)	13.5		16.5		12.0	7.5	10.0
MASS OF WATER (g)	4.50		6.50		2.50	1.50	2.00
MOISTURE CONTENT %	33.3	34.0	39.4	39.0	20.8	20.0	20.0
No. BLOWS	34		22			20.3	

LINEAR SHRINKAGE	19
INITIAL LENGTH OF SPECIMEN (cm)	14.0
LENGTH OF OVERN DRY SPECIMEN (cm)	13.0
LINEAR SHRINKAGE %	7.7
LIQUID LIMIT (LL) %	36.5
PLASTIC LIMIT (PL) %	20.3
PLASTICITY INDEX (PI)	**16**
NATURAL MOISTURE CONTENT %	12.5
FINENESS INDEX	1008



REMARKS: SAMPLED FROM TRIAL PIT 10 @ 2.000-3.000M. SOLAR PV SITE INVESTIGATION

Triaxial test - UU
BS 1377 part 7, 1377 part 8

GEOCONSULT LIMITED

P.O. BOX 40 LILONGWE

Site :	GOLOMOTI SOALR PV	Levy date :	26-Jun-19
Technicien's name :		Date of test :	26-Jun-19
File N° :	30	Survey depth (m) :	1.000
Survey N° :	TRIAL PIT No. 10	Level of water (m) :	
Kind of soil :	Moist Dark Brown Sandy Silty CLAY		

Identification of samples :

σvo, Total stress of the soil in situ (kPa) :	0.000	Uo, Pore pressure of the soil in situ (kPa) :	0.000
Category of soil :	Soft/Granular	Kind of drainage :	Without lateral drain
ρs, Grain density (kg/m³) :	0.000		
Sm :	☐	Sd :	☐

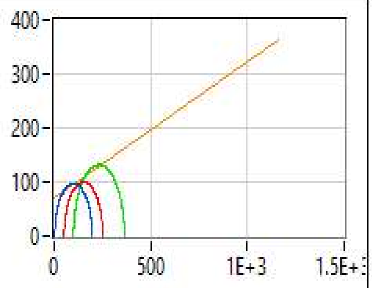
Samples before test : / Samples after saturation :

	N°	Hi (mm)	Di (mm)	mi (g)	ρi (kg/m³)	ρdi (kg/m³)	wi (%)	ei	Sri (%)	Ucp (kPa)	ΔVsat. (mm³)	B (%)
🟦	1	76.00	38	162.0	1880	1520	23.66	-1.000	-0.000		0.000	0.000
🟥	2	76.00	38	159.0	1845	1497	23.26	-1.000	-0.000		0.000	0.000
🟩	3	76.00	38	159.0	1845	1479	24.71	-1.000	-0.000		0.000	0.000

Samples after consolidation : / Samples after shearing

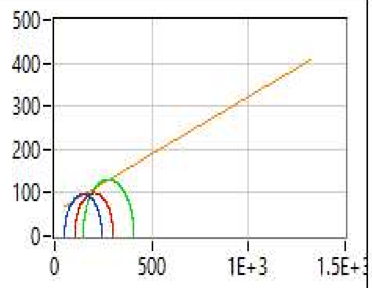
	N°	Hs (mm)	Ds (mm)	ΔVs (mm³)	T100 (min)	Vmax (µm/min)	σ'c (kPa)	Hf (mm)	Df (mm)	mf (g)	md (g)	wf (%)	ρdf (kg/m³)	ef	Srf (%)
🟦	1	76.00	38.00	0.000	0.000	0.000	0.000	76.00	38.00	162.0	131.0	23.66	1520	-1.000	-0.000
🟥	2	76.00	38.00	0.000	0.000	0.000	0.000	76.00	38.00	159.0	129.0	23.26	1497	-1.000	-0.000
🟩	3	76.00	38.00	0.000	0.000	0.000	0.000	76.00	38.00	158.0	127.5	23.92	1479	-1.000	-0.000

Total stress :



	Mohr
C (kPa)	69.22
φ (°)	14.23

Effective stress :



	Mohr	Lambe
C' (kPa)	54.50	51.77
φ' (°)	15.01	15.45

Comments :

Visa : p.1/3

3.14 Trial Pit 11

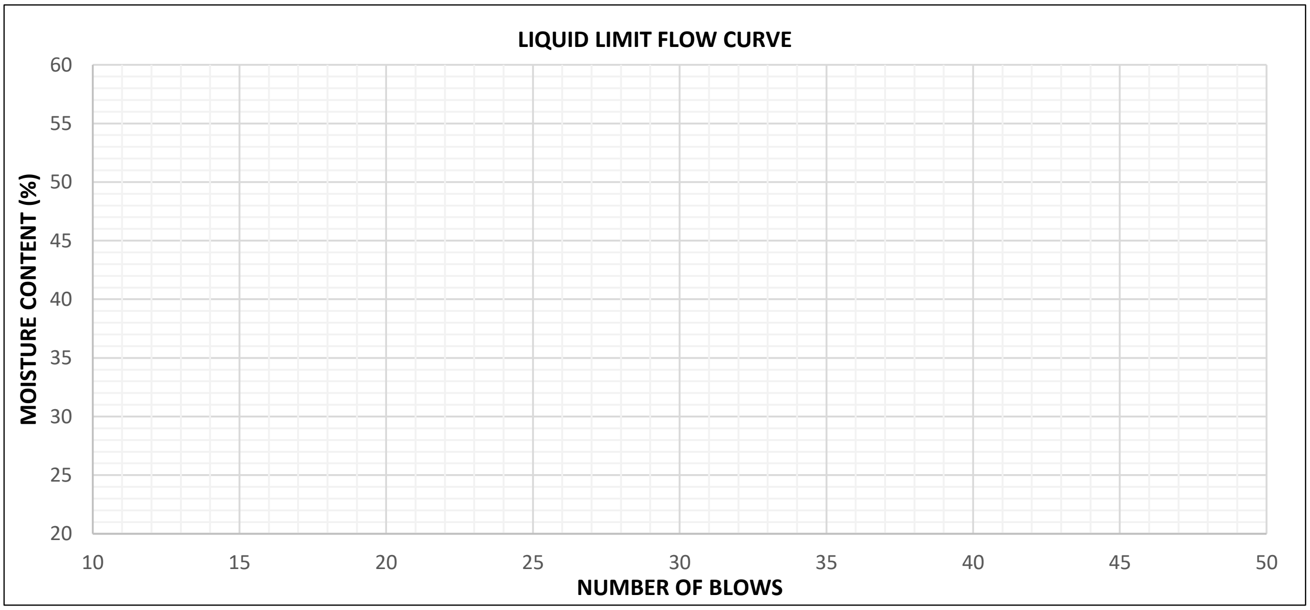
GEOCONSULT	LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP11 / AL033 / 01MAY19			
	SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 01 - 05 - 2019	TIME: 12:45		
	LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)	
	GOLOMOTI - SOLAR PV	0 672 996	8 402 377	(m)	2.000-4.200	
	TYPE OF MATERIAL: MOIST BROWN SANDY SILTY CLAY					
	TESTED BY: M. MILANZI		DATE: 24 - 05 - 2019	TIME: 14:44		
+265 0888 846 543	CHECKED BY: S. THANGATO		DATE: 31 - 05 - 2019	TIME: 09:35		
sabelli@geoconsult.cc	APPROVED BY: M. SABELLI		DATE: 31 - 05 - 2019	TIME: 14:18		

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

ATTERBURG LIMITS STANDARD: BS 1377, 2 (C)

TYPE OF TEST	**LIQUID LIMITS (LL)**				**PLASTIC LIMITS (PL)**		
TEST No.	1	2	3	4	1	2	3
CONTAINER No.	C20		C17		R10	R27	R8
MASS OF WET SOIL + CONTAINER(g)	54.0		56.5		44.5	44.5	44.0
MASS OF DRY SOIL + CONTAINER(g)	48.5		48.5		42.5	42.0	41.5
MASS OF CONTAINER (g)	30		26.5		32.5	30	29
MASS OF DRY SOIL (g)	18.5		22.0		10.0	12.0	12.5
MASS OF WATER (g)	5.50		8.00		2.00	2.50	2.50
MOISTURE CONTENT %	29.7	30.0	36.4	35.3	20.0	20.8	20.0
No. BLOWS	28		18			20.3	

LINEAR SHRINKAGE	4
INITIAL LENGTH OF SPECIMEN (cm)	14.0
LENGTH OF OVERN DRY SPECIMEN (cm)	12.9
LINEAR SHRINKAGE %	8.5
LIQUID LIMIT (LL) %	32.6
PLASTIC LIMIT (PL) %	20.3
PLASTICITY INDEX (PI)	**12**
NATURAL MOISTURE CONTENT %	13.0
FINENESS INDEX	576



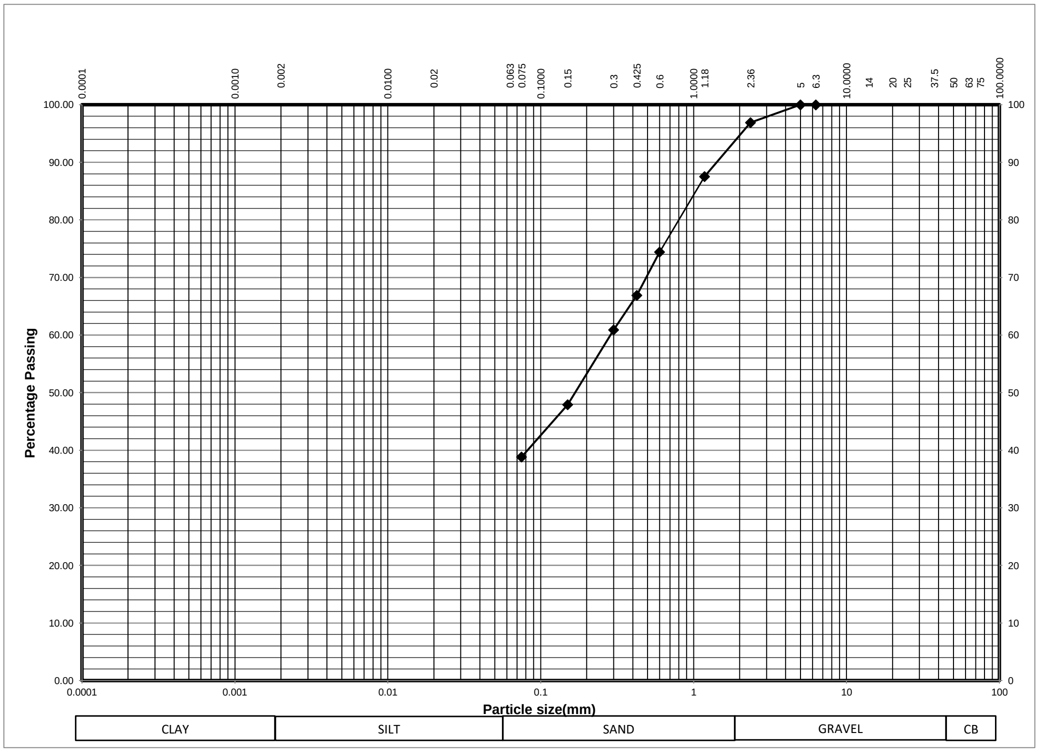
REMARKS: SAMPLED FROM TRIAL PIT 11 @ 2.000-4.200M. SOLAR PV SITE INVESTIGATION

GEOCONSULT	LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP11 / G032 / 01MAY19		
	SAMPLED BY: GEOCONSULT LAB TEAM		DATE: 01 / 05 / 2019	TIME: 12:17	
	LOCATION:	EASTING	NORTHING	ELEVATION	DEPTH (m)
	GOLOMOTI - SOLAR PV	0 672 996	8 402 377	(m)	0.100-2.000
	TYPE OF MATERIAL: MOIST DARK BROWN SANDY SILTY CLAY				
	TESTED BY: G. KONDE		DATE: 28 - 05 - 2019	TIME: 11:20	
+265 0888 846 543	CHECKED BY:G. KACHIWALA		DATE: 29 - 05 - 2019	TIME: 13:30	
sabelli@geoconsult.cc	APPROVED BY: M. SABELLI		DATE: 29 - 05 - 2019	TIME: 15:00	

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

SIEVE ANALYSIS (GRADATION) STANDARD: TRH14:1985

SIEVE	MASS	PERCENTAGE			GRADATION SPECIFICATION			ZONE
(mm)	RETAINED	RETAINED	PASSING		BASE	SUBBASE	SL SEAL	
75.000								
50.000								
37.500								
28.000								
25.000								
20.000								
14.000								
12.500								
10.000								
6.300	0.00	0.00	100.00	100				
5.000	0.00	0.00	100.00	100				
2.360	12.00	3.12	96.88	97				
1.180	48.00	12.47	87.53	88				
0.600	98.50	25.58	74.42	74				
0.425	127.50	33.12	66.88	67				
0.300	150.50	39.09	60.91	61				
0.150	200.50	52.08	47.92	48				
0.075	235.50	61.17	38.83	39				
0 pan	149.50	38.83						
TOTAL (g)	385.00							



REMARKS: SAMPLED FROM TRIAL PIT 11 @ 0.100-2.000M. **SOLAR PV SITE INVESTIGATION** **PAGE No.**

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LAB REF: GC499 / 04MAY19 / 15:00	SAMPLE No. GSPV / TP11 / G033 / 01MAY19
SAMPLED BY: GEOCONSULT LAB TEAM	DATE: 01 / 05 / 2019 TIME: 12:45

LOCATION:	EASTING	NORTHING	ELEVATION (m)	DEPTH (m)
GOLOMOTI - SOLAR PV	0 672 996	8 402 377		2.000-4.200

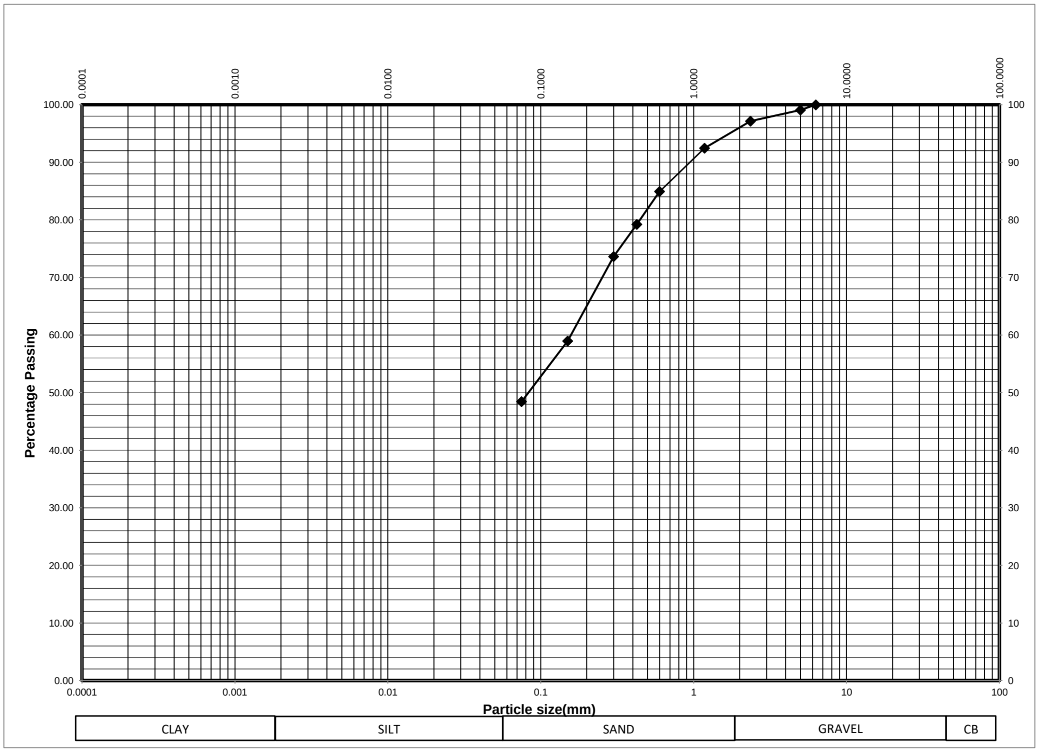
TYPE OF MATERIAL: MOIST BROWN SANDY SILTY CLAY

TESTED BY: G. KONDE	DATE: 28 - 05 - 2019	TIME: 11:20
CHECKED BY: E. NKHUKU	DATE: 29 - 05 - 2019	TIME: 13:30
APPROVED BY: M. SABELLI	DATE: 29 - 05 - 2019	TIME: 15:00

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

SIEVE ANALYSIS (GRADATION) STANDARD: TRH14:1985

SIEVE (mm)	MASS RETAINED	PERCENTAGE RETAINED	PERCENTAGE PASSING		GRADATION SPECIFICATION BASE	GRADATION SPECIFICATION SUBBASE	GRADATION SPECIFICATION SL SEAL	ZONE
75.000								
50.000								
37.500								
28.000								
25.000								
20.000								
14.000								
12.500								
10.000								
6.300	0.00	0.00	100.00	100				
5.000	3.50	0.91	99.09	99				
2.360	11.00	2.86	97.14	97				
1.180	29.00	7.53	92.47	92				
0.600	58.00	15.06	84.94	85				
0.425	80.00	20.78	79.22	79				
0.300	101.50	26.36	73.64	74				
0.150	158.00	41.04	58.96	59				
0.075	198.50	51.56	48.44	48				
0 pan	186.50	48.44						
TOTAL (g)	385.00							



REMARKS: SAMPLED FROM TRIAL PIT 11 @ 2.000-4.200M. **SOLAR PV SITE INVESTIGATION**

PAGE No.

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LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP011 / NMC032 / 01MAY19		
SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 01 - 05 - 2019	TIME: 12:45	
LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 672 996	8 402 377	(m)	0.100-2.000
TYPE OF MATERIAL: MOIST DARK BROWN SANDY SILTY CLAY				
TESTED BY: C. NDALAMA		DATE: 05 - 05 - 2019	TIME: 13:38	
CHECKED BY: G. KACHIWALA		DATE: 06 - 05 - 2019	TIME: 09:46	
APPROVED BY: M. SABELLI		DATE: 06 - 05 - 2019	TIME: 10:00	

PROJECT: GOLOMOTI SOLAR PV

CLIENT: JCM

NATURAL MOISTURE CONTENT - OVEN DRYING METHOD STANDARD: ASTM D7263

MASS OF WET SOIL + CONTAINER (g)		336.0	
MASS OF DRY SOIL AND CONTAINER (g)		301.0	
CONTAINER No.		GC7	
MASS OF CONTAINER (g)		73.5	
MASS OF DRY SOIL (g)		227.5	
MASS OF WATER (g)		35.0	
MOISTURE CONTENT %		15.4	
AVERAGE MOISTURE CONTENT %		**15.4**	

REMARKS: SAMPLED FROM TRIAL PIT 09 @0.100-2.000M. **SOLAR PV SITE INVESTIGATION**

PAGE No.

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sabelli@geoconsult.cc

LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP011 / NMC033 / 01MAY19		
SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 01 - 05 - 2019	TIME: 12:45	
LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 672 996	8 402 377	(m)	2.000-4.200
TYPE OF MATERIAL: MOIST BROWN SANDY SILTY CLAY				
TESTED BY: C. NDALAMA		DATE: 05 - 05 - 2019	TIME: 13:38	
CHECKED BY: G. KACHIWALA		DATE: 06 - 05 - 2019	TIME: 09:46	
APPROVED BY: M. SABELLI		DATE: 06 - 05 - 2019	TIME: 10:00	

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

NATURAL MOISTURE CONTENT - OVEN DRYING METHOD STANDARD: ASTM D7263

MASS OF WET SOIL + CONTAINER (g)		386.0	
MASS OF DRY SOIL AND CONTAINER (g)		350.0	
CONTAINER No.		GC7	
MASS OF CONTAINER (g)		73.5	
MASS OF DRY SOIL (g)		276.5	
MASS OF WATER (g)		36.0	
MOISTURE CONTENT %		13.0	
AVERAGE MOISTURE CONTENT %		**13.0**	

REMARKS: SAMPLED FROM TRIAL PIT 09 @2.000-4.200M. **SOLAR PV SITE INVESTIGATION** **PAGE No.**

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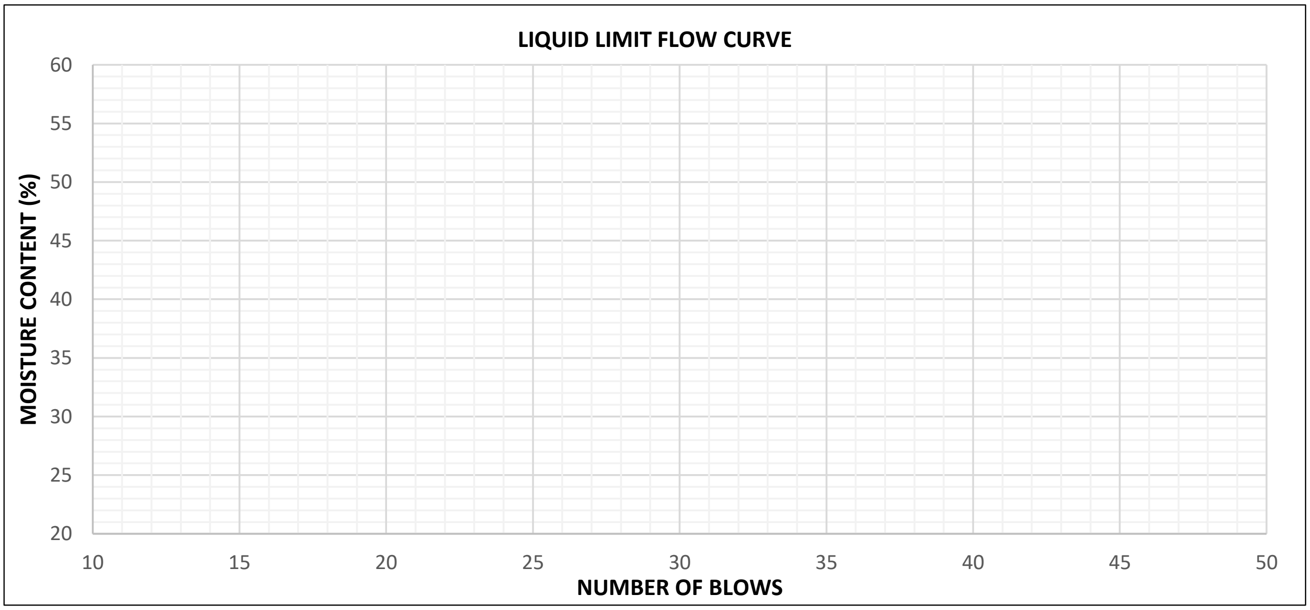
LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP11 / AL032 / 01MAY19		
SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 01 - 05 - 2019	TIME: 12:17	
LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 672 996	8 402 377	(m)	0.100-2.000
TYPE OF MATERIAL: MOIST DARK BROWN SANDY SILTY CLAY				
TESTED BY: M. MILANZI		DATE: 27 - 05 - 2019	TIME: 11:02	
CHECKED BY: G. KACHIWALA		DATE: 31 - 05 - 2019	TIME: 09:35	
APPROVED BY: M. SABELLI		DATE: 31 - 05 - 2019	TIME: 14:18	

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

ATTERBURG LIMITS STANDARD: BS 1377, 2 (C)

TYPE OF TEST	**LIQUID LIMITS (LL)**				**PLASTIC LIMITS (PL)**		
TEST No.	1	2	3	4	1	2	3
CONTAINER No.	R24		R16		R21	K3	R14
MASS OF WET SOIL + CONTAINER(g)	53.5		52.5		34.5	39.0	35.5
MASS OF DRY SOIL + CONTAINER(g)	47.5		45.5		33.5	37.5	34.5
MASS OF CONTAINER (g)	31.5		28.5		27	28	28
MASS OF DRY SOIL (g)	16.0		17.0		6.5	9.5	6.5
MASS OF WATER (g)	6.00		7.00		1.00	1.47	1.00
MOISTURE CONTENT %	37.5	36.8	41.2	39.5	15.4	15.4	15.4
No. BLOWS	21		16			15.4	

LINEAR SHRINKAGE	6
INITIAL LENGTH OF SPECIMEN (cm)	14.0
LENGTH OF OVERN DRY SPECIMEN (cm)	12.7
LINEAR SHRINKAGE %	10.2
LIQUID LIMIT (LL) %	38.1
PLASTIC LIMIT (PL) %	15.4
PLASTICITY INDEX (PI)	**23**
NATURAL MOISTURE CONTENT %	15.4
FINENESS INDEX	1357



REMARKS: SAMPLED FROM TRIAL PIT 11 @ 0.100-2.000M. SOLAR PV SITE INVESTIGATION

	Triaxial test - UU BS 1377 part 7, 1377 part 8			
	Site :	GOLOMOTI SOLAR PV	Levy date :	25-Jun-19
	Technicien's name :		Date of test :	25-Jun-19
GEOCONSULT LIMITED	File N° :	25	Survey depth (m) :	1.000
P.O. BOX 40 LILONGWE	Survey N° :	TRIAL PIT No. 11	Level of water (m) :	
	Kind of soil :			Moist Dark Brown Sandy Silty CLAY

Identification of samples :

σvo, Total stress of the soil in situ (kPa) :	0.000	Uo, Pore pressure of the soil in situ (kPa) :	0.000
Category of soil :	Soft/Granular	Kind of drainage :	Without lateral drain
ρs, Grain density (kg/m^3) :	0.000		
Sm :	☐	Sd :	☐

Samples before test :

	N°	Hi (mm)	Di (mm)	mi (g)	ρi (kg/m^3)	ρdi (kg/m^3)	wi (%)	ei	Sri (%)
🟦	1	76.00	38	175.0	2030	1740	16.67	-1.000	-0.000
🟥	2	76.00	38	171.0	1984	1734	14.38	-1.000	-0.000

Samples after saturation :

Ucp (kPa)	ΔVsat. (mm^3)	B (%)
	0.000	0.000
	0.000	0.000

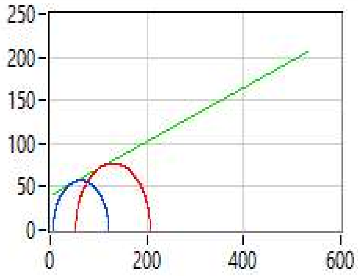
Samples after consolidation :

	N°	Hs (mm)	Ds (mm)	ΔVs (mm^3)	T100 (min)	Vmax (µm/min)	σ'c (kPa)
🟦	1	76.00	38.00	0.000	0.000	0.000	0.000
🟥	2	76.00	38.00	0.000	0.000	0.000	0.000

Samples after shearing

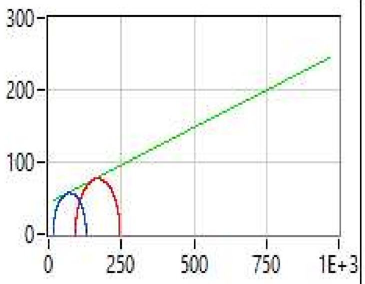
Hf (mm)	Df (mm)	mf (g)	md (g)	wf (%)	ρdf (kg/m^3)	ef	Srf (%)
76.00	38.00	174.5	150.0	16.33	1740	-1.000	-0.000
76.00	38.00	171.5	149.5	14.72	1734	-1.000	-0.000

Total stress :



	Mohr
C (kPa)	40.12
φ (°)	17.37

Effective stress :



	Mohr	Lambe
C' (kPa)	43.62	42.71
φ' (°)	11.76	11.52

Comments :

Visa :

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P.O. BOX 40 LILONGWE

Triaxial test - UU
BS 1377 part 7, 1377 part 8

Site :	GOLOMOTI SOLAR PV	Levy date :	21-Jun-19
Technicien's name :		Date of test :	21-Jun-19
File N° :	19	Survey depth (m) :	2.000
Survey N° :	TRIL PIT No. 11	Level of water (m) :	
Kind of soil :			MOIST BROWN SANDY SILTY CLAY

Identification of samples :

σvo, Total stress of the soil in situ (kPa) : 0.000

Uo, Pore pressure of the soil in situ (kPa) : 0.000

Category of soil : Soft/Granular

Kind of drainage : Without lateral drain

ρs, Grain density (kg/m^3) : 0.000

Sm : ☐

Sd : ☐

Samples before test :

	N°	Hi (mm)	Di (mm)	mi (g)	ρi (kg/m^3)	ρdi (kg/m^3)	wi (%)	ei	Sri (%)
🟦	1	76.00	38	168.0	1949	1717	13.51	-1.000	-0.000
🟥	2	76.00	38	151.0	1752	1578	11.03	-1.000	-0.000

Samples after saturation :

Ucp (kPa)	ΔVsat. (mm^3)	B (%)
	0.000	0.000
	0.000	0.000

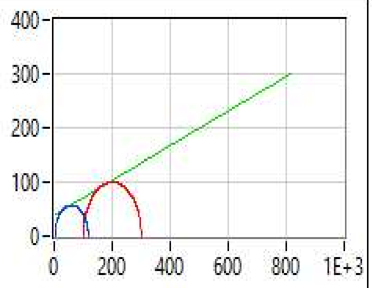
Samples after consolidation :

	N°	Hs (mm)	Ds (mm)	ΔVs (mm^3)	T100 (min)	Vmax (μm/min)	σ'_c (kPa)
🟦	1	76.00	38.00	0.000	0.000	0.000	0.000
🟥	2	76.00	38.00	0.000	0.000	0.000	0.000

Samples after shearing

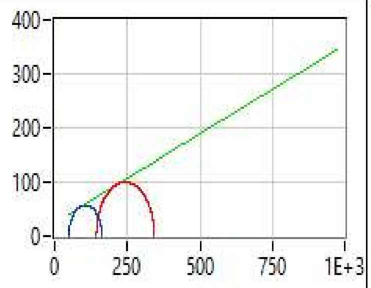
Hf (mm)	Df (mm)	mf (g)	md (g)	wf (%)	ρdf (kg/m^3)	ef	Srf (%)
76.00	38.00	167.0	148.0	12.84	1717	-1.000	-0.000
76.00	38.00	148.5	136.0	9.191	1578	-1.000	-0.000

Total stress :



	Mohr
C (kPa)	40.95
φ (°)	17.66

Effective stress :



	Mohr	Lambe
C' (kPa)	26.03	24.75
φ' (°)	18.04	17.21

Comments :

Visa :

p.1/3

3.15 Trial Pit 12

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LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP12 / AL036 / 02MAY19		
SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 02 - 05 - 2019	TIME: 09:57	
LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 672 650	8 402 797	(m)	3.000-3.800
TYPE OF MATERIAL: MOIST BROWN REDDISH STIFF GRAVELLY SANDY SILTY CLAY				
TESTED BY: M. MILANZI		DATE: 27 - 05 - 2019	TIME: 13:14	
CHECKED BY: G. KACHIWALA		DATE: 31 - 05 - 2019	TIME: 09:35	
APPROVED BY: M. SABELLI		DATE: 31 - 05 - 2019	TIME: 14:18	

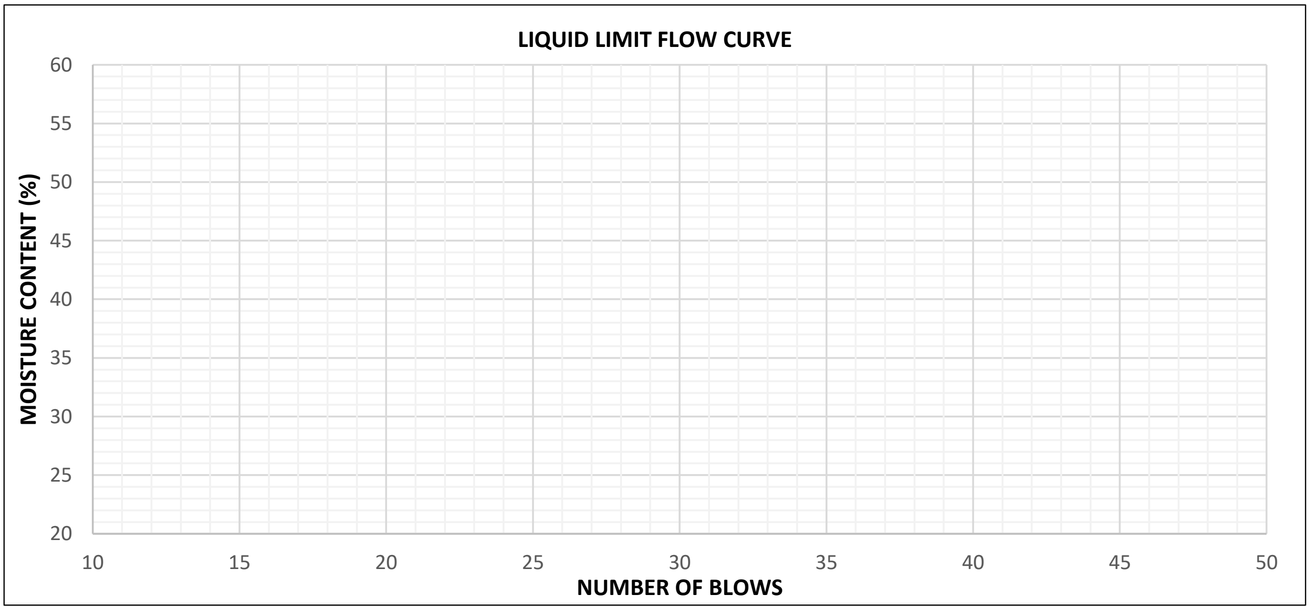
PROJECT: GOLOMOTI SOLAR PV

CLIENT: JCM

ATTERBURG LIMITS STANDARD: BS 1377, 2 (C)

TYPE OF TEST	**LIQUID LIMITS (LL)**				**PLASTIC LIMITS (PL)**		
TEST No.	1	2	3	4	1	2	3
CONTAINER No.	K3		R16		C14	R13	R5
MASS OF WET SOIL + CONTAINER(g)	65.5		63.0		46.0	42.0	42.5
MASS OF DRY SOIL + CONTAINER(g)	57.5		55.0		44.0	40.5	40.5
MASS OF CONTAINER (g)	28.5		28.5		31	31	27.5
MASS OF DRY SOIL (g)	29.0		26.5		13.0	9.5	13.0
MASS OF WATER (g)	8.00		8.00		2.00	1.50	2.00
MOISTURE CONTENT %	27.6	27.9	30.2	29.0	15.4	15.8	15.4
No. BLOWS	29		16			15.5	

LINEAR SHRINKAGE	12
INITIAL LENGTH OF SPECIMEN (cm)	14.0
LENGTH OF OVERN DRY SPECIMEN (cm)	13.2
LINEAR SHRINKAGE %	6.1
LIQUID LIMIT (LL) %	28.4
PLASTIC LIMIT (PL) %	15.5
PLASTICITY INDEX (PI)	**13**
NATURAL MOISTURE CONTENT %	9.3
FINENESS INDEX	840



REMARKS: SAMPLED FROM TRIAL PIT 12 @ 3.000-3.800M. SOLAR PV SITE INVESTIGATION

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LAB REF: GC499 / 04MAY19 / 15:00
SAMPLE No. GSPV / TP012 / G034 / 02MAY19
SAMPLED BY: GEOCONSULT LAB TEAM
DATE: 02 / 05 / 2019
TIME: 08:49

LOCATION:	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 672 650	8 403 797	(m)	0.100-1.500

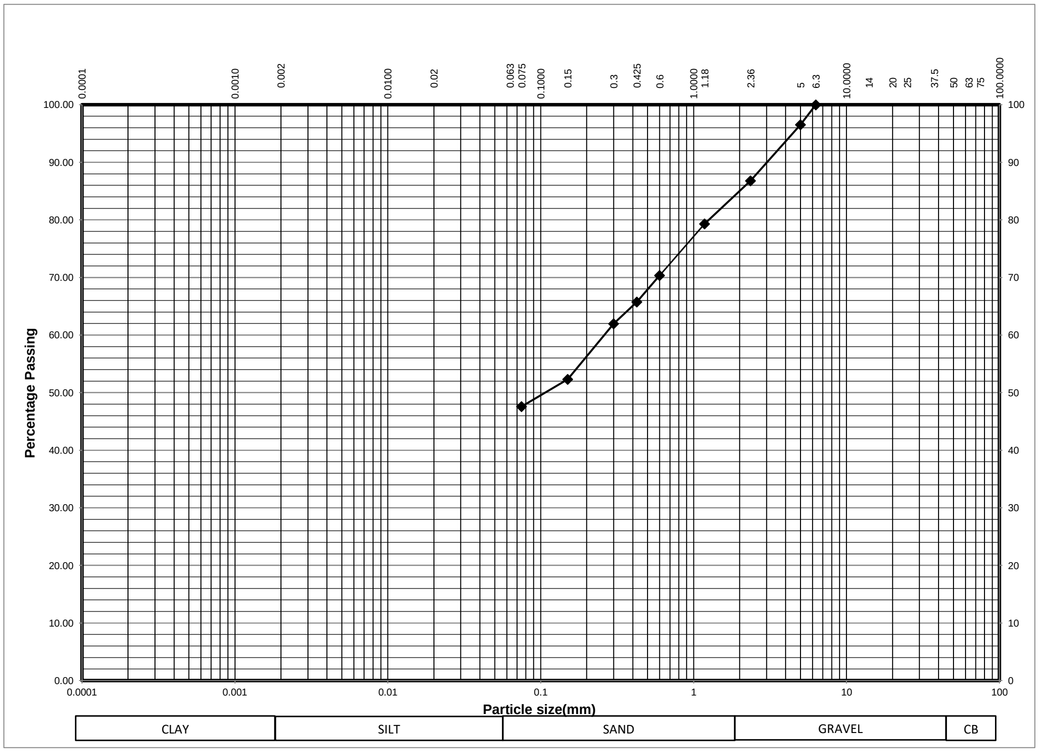
TYPE OF MATERIAL: MOIST BROWN MOLTLED SANDY SILTY CLAY

TESTED BY: C. NDALAMA	DATE: 31- 05 - 2019	TIME: 10:43
CHECKED BY: G. KACHIWALA	DATE: 04 - 06 - 2019	TIME: 13:30
APPROVED BY: M. SABELLI	DATE: 04 - 06 - 2019	TIME: 15:00

PROJECT: GOLOMOTI SOLAR PV
CLIENT: JCM

SIEVE ANALYSIS (GRADATION) STANDARD: TRH14:1985

SIEVE	MASS	PERCENTAGE			GRADATION SPECIFICATION			ZONE
(mm)	RETAINED	RETAINED	PASSING		BASE	SUBBASE	SL SEAL	
75.000								
50.000								
37.500								
28.000								
25.000								
20.000								
14.000								
12.500								
10.000								
6.300	0.00	0.00	100.00	100				
5.000	15.00	3.45	96.55	97				
2.360	57.50	13.22	86.78	87				
1.180	90.00	20.69	79.31	79				
0.600	129.00	29.66	70.34	70				
0.425	149.00	34.25	65.75	66				
0.300	165.50	38.05	61.95	62				
0.150	207.50	47.70	52.30	52				
0.075	228.00	52.41	47.59	48				
0 pan	207.00	47.59						
TOTAL (g)	435.00							



REMARKS: SAMPLED FROM TRIAL PIT 12 @ 0.100-1.500M. **SOLAR PV SITE INVESTIGATION**

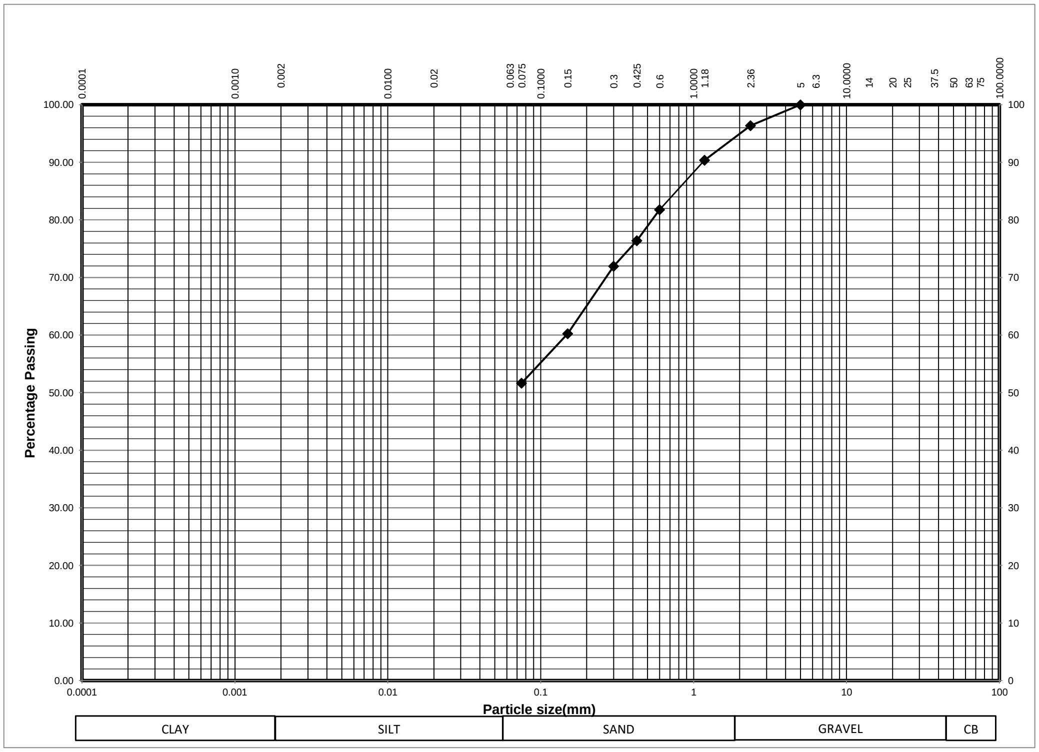
PAGE No.

GEOCONSULT	LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP012 / G035 / 02MAY19		
	SAMPLED BY: GEOCONSULT LAB TEAM		DATE: 02 / 05 / 2019	TIME: 09:57	
	LOCATION:	EASTING	NORTHING	ELEVATION	DEPTH (m)
	GOLOMOTI - SOLAR PV	0 672 650	8 402 797	(m)	1.500-3.000
	TYPE OF MATERIAL: MOIST BROWN GRAVELLY SANDY SILTY CLAY				
	TESTED BY: C. NDALAMA		DATE: 31- 05 - 2019	TIME: 10:43	
+265 0888 846 543	CHECKED BY: G. KACHIWALA		DATE: 04 - 06 - 2019	TIME: 13:30	
sabelli@geoconsult.cc	APPROVED BY: M. SABELLI		DATE: 04 - 06 - 2019	TIME: 15:00	

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

SIEVE ANALYSIS (GRADATION) STANDARD: TRH14:1985

SIEVE (mm)	MASS RETAINED	PERCENTAGE RETAINED	PASSING		GRADATION SPECIFICATION BASE	SUBBASE	SL SEAL	ZONE
75.000								
50.000								
37.500								
28.000								
25.000								
20.000								
14.000								
12.500								
10.000								
6.300								
5.000	0.00	0.00	100.00	100				
2.360	17.50	3.62	96.38	96				
1.180	46.50	9.63	90.37	90				
0.600	88.00	18.22	81.78	82				
0.425	114.00	23.60	76.40	76				
0.300	135.50	28.05	71.95	72				
0.150	192.00	39.75	60.25	60				
0.075	233.50	48.34	51.66	52				
0 pan	249.50	51.66						
TOTAL (g)	483.00							



REMARKS: SAMPLED FROM TRIAL PIT 12 @1.500-3.000M. **SOLAR PV SITE INVESTIGATION**	**PAGE No.**

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LAB REF: GC499 / 04MAY19 / 15:00
SAMPLE No. GSPV / TP012 / G036 / 02MAY19
SAMPLED BY: GEOCONSULT LAB TEAM
DATE: 02 / 05 / 2019
TIME: 09:57

LOCATION:	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 672 650	8 402 797	(m)	3.000-3.800

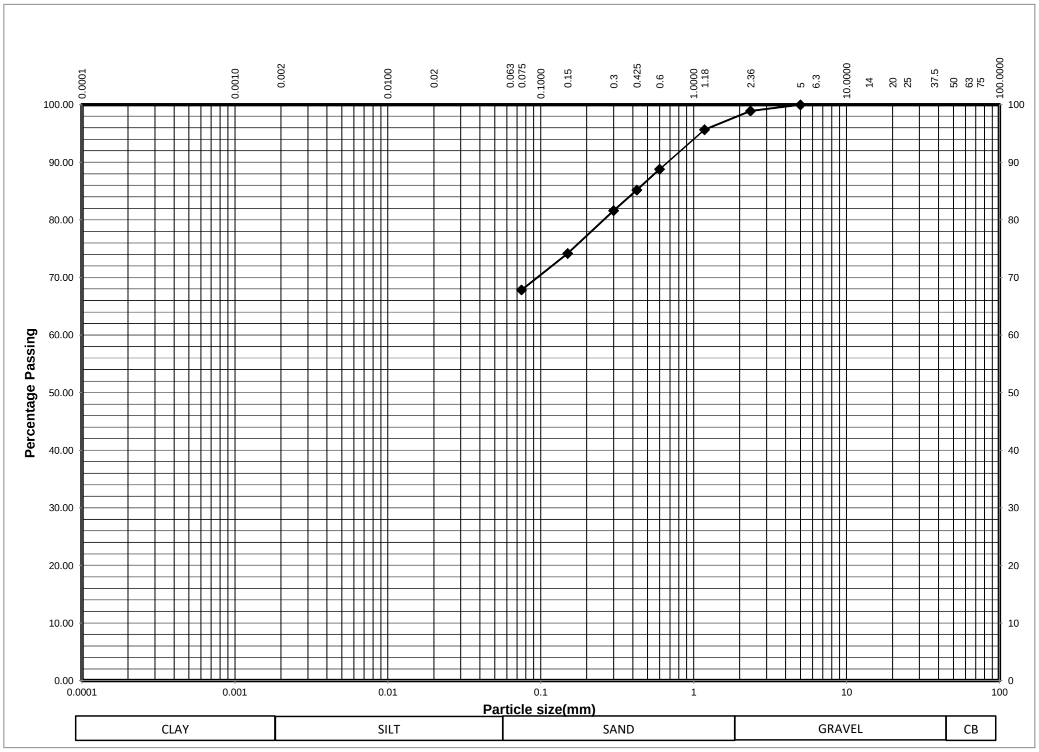
TYPE OF MATERIAL: MOIST BROWN REDDISH STIFF GRAVELLY SANDY SILTY CLAY

TESTED BY: C. NDALAMA | DATE: 31- 05 - 2019 | TIME: 10:43
CHECKED BY: G. KACHIWALA | DATE: 04 - 06 - 2019 | TIME: 13:30
APPROVED BY: M. SABELLI | DATE: 04 - 06 - 2019 | TIME: 15:00

PROJECT: GOLOMOTI SOLAR PV
CLIENT: JCM

SIEVE ANALYSIS (GRADATION) STANDARD: TRH14:1985

SIEVE	MASS	PERCENTAGE			GRADATION SPECIFICATION			ZONE
(mm)	RETAINED	RETAINED	PASSING		BASE	SUBBASE	SL SEAL	
75.000								
50.000								
37.500								
28.000								
25.000								
20.000								
14.000								
12.500								
10.000								
6.300								
5.000	0.00	0.00	100.00	100				
2.360	6.00	1.10	98.90	99				
1.180	23.50	4.32	95.68	96				
0.600	61.00	11.21	88.79	89				
0.425	80.50	14.80	85.20	85				
0.300	100.00	18.38	81.62	82				
0.150	140.50	25.83	74.17	74				
0.075	175.00	32.17	67.83	68				
0 pan	369.00	67.83						
TOTAL (g)	544.00							



REMARKS: SAMPLED FROM TRIAL PIT 12 @ 3.000-3.800M. **SOLAR PV SITE INVESTIGATION**

PAGE No.

	LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP012 / NMC034 / 02MAY19		
	SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 02 - 05 - 2019	TIME: 08:49	
	LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
	GOLOMOTI - SOLAR PV	0 672 650	8 402 797	(m)	0.100-1.500
	TYPE OF MATERIAL: MOIST BROWN MOLTLED SANDY SILTY CLAY				
	TESTED BY: C. NDALAMA		DATE: 05 - 05 - 2019	TIME: 13:38	
+265 0888 846 543	CHECKED BY: G. KACHIWALA		DATE: 06 - 05 - 2019	TIME: 09:46	
sabelli@geoconsult.cc	APPROVED BY: M. SABELLI		DATE: 06 - 05 - 2019	TIME: 10:00	

PROJECT: GOLOMOTI SOLAR PV

CLIENT: JCM

NATURAL MOISTURE CONTENT - OVEN DRYING METHOD STANDARD: ASTM D7263

MASS OF WET SOIL + CONTAINER (g)		325.5	
MASS OF DRY SOIL AND CONTAINER (g)		305.0	
CONTAINER No.		GC7	
MASS OF CONTAINER (g)		73.5	
MASS OF DRY SOIL (g)		231.5	
MASS OF WATER (g)		20.5	
MOISTURE CONTENT %		8.9	
AVERAGE MOISTURE CONTENT %		**8.9**	

REMARKS: SAMPLED FROM TRIAL PIT 12 @0.100-1.500M. **SOLAR PV SITE INVESTIGATION**

PAGE No.

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LAB REF: GC499 / 04MAY19 / 15:00
SAMPLE No. GSPV / TP012 / NMC035 / 02MAY19
SAMPLED BY: GEOCONSULT LAB. TEAM
DATE: 02 - 05 - 2019
TIME: 09:29

LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 372 650	8 402 797	(m)	1.500-3.000

TYPE OF MATERIAL: MOIST BROWN GRAVELLY SANDY SILTY CLAY

TESTED BY: C. NDALAMA	DATE: 05 - 05 - 2019	TIME: 13:38
CHECKED BY: G. KACHIWALA	DATE: 06 - 05 - 2019	TIME: 09:46
APPROVED BY: M. SABELLI	DATE: 06 - 05 - 2019	TIME: 10:00

PROJECT: GOLOMOTI SOLAR PV

CLIENT: JCM

NATURAL MOISTURE CONTENT - OVEN DRYING METHOD STANDARD: ASTM D7263

MASS OF WET SOIL + CONTAINER (g)		338.0	
MASS OF DRY SOIL AND CONTAINER (g)		310.0	
CONTAINER No.		GC12	
MASS OF CONTAINER (g)		70.0	
MASS OF DRY SOIL (g)		240.0	
MASS OF WATER (g)		28.0	
MOISTURE CONTENT %		11.7	
AVERAGE MOISTURE CONTENT %		**11.7**	

REMARKS: SAMPLED FROM TRIAL PIT 12 @1.500-3.000M. **SOLAR PV SITE INVESTIGATION**

PAGE No.

GEOCONSULT	LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP012 / NMC036 / 02MAY19	
	SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 02 - 05 - 2019	TIME: 09:29
	LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
	GOLOMOTI - SOLAR PV	0 672 650	8 402 797	(m)	3.000-3.800
	TYPE OF MATERIAL: MOIST BROWN REDDISH STIFF LATERITE GRAVELLY SANDY SILTY CLAY				
	TESTED BY: C. NDALAMA		DATE: 05 - 05 - 2019	TIME: 13:38
+265 0888 846 543	CHECKED BY: G. KACHIWALA		DATE: 06 - 05 - 2019	TIME: 09:46
sabelli@geoconsult.cc	APPROVED BY: M. SABELLI		DATE: 06 - 05 - 2019	TIME: 10:00

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

NATURAL MOISTURE CONTENT - OVEN DRYING METHOD STANDARD: ASTM D7263

MASS OF WET SOIL + CONTAINER (g)		317.5	
MASS OF DRY SOIL AND CONTAINER (g)		295.0	
CONTAINER No.		GC116	
MASS OF CONTAINER (g)		52.0	
MASS OF DRY SOIL (g)		243.0	
MASS OF WATER (g)		22.5	
MOISTURE CONTENT %		9.3	
AVERAGE MOISTURE CONTENT %		**9.3**	

REMARKS: SAMPLED FROM TRIAL PIT 12 @3.000-3.800M. **SOLAR PV SITE INVESTIGATION** **PAGE No.**

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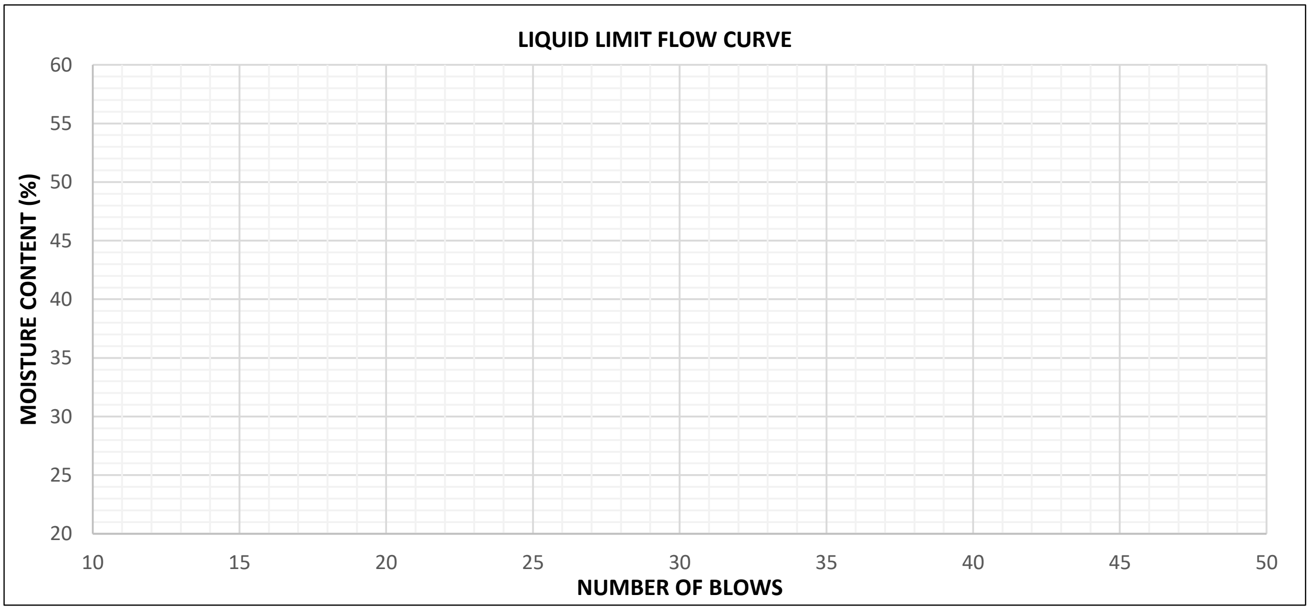
LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP12 / AL034 / 02MAY19		
SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 02 - 05 - 2019	TIME: 09:29	
LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 672 650	8 402 797	(m)	0.100-1.500
TYPE OF MATERIAL: MOIST BROWN MOLTLED SANDY SILTY CLAY				
TESTED BY: M. MILANZI		DATE: 27 - 05 - 2019	TIME: 13:14	
CHECKED BY: S. THANGATO		DATE: 31 - 05 - 2019	TIME: 09:35	
APPROVED BY: M. SABELLI		DATE: 31 - 05 - 2019	TIME: 14:18	

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

ATTERBURG LIMITS STANDARD: BS 1377, 2 (C)

TYPE OF TEST	**LIQUID LIMITS (LL)**				**PLASTIC LIMITS (PL)**		
TEST No.	1	2	3	4	1	2	3
CONTAINER No.	R30		RAI		C8	C24	R4
MASS OF WET SOIL + CONTAINER(g)	51.0		50.0		43.0	42.0	42.5
MASS OF DRY SOIL + CONTAINER(g)	45.0		44.0		40.5	40.0	40.5
MASS OF CONTAINER (g)	28.5		29		29.5	31	31.5
MASS OF DRY SOIL (g)	16.5		15.0		11.0	9.0	9.0
MASS OF WATER (g)	6.00		6.00		2.50	2.00	2.00
MOISTURE CONTENT %	36.4	37.1	40.0	38.4	22.7	22.2	22.2
No. BLOWS	30		16			22.4	

LINEAR SHRINKAGE	10
INITIAL LENGTH OF SPECIMEN (cm)	14.0
LENGTH OF OVERN DRY SPECIMEN (cm)	13.0
LINEAR SHRINKAGE %	7.7
LIQUID LIMIT (LL) %	37.7
PLASTIC LIMIT (PL) %	22.4
PLASTICITY INDEX (PI)	**15**
NATURAL MOISTURE CONTENT %	8.9
FINENESS INDEX	720



REMARKS: SAMPLED FROM TRIAL PIT 11 @ 0.100-1.500M. SOLAR PV SITE INVESTIGATION

LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP12 / AL035 / 02MAY19			
SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 02 - 05 - 2019	TIME: 09:29		
LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)	
GOLOMOTI - SOLAR PV	0 672 650	8 402 797	(m)	1.500-3.000	
TYPE OF MATERIAL: MOIST BROWN GRAVELLY SANDY SILTY CLAY					
TESTED BY: M. MILANZI		DATE: 27 - 05 - 2019	TIME: 13:14		
CHECKED BY: S. THANGATO		DATE: 31 - 05 - 2019	TIME: 09:35		
APPROVED BY: M. SABELLI		DATE: 31 - 05 - 2019	TIME: 14:18		

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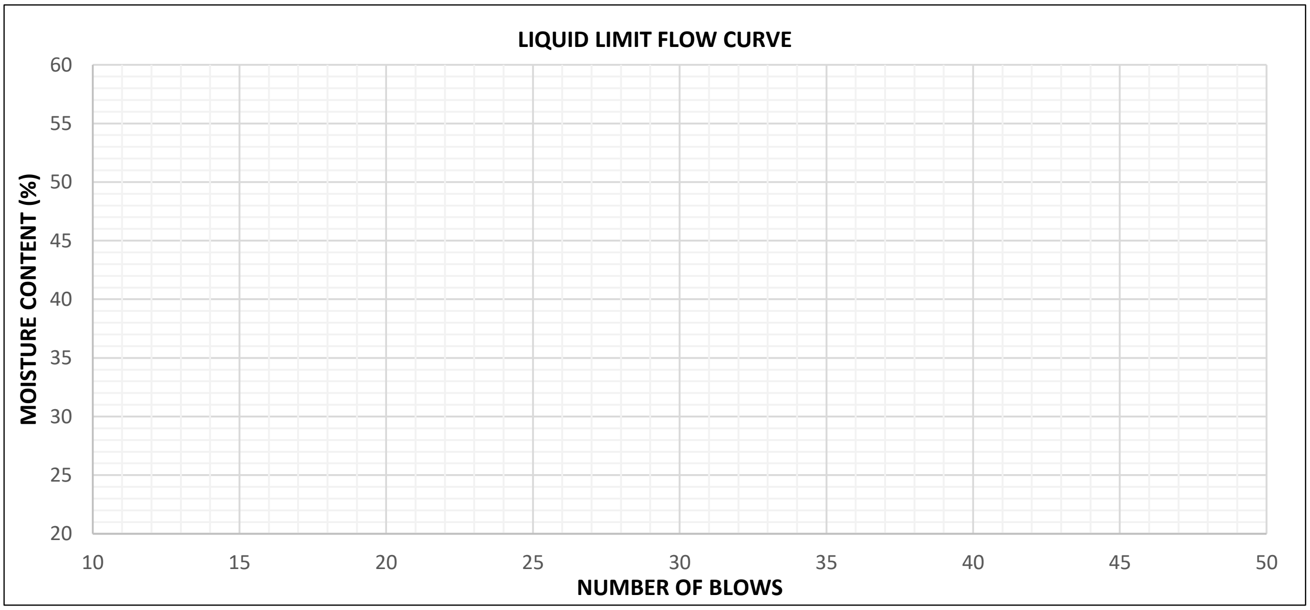
PROJECT: GOLOMOTI SOLAR PV

CLIENT: JCM

ATTERBURG LIMITS STANDARD: BS 1377, 2 (C)

TYPE OF TEST	LIQUID LIMITS (LL)				PLASTIC LIMITS (PL)		
TEST No.	1	2	3	4	1	2	3
CONTAINER No.	R31		R10		C9	C20	R5
MASS OF WET SOIL + CONTAINER(g)	51.0		50.0		43.0	42.0	42.5
MASS OF DRY SOIL + CONTAINER(g)	45.0		44.0		40.5	40.0	40.5
MASS OF CONTAINER (g)	28		29.5		29	30.5	31
MASS OF DRY SOIL (g)	17.0		14.5		11.5	9.5	9.5
MASS OF WATER (g)	6.00		6.00		2.50	2.00	2.00
MOISTURE CONTENT %	35.3	36.0	41.4	39.7	21.7	21.1	21.1
No. BLOWS	30		17			21.3	

LINEAR SHRINKAGE	17
INITIAL LENGTH OF SPECIMEN (cm)	14.0
LENGTH OF OVERN DRY SPECIMEN (cm)	12.9
LINEAR SHRINKAGE %	8.5
LIQUID LIMIT (LL) %	37.9
PLASTIC LIMIT (PL) %	21.3
PLASTICITY INDEX (PI)	**17**
NATURAL MOISTURE CONTENT %	11.7
FINENESS INDEX	884



REMARKS: SAMPLED FROM TRIAL PIT 12 @ 1.500-3.000M. SOLAR PV SITE INVESTIGATION

	Triaxial test - UU BS 1377 part 7, 1377 part 8			
	Site :	GOLOMOTI SOLAR PV	Levy date :	14-Jun-19
	Technicien's name :		Date of test :	14-Jun-19
GEOCONSULT LIMITED	File N° :	14	Survey depth (m) :	2.000
P.O. BOX 40 LILONGWE	Survey N° :	TRIAL PIT No. 12	Level of water (m) :	
	Kind of soil :			MOIST BROWN GRAVELLY SANDY SILTY CLAY

Identification of samples :

σvo, Total stress of the soil in situ (kPa) :	0.000	Uo, Pore pressure of the soil in situ (kPa) :	0.000
Category of soil :	Steep/Strongly overconsolidated	Kind of drainage :	Without lateral drain
ρs, Grain density (kg/m^3) :	0.000		
Sm :	☐	Sd :	☐

Samples before test :

	N°	Hi (mm)	Di (mm)	mi (g)	ρi (kg/m^3)	ρdi (kg/m^3)	wi (%)	ei	Sri (%)
🟦	1	71.00	38	166.0	2062	2049	0.606	-1.000	-0.000
🟥	2	72.00	38	162.0	1984	1672	18.68	-1.000	-0.000
🟩	3	71.00	38	165.5	2055	1776	15.73	-1.000	-0.000

Samples after saturation :

Ucp (kPa)	ΔVsat. (mm^3)	B (%)
	0.000	0.000
	0.000	0.000
	0.000	0.000

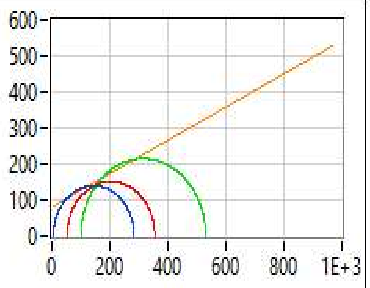
Samples after consolidation :

	N°	Hs (mm)	Ds (mm)	ΔVs (mm^3)	T100 (min)	Vmax (µm/min)	σ'c (kPa)
🟦	1	71.00	38.00	0.000	0.000	0.000	0.000
🟥	2	72.00	38.00	0.000	0.000	0.000	0.000
🟩	3	71.00	38.00	0.000	0.000	0.000	0.000

Samples after shearing

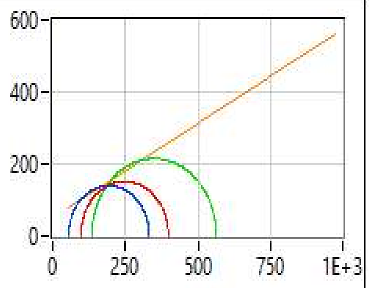
Hf (mm)	Df (mm)	mf (g)	md (g)	wf (%)	ρdf (kg/m^3)	ef	Srf (%)
71.00	38.00	166.0	165.0	0.606	2049	-1.000	-0.000
72.00	38.00	162.0	136.5	18.68	1672	-1.000	-0.000
71.00	38.00	165.5	143.0	15.73	1776	-1.000	-0.000

Total stress :



	Mohr
C (kPa)	79.55
φ (°)	24.95

Effective stress :



	Mohr	Lambe
C' (kPa)	48.22	35.63
φ' (°)	27.97	26.77

Comments :

Visa : p.1/3

3.16 Trial Pit 13

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LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP13 / AL039 / 02MAY19		
SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 02 - 05 - 2019	TIME: 10:15	
LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 672 640	8 402 630	(m)	2.000-4.000
TYPE OF MATERIAL: MOIST BROWN STIFF LATERITE GRAVELLY SANDY SILTY CLAY				
TESTED BY: M. MILANZI		DATE: 28 - 05 - 2019	TIME: 14:14	
CHECKED BY: G. KACHIWALA		DATE: 31 - 05 - 2019	TIME: 09:35	
APPROVED BY: M. SABELLI		DATE: 31 - 05 - 2019	TIME: 14:18	

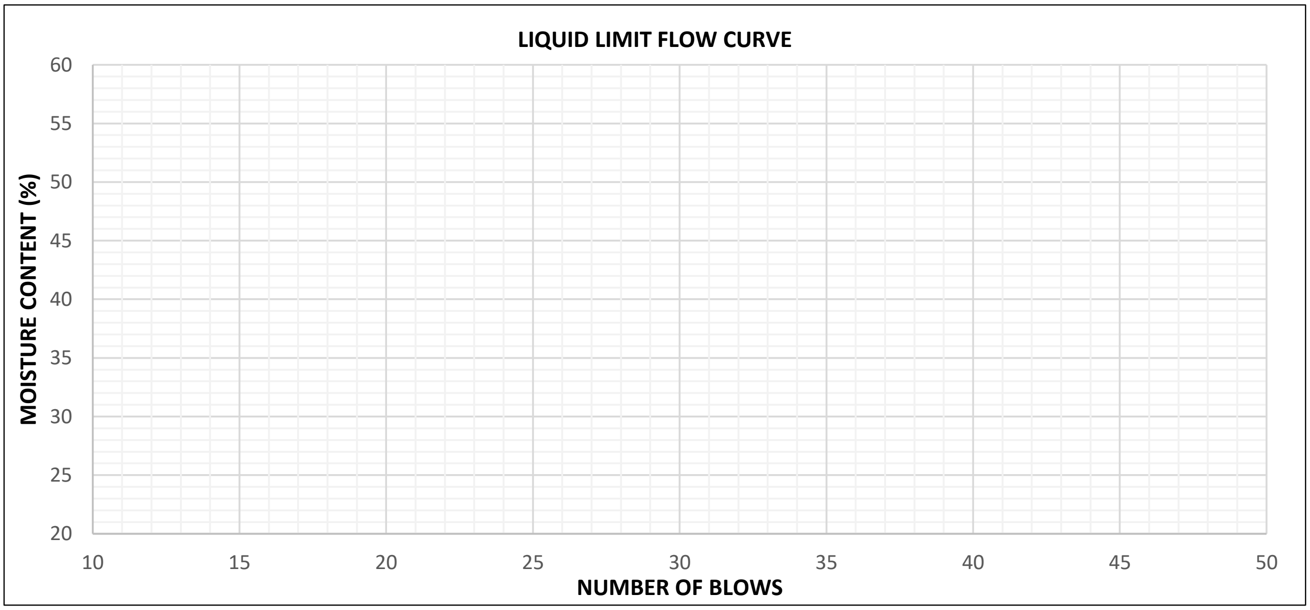
PROJECT: GOLOMOTI SOLAR PV

CLIENT: JCM

ATTERBURG LIMITS STANDARD: BS 1377, 2 (C)

TYPE OF TEST	LIQUID LIMITS (LL)				PLASTIC LIMITS (PL)		
TEST No.	1	2	3	4	1	2	3
CONTAINER No.	C6		R20		C22	R18	R24
MASS OF WET SOIL + CONTAINER(g)	51.5		51.5		35.5	39.0	35.0
MASS OF DRY SOIL + CONTAINER(g)	45.5		44.5		34.5	37.0	33.5
MASS OF CONTAINER (g)	30.5		30		30.5	29	27.5
MASS OF DRY SOIL (g)	15.0		14.5		4.0	8.0	6.0
MASS OF WATER (g)	6.00		7.00		1.00	2.00	1.50
MOISTURE CONTENT %	40.0	40.8	48.3	46.8	25.0	25.0	25.0
No. BLOWS	34		18			25.0	

LINEAR SHRINKAGE	5
INITIAL LENGTH OF SPECIMEN (cm)	14.0
LENGTH OF OVERN DRY SPECIMEN (cm)	12.9
LINEAR SHRINKAGE %	8.5
LIQUID LIMIT (LL) %	43.8
PLASTIC LIMIT (PL) %	25.0
PLASTICITY INDEX (PI)	**19**
NATURAL MOISTURE CONTENT %	7.1
FINENESS INDEX	1064



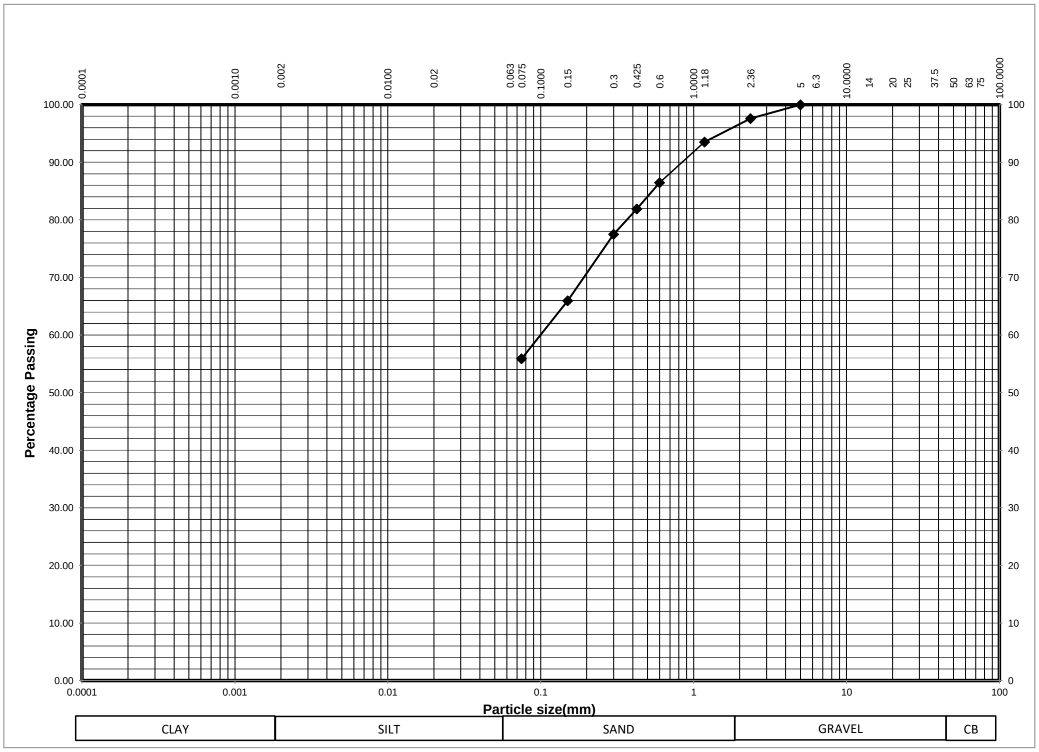
REMARKS: SAMPLED FROM TRIAL PIT 13 @ 2.000-4.000M. SOLAR PV SITE INVESTIGATION

GEOCONSULT	LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP013 / G037 / 02MAY19		
	SAMPLED BY: GEOCONSULT LAB TEAM		DATE: 02 / 05 / 2019	TIME: 08:27	
	LOCATION:	EASTING	NORTHING	ELEVATION	DEPTH (m)
	GOLOMOTI - SOLAR PV	0 672 640	8 402 630	(m)	0.100-1.000
	TYPE OF MATERIAL: MOIST BROWN MOLTLED SANDY SILTY CLAY				
	TESTED BY: C. NDALAMA		DATE: 28- 05 - 2019	TIME: 10:43	
+265 0888 846 543	CHECKED BY: G. KACHIWALA		DATE: 04 - 06 - 2019	TIME: 13:30	
sabelli@geoconsult.cc	APPROVED BY: M. SABELLI		DATE: 04 - 06 - 2019	TIME: 15:00	

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

SIEVE ANALYSIS (GRADATION) STANDARD: TRH14:1985

SIEVE	MASS	PERCENTAGE			GRADATION SPECIFICATION			ZONE
(mm)	RETAINED	RETAINED	PASSING		BASE	SUBBASE	SL SEAL	
75.000								
50.000								
37.500								
28.000								
25.000								
20.000								
14.000								
12.500								
10.000								
6.300								
5.000	0.00	0.00	100.00	100				
2.360	11.50	2.39	97.61	98				
1.180	31.00	6.45	93.55	94				
0.600	65.00	13.53	86.47	86				
0.425	87.00	18.11	81.89	82				
0.300	108.00	22.48	77.52	78				
0.150	163.50	34.03	65.97	66				
0.075	212.00	44.12	55.88	56				
0 pan	268.50	55.88						
TOTAL (g)	480.50							



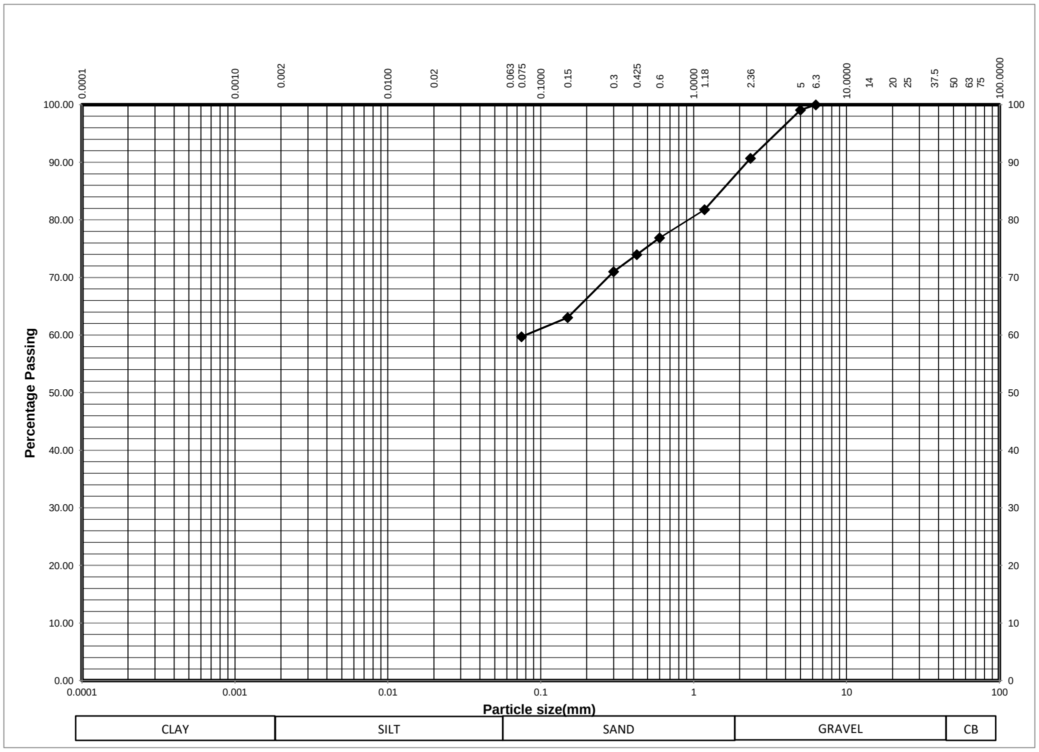
REMARKS: SAMPLED FROM TRIAL PIT 13 @ 0.100-1.000M. **SOLAR PV SITE INVESTIGATION** **PAGE No.**

	LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP013 / G038 / 02MAY19		
	SAMPLED BY: GEOCONSULT LAB TEAM		DATE: 02 / 05 / 2019	TIME: 08:27	
	LOCATION:	EASTING	NORTHING	ELEVATION	DEPTH (m)
	GOLOMOTI - SOLAR PV	0 672 640	8 402 630	(m)	1.000-2.000
	TYPE OF MATERIAL: MOIST BROWN SANDY SILTY CLAY				
	TESTED BY: C. NDALAMA		DATE: 28- 05 - 2019	TIME: 10:43	
+265 0888 846 543	CHECKED BY: G. KACHIWALA		DATE: 04 - 06 - 2019	TIME: 13:30	
sabelli@geoconsult.cc	APPROVED BY: M. SABELLI		DATE: 04 - 06 - 2019	TIME: 15:00	

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

SIEVE ANALYSIS (GRADATION) STANDARD: TRH14:1985

SIEVE	MASS	PERCENTAGE			GRADATION SPECIFICATION			ZONE
(mm)	RETAINED	RETAINED	PASSING		BASE	SUBBASE	SL SEAL	
75.000								
50.000								
37.500								
28.000								
25.000								
20.000								
14.000								
12.500								
10.000								
6.300	0.00	0.00	100.00	100				
5.000	6.50	0.92	99.08	99				
2.360	65.50	9.29	90.71	91				
1.180	128.50	18.23	81.77	82				
0.600	163.00	23.12	76.88	77				
0.425	183.50	26.03	73.97	74				
0.300	204.50	29.01	70.99	71				
0.150	260.50	36.95	63.05	63				
0.075	284.00	40.28	59.72	60				
0 pan	421.00	59.72						
TOTAL (g)	705.00							



REMARKS: SAMPLED FROM TRIAL PIT 13 @ 1.000-2.000M. **SOLAR PV SITE INVESTIGATION** **PAGE No.**

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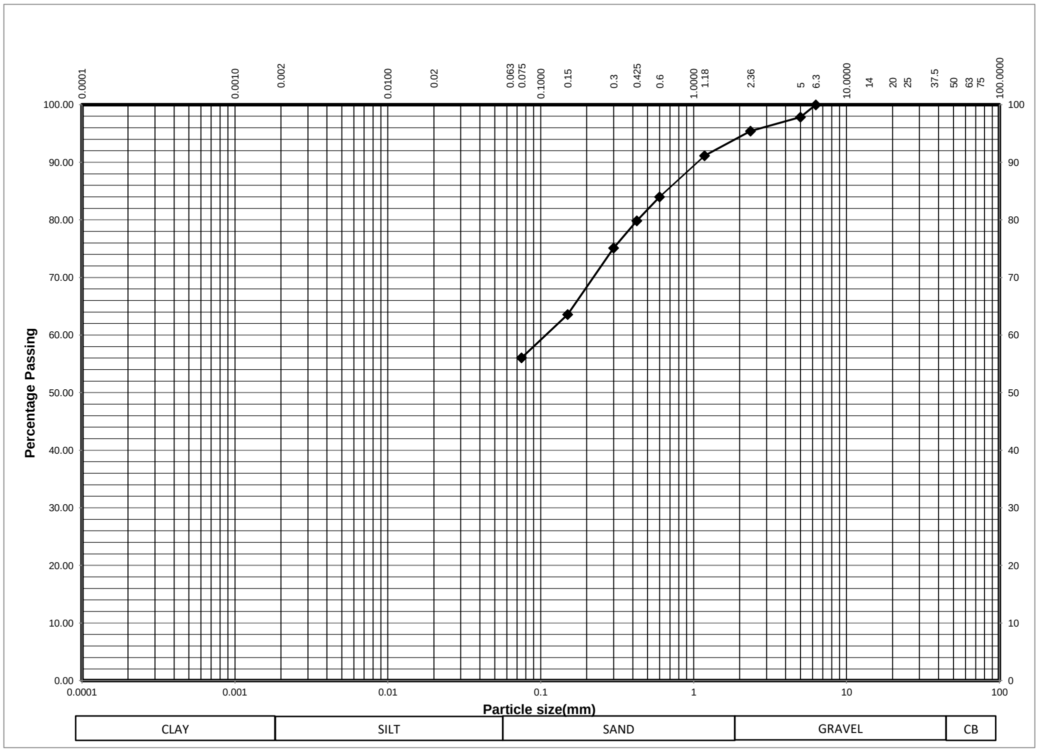
LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP013 / G039 / 02MAY19		
SAMPLED BY: GEOCONSULT LAB TEAM		DATE: 02 / 05 / 2019	TIME: 08:27	
LOCATION:	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 672 640	8 402 630	(m)	2.000-4.000
TYPE OF MATERIAL: MOIST BROWN STIFF LATERITE GRAVELLY SANDY SILTY CLAY				
TESTED BY: C. NDALAMA		DATE: 28- 05 - 2019	TIME: 10:43	
CHECKED BY: G. KACHIWALA		DATE: 04 - 06 - 2019	TIME: 13:30	
APPROVED BY: M. SABELLI		DATE: 04 - 06 - 2019	TIME: 15:00	

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

SIEVE ANALYSIS (GRADATION) STANDARD: TRH14:1985

SIEVE	MASS	PERCENTAGE			GRADATION SPECIFICATION			ZONE
(mm)	RETAINED	RETAINED	PASSING		BASE	SUBBASE	SL SEAL	
75.000								
50.000								
37.500								
28.000								
25.000								
20.000								
14.000								
12.500								
10.000								
6.300	0.00	0.00	100.00	100				
5.000	8.00	2.15	97.85	98				
2.360	17.00	4.57	95.43	95				
1.180	33.00	8.87	91.13	91				
0.600	59.50	15.99	84.01	84				
0.425	75.00	20.16	79.84	80				
0.300	92.50	24.87	75.13	75				
0.150	135.50	36.42	63.58	64				
0.075	163.50	43.95	56.05	56				
0 pan	208.50	56.05						
TOTAL (g)	372.00							



REMARKS: SAMPLED FROM TRIAL PIT 13 @ 2.000-4.000M. **SOLAR PV SITE INVESTIGATION** **PAGE No.**

GEOCONSULT +265 0888 846 543 sabelli@geoconsult.cc	LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP013 / NMC037 / 02MAY19	
	SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 02 - 05 - 2019	TIME: 08:27
	LOCATION: 36 L UTM GOLOMOTI - SOLAR PV	EASTING 0 672 640	NORTHING 8 402 630	ELEVATION (m) / DEPTH (m) 0.100-1.000
	TYPE OF MATERIAL: MOIST BROWN MOLTLED SANDY SILTY CLAY			
	TESTED BY: C. NDALAMA		DATE: 05 - 05 - 2019	TIME: 13:38
	CHECKED BY: G. KACHIWALA		DATE: 06 - 05 - 2019	TIME: 09:46
	APPROVED BY: M. SABELLI		DATE: 06 - 05 - 2019	TIME: 10:00

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

NATURAL MOISTURE CONTENT - OVEN DRYING METHOD STANDARD: ASTM D7263

MASS OF WET SOIL + CONTAINER (g)		306.5	
MASS OF DRY SOIL AND CONTAINER (g)		294.5	
CONTAINER No.		GC19	
MASS OF CONTAINER (g)		67.0	
MASS OF DRY SOIL (g)		227.5	
MASS OF WATER (g)		12.0	
MOISTURE CONTENT %		5.3	
AVERAGE MOISTURE CONTENT %		**5.3**	

REMARKS: SAMPLED FROM TRIAL PIT 13 @0.100-1.000M. **SOLAR PV SITE INVESTIGATION** **PAGE No.**

GEOCONSULT +265 0888 846 543 sabelli@geoconsult.cc	LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP013 / NMC038 / 02MAY19		
	SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 02 - 05 - 2019	TIME: 08:27	
	LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
	GOLOMOTI - SOLAR PV	0 672 640	8 402 630	(m)	1.000-2.000
	TYPE OF MATERIAL: MOIST BROWN SANDY SILTY CLAY				
	TESTED BY: C. NDALAMA		DATE: 05 - 05 - 2019	TIME: 13:38	
	CHECKED BY: G. KACHIWALA		DATE: 06 - 05 - 2019	TIME: 09:46	
	APPROVED BY: M. SABELLI		DATE: 06 - 05 - 2019	TIME: 10:00	

PROJECT: GOLOMOTI SOLAR PV

CLIENT: JCM

NATURAL MOISTURE CONTENT - OVEN DRYING METHOD STANDARD: ASTM D7263

MASS OF WET SOIL + CONTAINER (g)		309.5	
MASS OF DRY SOIL AND CONTAINER (g)		294.0	
CONTAINER No.		GC11	
MASS OF CONTAINER (g)		70.0	
MASS OF DRY SOIL (g)		224.0	
MASS OF WATER (g)		15.5	
MOISTURE CONTENT %		6.9	
AVERAGE MOISTURE CONTENT %		**6.9**	

REMARKS: SAMPLED FROM TRIAL PIT 13 @1.000-2.000M. **SOLAR PV SITE INVESTIGATION**

PAGE No.

GEOCONSULT +265 0888 846 543 sabelli@geoconsult.cc	LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP013 / NMC039 / 02MAY19		
	SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 02 - 05 - 2019	TIME: 08:27	
	LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
	GOLOMOTI - SOLAR PV	0 672 640	8 402 630	(m)	2.000-4.000
	TYPE OF MATERIAL: MOIST BROWN STIFF LATERITE GRAVELLY SANDY SILTY CLAY				
	TESTED BY: C. NDALAMA		DATE: 05 - 05 - 2019	TIME: 13:38	
	CHECKED BY: G. KACHIWALA		DATE: 06 - 05 - 2019	TIME: 09:46	
	APPROVED BY: M. SABELLI		DATE: 06 - 05 - 2019	TIME: 10:00	

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

NATURAL MOISTURE CONTENT - OVEN DRYING METHOD STANDARD: ASTM D7263

MASS OF WET SOIL + CONTAINER (g)		300.5	
MASS OF DRY SOIL AND CONTAINER (g)		285.0	
CONTAINER No.		GC111	
MASS OF CONTAINER (g)		65.5	
MASS OF DRY SOIL (g)		219.5	
MASS OF WATER (g)		15.5	
MOISTURE CONTENT %		7.1	
AVERAGE MOISTURE CONTENT %		**7.1**	

REMARKS: SAMPLED FROM TRIAL PIT 13 @2.000-4.000M. **SOLAR PV SITE INVESTIGATION** **PAGE No.**

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LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP13 / AL037 / 02MAY19		
SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 02 - 05 - 2019	TIME: 07:15	
LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 672 640	8 402 630	(m)	0.200-1.000
TYPE OF MATERIAL: MOIST BROWN MOLTLED SANDY SILTY CLAY				
TESTED BY: M. MILANZI		DATE: 27 - 05 - 2019	TIME: 13:14	
CHECKED BY: G. KACHIWALA		DATE: 31 - 05 - 2019	TIME: 09:35	
APPROVED BY: M. SABELLI		DATE: 31 - 05 - 2019	TIME: 14:18	

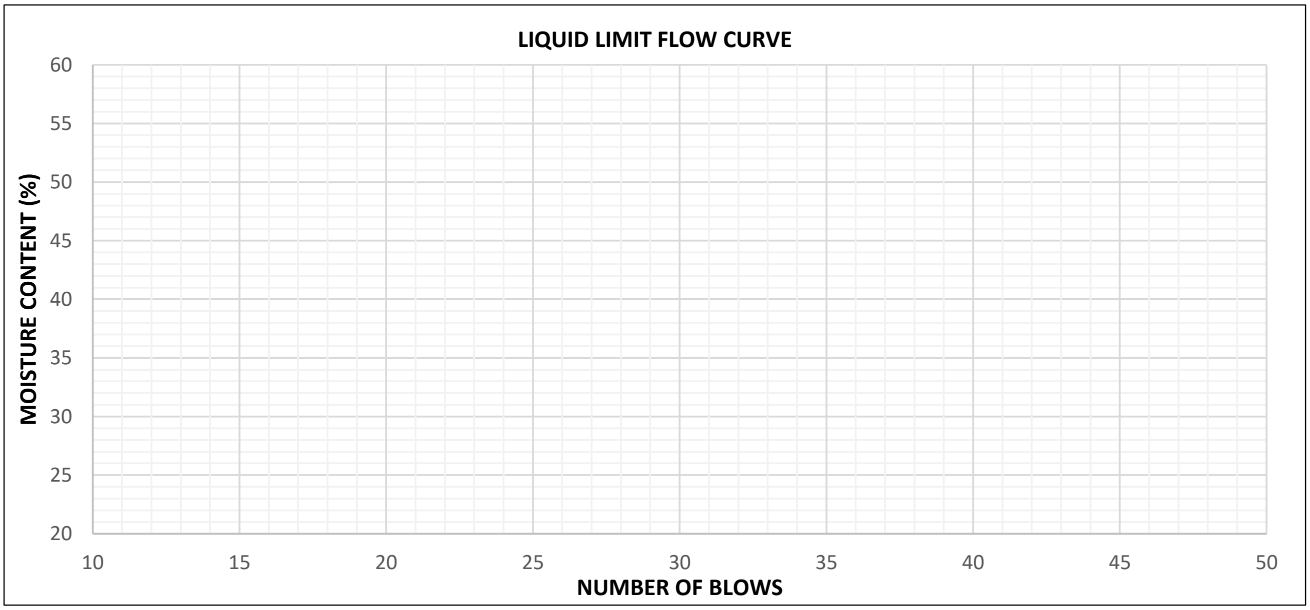
PROJECT: GOLOMOTI SOLAR PV

CLIENT: JCM

ATTERBURG LIMITS   STANDARD: BS 1377, 2 (C)

TYPE OF TEST	**LIQUID LIMITS (LL)**				**PLASTIC LIMITS (PL)**		
TEST No.	1	2	3	4	1	2	3
CONTAINER No.	K2		R8		C27	R19	C13
MASS OF WET SOIL + CONTAINER(g)	50.0		49.5		35.5	38.0	34.0
MASS OF DRY SOIL + CONTAINER(g)	45.5		45.0		34.5	37.0	33.0
MASS OF CONTAINER (g)	28		30		29	31.5	27.5
MASS OF DRY SOIL (g)	17.5		15.0		5.5	5.5	5.5
MASS OF WATER (g)	4.50		4.50		1.00	1.00	1.00
MOISTURE CONTENT %	25.7	26.2	30.0	28.8	18.2	18.2	18.2
No. BLOWS	33		17			18.2	

LINEAR SHRINKAGE	17
INITIAL LENGTH OF SPECIMEN (cm)	14.0
LENGTH OF OVERN DRY SPECIMEN (cm)	13.2
LINEAR SHRINKAGE %	6.1
LIQUID LIMIT (LL) %	27.5
PLASTIC LIMIT (PL) %	18.2
PLASTICITY INDEX (PI)	**9**
NATURAL MOISTURE CONTENT %	5.3
FINENESS INDEX	504



REMARKS: SAMPLED FROM TRIAL PIT 13 @ 0.200-1.000M. SOLAR PV SITE INVESTIGATION

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LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP13 / AL038 / 02MAY19		
SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 02 - 05 - 2019	TIME: 10:15	
LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 672 640	8 402 630	(m)	1.000-2.000
TYPE OF MATERIAL: MOIST BROWN MOLTLED SANDY SILTY CLAY				
TESTED BY: M. MILANZI		DATE: 28 - 05 - 2019	TIME: 13:14	
CHECKED BY: G. KACHIWALA		DATE: 31 - 05 - 2019	TIME: 09:35	
APPROVED BY: M. SABELLI		DATE: 31 - 05 - 2019	TIME: 14:18	

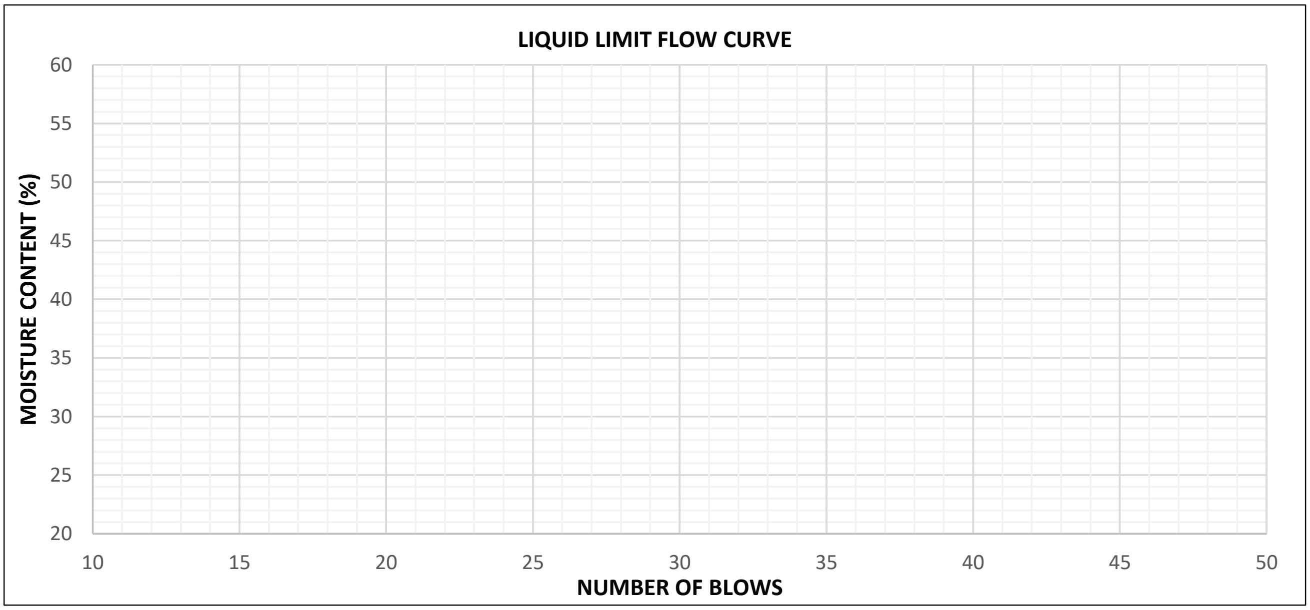
PROJECT: GOLOMOTI SOLAR PV

CLIENT: JCM

ATTERBURG LIMITS STANDARD: BS 1377, 2 (C)

TYPE OF TEST	**LIQUID LIMITS (LL)**				**PLASTIC LIMITS (PL)**		
TEST No.	1	2	3	4	1	2	3
CONTAINER No.	K4		R18		C28	R16	C7
MASS OF WET SOIL + CONTAINER(g)	50.5		50.5		35.5	38.0	34.0
MASS OF DRY SOIL + CONTAINER(g)	45.5		45.5		34.5	37.0	33.0
MASS OF CONTAINER (g)	28		30		28	30.5	26.5
MASS OF DRY SOIL (g)	17.5		15.5		6.5	6.5	6.5
MASS OF WATER (g)	5.00		5.00		1.00	1.00	1.00
MOISTURE CONTENT %	28.6	29.1	32.3	31.0	15.4	15.4	15.4
No. BLOWS	32		16			15.4	

LINEAR SHRINKAGE	11
INITIAL LENGTH OF SPECIMEN (cm)	14.0
LENGTH OF OVERN DRY SPECIMEN (cm)	13.1
LINEAR SHRINKAGE %	6.9
LIQUID LIMIT (LL) %	30.1
PLASTIC LIMIT (PL) %	15.4
PLASTICITY INDEX (PI)	**15**
NATURAL MOISTURE CONTENT %	6.9
FINENESS INDEX	900



REMARKS: SAMPLED FROM TRIAL PIT 13 @ 1.000-2.000M. SOLAR PV SITE INVESTIGATION

Triaxial test - UU
BS 1377 part 7, 1377 part 8

GEOCONSULT LIMITED

P.O. BOX 40 LILONGWE

Site :	GOLOMOTI SOLAR PV	Levy date :	28-Jun-19
Technicien's name :		Date of test :	28-Jun-19
File N° :	35	Survey depth (m) :	1.000
Survey N° :	TRIAL PIT No. 13	Level of water (m) :	
Kind of soil :			Moist Brown Sandy Silty CLAY

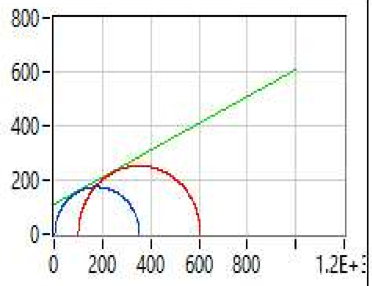
Identification of samples :

σvo, Total stress of the soil in situ (kPa) :	0.000	Uo, Pore pressure of the soil in situ (kPa) :	0.000
Category of soil :	Steep/Strongly overconsolidated	Kind of drainage :	Without lateral drain
ρs, Grain density (kg/m³) :	0.000		
Sm :	☐	Sd :	☐

		Samples before test :								Samples after saturation :		
	N°	Hi (mm)	Di (mm)	mi (g)	ρi (kg/m³)	ρdi (kg/m³)	wi (%)	ei	Sri (%)	Ucp (kPa)	ΔVsat. (mm³)	B (%)
🟦	1	76.00	38	158.5	1839	1572	16.97	-1.000	-0.000		0.000	0.000
🟥	2	76.00	38	174.0	2019	1746	15.61	-1.000	-0.000		0.000	0.000

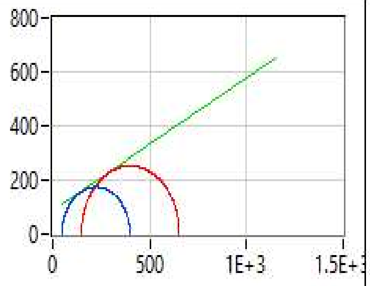
		Samples after consolidation :						Samples after shearing							
	N°	Hs (mm)	Ds (mm)	ΔVs (mm³)	T100 (min)	Vmax (µm/min)	σ'c (kPa)	Hf (mm)	Df (mm)	mf (g)	md (g)	wf (%)	ρdf (kg/m³)	ef	Srf (%)
🟦	1	76.00	38.00	0.000	0.000	0.000	0.000	76.00	38.00	162.0	135.5	19.56	1572	-1.000	-0.000
🟥	2	76.00	38.00	0.000	0.000	0.000	0.000	76.00	38.00	175.5	150.5	16.61	1746	-1.000	-0.000

Total stress :



	Mohr
C (kPa)	106.5
φ (°)	26.50

Effective stress :



	Mohr	Lambe
C' (kPa)	85.20	76.46
φ' (°)	26.19	23.81

Comments :

Visa :

p.1/3

3.17 Trial Pit 14

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LAB REF: GC499 / 04MAY19 / 15:00
SAMPLE No. GSPV / TP14 / AL041 / 01MAY19
SAMPLED BY: GEOCONSULT LAB. TEAM
DATE: 01 - 05 - 2019
TIME: 10:15

LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 672 645	8 402 499	(m)	1.000-3.800

TYPE OF MATERIAL: MOIST BROWN SANDY SILTY CLAY

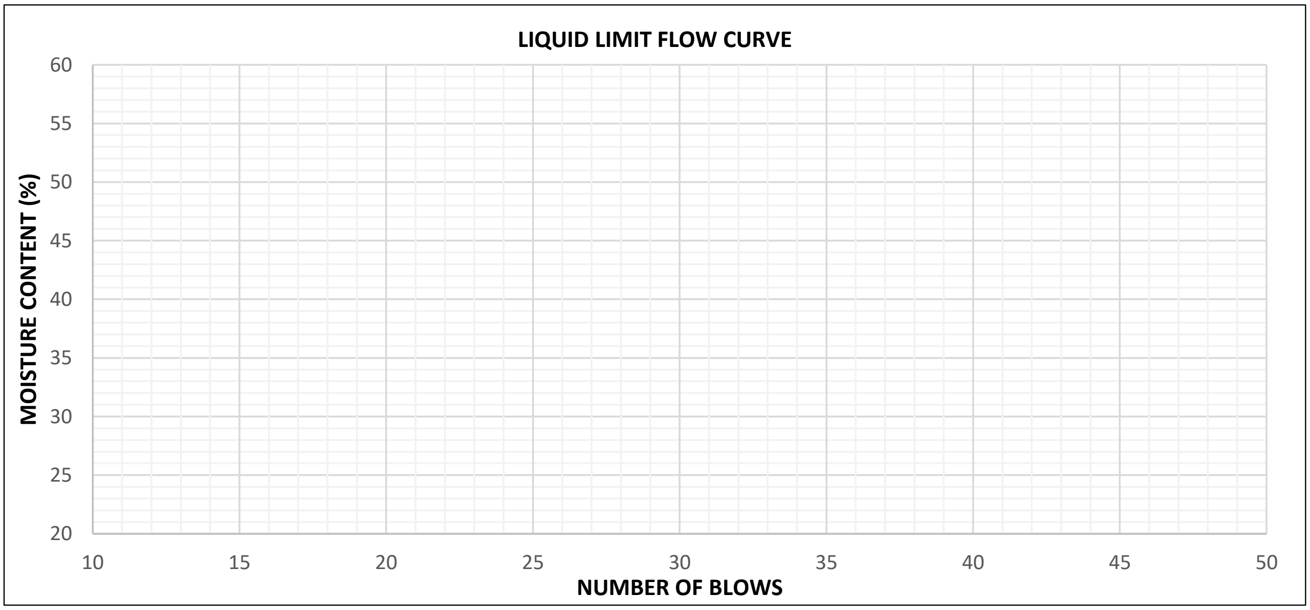
TESTED BY: M. MILANZI	DATE: 10 - 06 - 2019	TIME: 10:20
CHECKED BY: G. KACHIWALA	DATE: 12 - 06 - 2019	TIME: 09:40
APPROVED BY: M. SABELLI	DATE: 12 - 06 - 2019	TIME: 14:28

PROJECT: GOLOMOTI SOLAR PV
CLIENT: JCM

ATTERBURG LIMITS STANDARD: BS 1377, 2 (C)

TYPE OF TEST	**LIQUID LIMITS (LL)**				**PLASTIC LIMITS (PL)**		
TEST No.	1	2	3	4	1	2	3
CONTAINER No.	C5		C3		RAI	N	R24
MASS OF WET SOIL + CONTAINER(g)	51.5		63.0		51.0	46.5	35.0
MASS OF DRY SOIL + CONTAINER(g)	44.5		50.5		46.5	42.5	33.5
MASS OF CONTAINER (g)	28.5		22.5		28.5	27	27.5
MASS OF DRY SOIL (g)	16.0		28.0		18.0	15.5	6.0
MASS OF WATER (g)	7.00		12.50		4.50	4.00	1.50
MOISTURE CONTENT %	43.8	44.2	44.6	43.8	25.0	25.8	25.0
No. BLOWS	29		20			25.3	

LINEAR SHRINKAGE	18
INITIAL LENGTH OF SPECIMEN (cm)	14.0
LENGTH OF OVERN DRY SPECIMEN (cm)	13.1
LINEAR SHRINKAGE %	6.9
LIQUID LIMIT (LL) %	44.0
PLASTIC LIMIT (PL) %	25.3
PLASTICITY INDEX (PI)	**19**
NATURAL MOISTURE CONTENT %	11.1
FINENESS INDEX	1235



REMARKS: SAMPLED FROM TRIAL PIT 14 @ 1.000-3.000M. SOLAR PV SITE INVESTIGATION

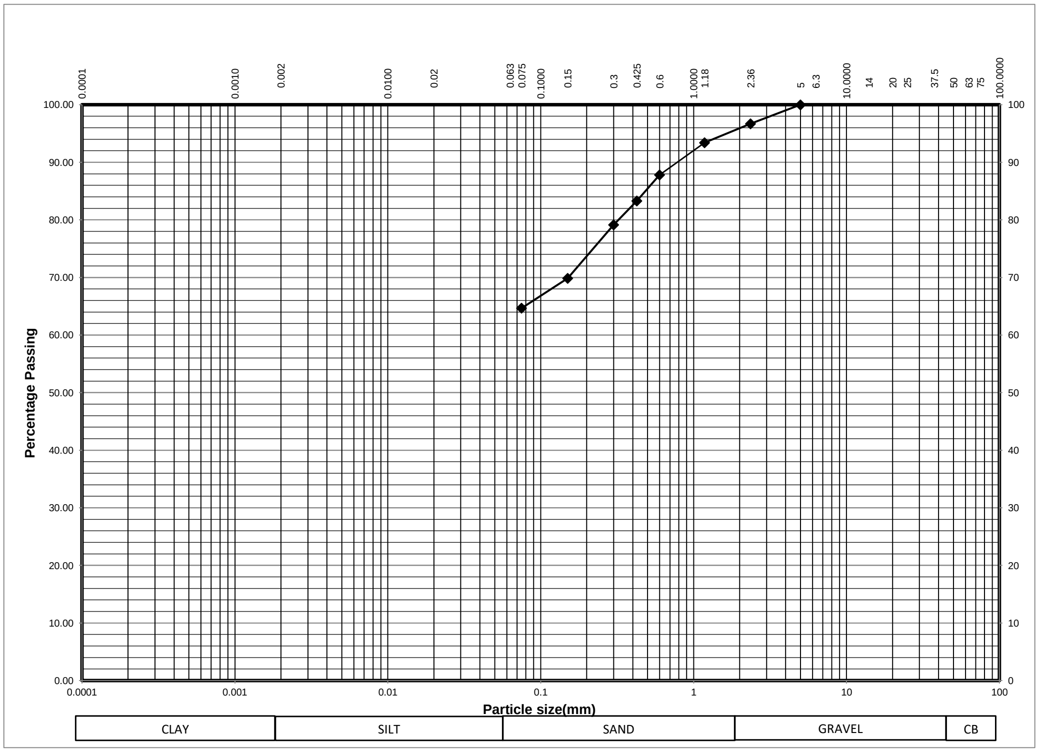
GEOCONSULT	LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP014 / G040 / 01MAY19	
	SAMPLED BY: GEOCONSULT LAB TEAM		DATE: 02 / 05 / 2019	TIME: 17:36
	LOCATION:	EASTING	NORTHING	ELEVATION (m)	DEPTH (m)
	GOLOMOTI - SOLAR PV	0 672 645	8 402 499		0.100-1.000
	TYPE OF MATERIAL: MOIST DARK BROWN SANDY SILTY CLAY			
	TESTED BY: C. NDALAMA		DATE: 06- 06 - 2019	TIME: 13:20
+265 0888 846 543	CHECKED BY: G. KACHIWALA		DATE: 07 - 06 - 2019	TIME: 13:30
sabelli@geoconsult.cc	APPROVED BY: M. SABELLI		DATE: 07 - 06 - 2019	TIME: 15:00

PROJECT: GOLOMOTI SOLAR PV

CLIENT: JCM

SIEVE ANALYSIS (GRADATION) STANDARD: TRH14:1985

SIEVE (mm)	MASS RETAINED	PERCENTAGE RETAINED	PASSING		GRADATION SPECIFICATION BASE	SUBBASE	SL SEAL	ZONE
75.000								
50.000								
37.500								
28.000								
25.000								
20.000								
14.000								
12.500								
10.000								
6.300								
5.000	0.00	0.00	100.00	100				
2.360	24.50	3.30	96.70	97				
1.180	49.00	6.59	93.41	93				
0.600	90.50	12.18	87.82	88				
0.425	124.00	16.69	83.31	83				
0.300	155.00	20.86	79.14	79				
0.150	224.00	30.15	69.85	70				
0.075	262.50	35.33	64.67	65				
0 pan	480.50	64.67						
TOTAL (g)	743.00							



REMARKS: SAMPLED FROM TRIAL PIT 14 @ 0.100-1.000M. **SOLAR PV SITE INVESTIGATION**

PAGE No.

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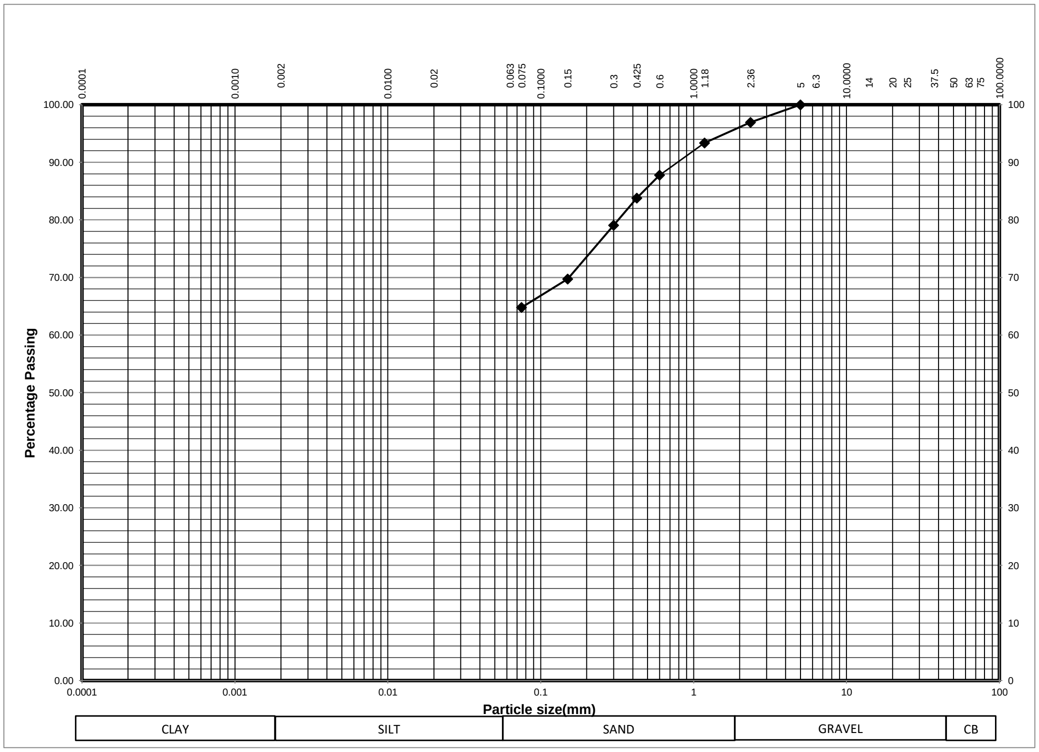
LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP014 / G041 / 01MAY19		
SAMPLED BY: GEOCONSULT LAB TEAM		DATE: 01 / 05 / 2019	TIME: 17:36	
LOCATION:	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 672 645	8 403 499	(m)	1.000-3.800
TYPE OF MATERIAL: MOIST BROWN SANDY SILTY CLAY				
TESTED BY: C. NDALAMA		DATE: 06- 06 - 2019	TIME: 13:20	
CHECKED BY: G. KACHIWALA		DATE: 07 - 06 - 2019	TIME: 13:30	
APPROVED BY: M. SABELLI		DATE: 07 - 06 - 2019	TIME: 15:00	

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

SIEVE ANALYSIS (GRADATION) STANDARD: TRH14:1985

SIEVE	MASS	PERCENTAGE			GRADATION SPECIFICATION			ZONE
(mm)	RETAINED	RETAINED	PASSING		BASE	SUBBASE	SL SEAL	
75.000								
50.000								
37.500								
28.000								
25.000								
20.000								
14.000								
12.500								
10.000								
6.300								
5.000	0.00	0.00	100.00	100				
2.360	22.50	3.04	96.96	97				
1.180	49.00	6.62	93.38	93				
0.600	90.50	12.23	87.77	88				
0.425	120.00	16.22	83.78	84				
0.300	155.00	20.95	79.05	79				
0.150	224.00	30.27	69.73	70				
0.075	260.50	35.20	64.80	65				
0 pan	479.50	64.80						
TOTAL (g)	740.00							



REMARKS: SAMPLED FROM TRIAL PIT 14 @ 1.000-3.800M. **SOLAR PV SITE INVESTIGATION** **PAGE No.**

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LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP014 / NMC040 / 01MAY19		
SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 01 - 05 - 2019	TIME: 09:29	
LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 672 645	8 402 499	(m)	0.100-1.000
TYPE OF MATERIAL: MOIST DARK BROWN SANDY SILTY CLAY				
TESTED BY: C. NDALAMA		DATE: 05 - 05 - 2019	TIME: 13:38	
CHECKED BY: G. KACHIWALA		DATE: 06 - 05 - 2019	TIME: 09:46	
APPROVED BY: M. SABELLI		DATE: 06 - 05 - 2019	TIME: 10:00	

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

NATURAL MOISTURE CONTENT - OVEN DRYING METHOD STANDARD: ASTM D7263

MASS OF WET SOIL + CONTAINER (g)		307.5	
MASS OF DRY SOIL AND CONTAINER (g)		294.0	
CONTAINER No.		GC18	
MASS OF CONTAINER (g)		67.5	
MASS OF DRY SOIL (g)		226.5	
MASS OF WATER (g)		13.5	
MOISTURE CONTENT %		6.0	
AVERAGE MOISTURE CONTENT %		**6.0**	

REMARKS: SAMPLED FROM TRIAL PIT 14 @0.100-1.000M. **SOLAR PV SITE INVESTIGATION** **PAGE No.**

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LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP014 / NMC041 / 01MAY19		
SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 01 - 05 - 2019	TIME: 17:39	
LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 672 645	8 402 499	(m)	1.000-3.800
TYPE OF MATERIAL: MOIST BROWN SANDY SILTY CLAY				
TESTED BY: C. NDALAMA		DATE: 05 - 05 - 2019	TIME: 13:58	
CHECKED BY: G. KACHIWALA		DATE: 06 - 05 - 2019	TIME: 09:46	
APPROVED BY: M. SABELLI		DATE: 06 - 05 - 2019	TIME: 10:00	

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

NATURAL MOISTURE CONTENT - OVEN DRYING METHOD STANDARD: ASTM D7263

MASS OF WET SOIL + CONTAINER (g)		378.0	
MASS OF DRY SOIL AND CONTAINER (g)		345.5	
CONTAINER No.		GC111	
MASS OF CONTAINER (g)		51.5	
MASS OF DRY SOIL (g)		294.0	
MASS OF WATER (g)		32.5	
MOISTURE CONTENT %		11.1	
AVERAGE MOISTURE CONTENT %		**11.1**	

REMARKS: SAMPLED FROM TRIAL PIT 14 @1.000-3.800M. **SOLAR PV SITE INVESTIGATION** **PAGE No.**

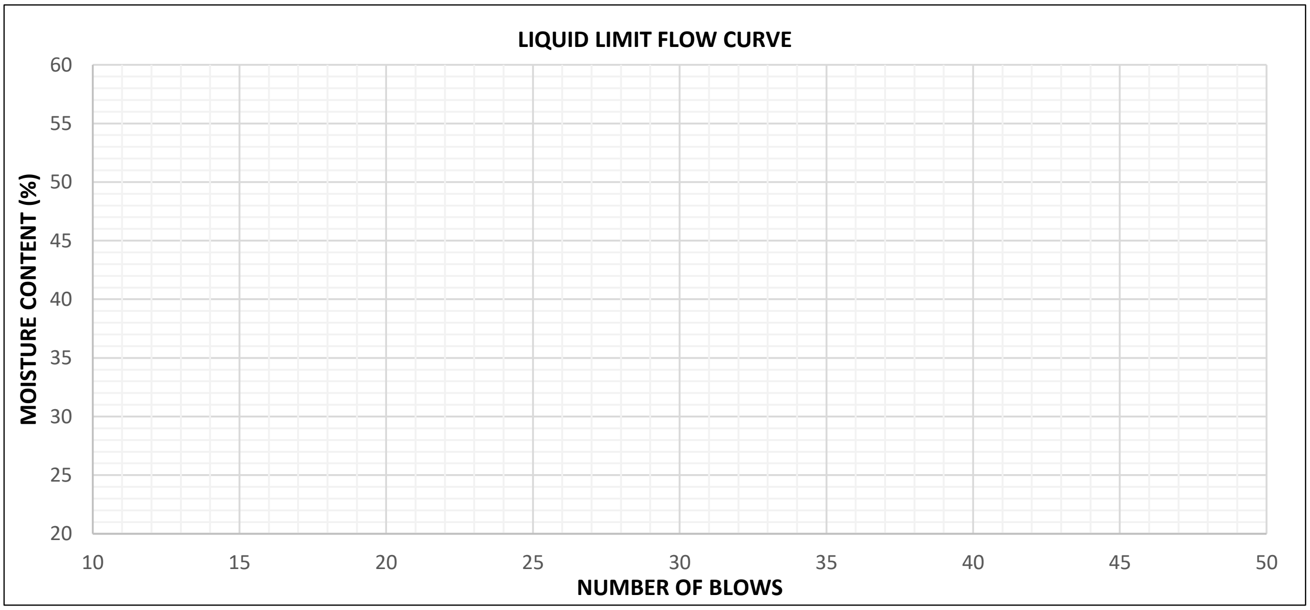
GEOCONSULT	LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP14 / AL040 / 01MAY19			
	SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 01 - 05 - 2019	TIME: 10:15		
	LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)	
	GOLOMOTI - SOLAR PV	0 672 645	8 402 499	(m)	0.100-1.000	
	TYPE OF MATERIAL: MOIST DARK BROWN SANDY SILTY CLAY					
	TESTED BY: M. MILANZI		DATE: 10 - 06 - 2019	TIME: 10:20		
+265 0888 846 543	CHECKED BY: G. KACHIWALA		DATE: 12 - 06 - 2019	TIME: 09:40		
sabelli@geoconsult.cc	APPROVED BY: M. SABELLI		DATE: 12 - 06 - 2019	TIME: 14:28		

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

ATTERBURG LIMITS STANDARD: BS 1377, 2 (C)

TYPE OF TEST	**LIQUID LIMITS (LL)**				**PLASTIC LIMITS (PL)**		
TEST No.	1	2	3	4	1	2	3
CONTAINER No.	C4		C3		RAI	N	R24
MASS OF WET SOIL + CONTAINER(g)	71.5		63.0		51.0	46.5	35.0
MASS OF DRY SOIL + CONTAINER(g)	58.5		50.5		46.5	42.5	33.5
MASS OF CONTAINER (g)	25		22.5		28.5	27	27.5
MASS OF DRY SOIL (g)	33.5		28.0		18.0	15.5	6.0
MASS OF WATER (g)	13.00		12.50		4.50	4.00	1.50
MOISTURE CONTENT %	38.8	39.2	44.6	43.8	25.0	25.8	25.0
No. BLOWS	29		20			25.3	

LINEAR SHRINKAGE	18
INITIAL LENGTH OF SPECIMEN (cm)	14.0
LENGTH OF OVERN DRY SPECIMEN (cm)	13.0
LINEAR SHRINKAGE %	7.7
LIQUID LIMIT (LL) %	41.5
PLASTIC LIMIT (PL) %	25.3
PLASTICITY INDEX (PI)	**16**
NATURAL MOISTURE CONTENT %	6.0
FINENESS INDEX	1040



REMARKS: SAMPLED FROM TRIAL PIT 14 @ 0.100-1.000M. SOLAR PV SITE INVESTIGATION

	Triaxial test - UU **BS 1377 part 7, 1377 part 8**			
	Site :	GOLOMOTI SOALR PV	Levy date :	26-Jun-19
	Technicien's name :		Date of test :	26-Jun-19
GEOCONSULT LIMITED P.O. BOX 40 LILONGWE	File N° :	29	Survey depth (m) :	1.000
	Survey N° :	TRIAL PIT No. 14	Level of water (m) :	
	Kind of soil :			Moist Brown Sandy Silty CLAY

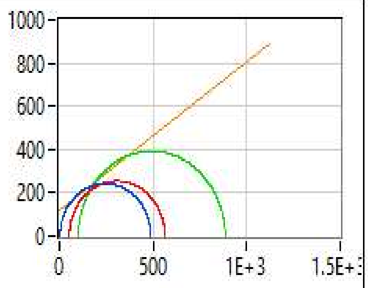
Identification of samples :

σvo, Total stress of the soil in situ (kPa) :	0.000	Uo, Pore pressure of the soil in situ (kPa) :	0.000
Category of soil :	Steep/Strongly overconsolidated	Kind of drainage :	Without lateral drain
ρs, Grain density (kg/m³) :	0.000		
Sm :	☐	Sd :	☐

	Samples before test :									Samples after saturation :		
	N°	Hi (mm)	Di (mm)	mi (g)	ρi (kg/m³)	ρdi (kg/m³)	wi (%)	ei	Sri (%)	Ucp (kPa)	ΔVsat. (mm³)	B (%)
🟦	1	76.00	38	167.0	1938	1618	19.71	-1.000	-0.000		0.000	0.000
🟥	2	76.00	38	166.0	1926	1601	20.29	-1.000	-0.000		0.000	0.000
🟩	3	76.00	38	169.0	1961	1636	19.86	-1.000	-0.000		0.000	0.000

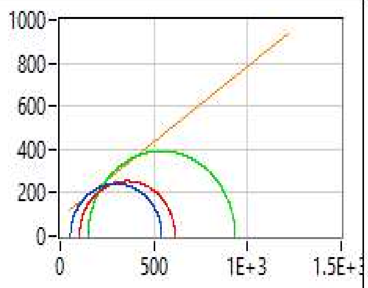
	Samples after consolidation :							Samples after shearing							
	N°	Hs (mm)	Ds (mm)	ΔVs (mm³)	T100 (min)	Vmax (µm/min)	σ'c (kPa)	Hf (mm)	Df (mm)	mf (g)	md (g)	wf (%)	ρdf (kg/m³)	ef	Srf (%)
🟦	1	76.00	38.00	0.000	0.000	0.000	0.000	76.00	38.00	168.0	139.5	20.43	1618	-1.000	-0.000
🟥	2	76.00	38.00	0.000	0.000	0.000	0.000	76.00	38.00	165.0	138.0	19.57	1601	-1.000	-0.000
🟩	3	76.00	38.00	0.000	0.000	0.000	0.000	76.00	38.00	167.5	141.0	18.79	1636	-1.000	-0.000

Total stress :



	Mohr
C (kPa)	119.9
φ (°)	34.31

Effective stress :



	Mohr	Lambe
C' (kPa)	82.54	40.32
φ' (°)	34.99	32.78

Comments :

Visa :

	Triaxial test - UU BS 1377 part 7, 1377 part 8			
	Site :	GOLOMOTI SOLAR PV	Levy date :	25-Jun-19
	Technicien's name :		Date of test :	25-Jun-19
GEOCONSULT LIMITED	File N° :	24	Survey depth (m) :	2.000
P.O. BOX 40 LILONGWE	Survey N° :	TRIAL PIT No. 14	Level of water (m) :	
	Kind of soil :			MOIST BROWN SANDY SILTY CLAY

Identification of samples :

σvo, Total stress of the soil in situ (kPa) :	0.000	Uo, Pore pressure of the soil in situ (kPa) :	0.000
Category of soil :	Soft/Granular	Kind of drainage :	Without lateral drain
ρs, Grain density (kg/m³) :	0.000		
Sm :	☐	Sd :	☐

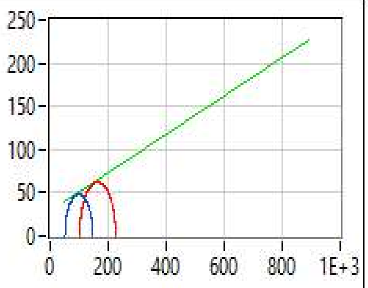
Samples before test : / Samples after saturation :

	N°	Hi (mm)	Di (mm)	mi (g)	ρi (kg/m³)	ρdi (kg/m³)	wi (%)	ei	Sri (%)	Ucp (kPa)	ΔVsat. (mm³)	B (%)
🟦	1	76.00	38	164.0	1903	1514	25.67	-1.000	-0.000		0.000	0.000
🟥	2	76.00	38	163.0	1891	1526	23.95	-1.000	-0.000		0.000	0.000

Samples after consolidation : / Samples after shearing

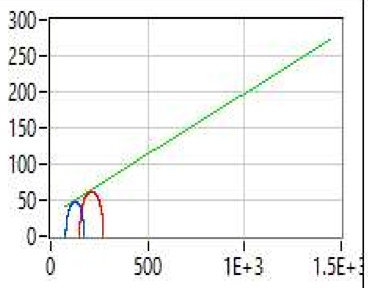
	N°	Hs (mm)	Ds (mm)	ΔVs (mm³)	T100 (min)	Vmax (µm/min)	σ'c (kPa)	Hf (mm)	Df (mm)	mf (g)	md (g)	wf (%)	ρdf (kg/m³)	ef	Srf (%)
🟦	1	76.00	38.00	0.000	0.000	0.000	0.000	76.00	38.00	164.0	130.5	25.67	1514	-1.000	-0.000
🟥	2	76.00	38.00	0.000	0.000	0.000	0.000	76.00	38.00	163.0	131.5	23.95	1526	-1.000	-0.000

Total stress :



	Mohr
C (kPa)	27.08
φ (°)	12.59

Effective stress :



	Mohr	Lambe
C' (kPa)	27.78	27.39
φ' (°)	9.591	9.459

Comments :

Visa :

p.1/3

3.18 Trial Pit 15

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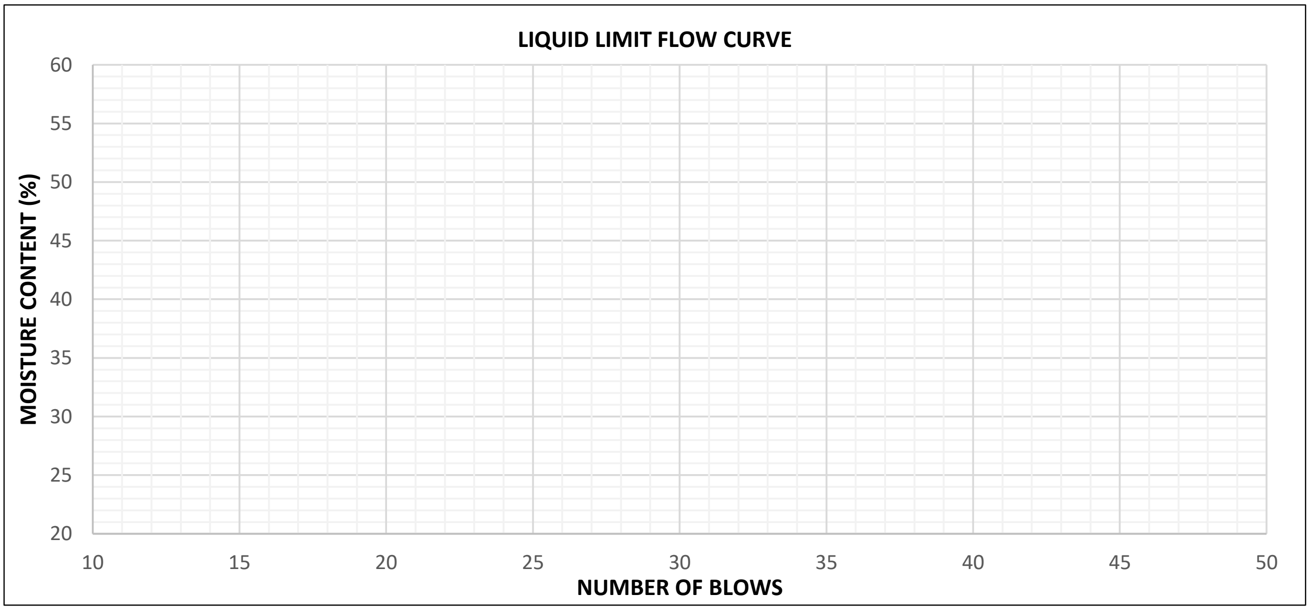
LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP15 / AL044/ 01MAY19		
SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 01 - 05 - 2019	TIME: 11:15	
LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 672 384	8 402 794	(m)	2.500-4.300
TYPE OF MATERIAL: MOIST BROWN REDDISH GRAVELLY SANDY SILTY CLAY				
TESTED BY: M. MILANZI		DATE: 06 - 06 - 2019	TIME: 13:35	
CHECKED BY: G. KACHIWALA		DATE: 12 - 06 - 2019	TIME: 09:40	
APPROVED BY: M. SABELLI		DATE: 12 - 06 - 2019	TIME: 14:28	

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

ATTERBURG LIMITS STANDARD: BS 1377, 2 (C)

TYPE OF TEST	LIQUID LIMITS (LL)				PLASTIC LIMITS (PL)		
TEST No.	1	2	3	4	1	2	3
CONTAINER No.	C18		C15		R22	C4	R7
MASS OF WET SOIL + CONTAINER(g)	47.0		50.0		35.0	35.5	36.5
MASS OF DRY SOIL + CONTAINER(g)	41.5		44.5		34.0	33.5	35.5
MASS OF CONTAINER (g)	26.5		30		29	23.5	30.5
MASS OF DRY SOIL (g)	15.0		14.5		5.0	10.0	5.0
MASS OF WATER (g)	5.50		5.50		1.00	2.00	1.00
MOISTURE CONTENT %	36.7	37.0	37.9	36.8	20.0	20.0	20.0
No. BLOWS	28		18			20.0	

LINEAR SHRINKAGE	16
INITIAL LENGTH OF SPECIMEN (cm)	14.0
LENGTH OF OVERN DRY SPECIMEN (cm)	13.1
LINEAR SHRINKAGE %	6.9
LIQUID LIMIT (LL) %	36.9
PLASTIC LIMIT (PL) %	20.0
PLASTICITY INDEX (PI)	**17**
NATURAL MOISTURE CONTENT %	10.1
FINENESS INDEX	952



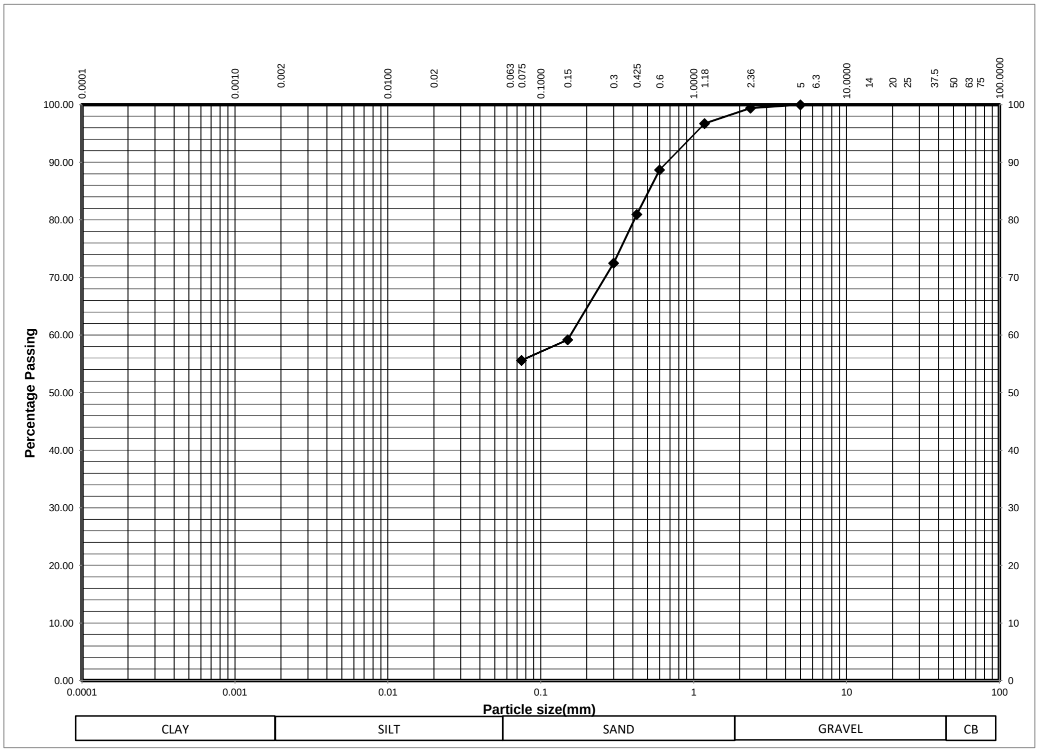
REMARKS: SAMPLED FROM TRIAL PIT 15 @ 2.500-4.300M. SOLAR PV SITE INVESTIGATION

GEOCONSULT	LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP015 / G042 / 02MAY19		
	SAMPLED BY: GEOCONSULT LAB TEAM		DATE: 02 / 05 / 2019	TIME: 10:34	
	LOCATION:	EASTING	NORTHING	ELEVATION	DEPTH (m)
	GOLOMOTI - SOLAR PV	0 672 384	8 402 794	(m)	0.100-0.600
	TYPE OF MATERIAL: MOIST DARK BROWN SANDY SILTY CLAY				
	TESTED BY: C. NDALAMA		DATE: 03 - 06 - 2019	TIME: 10:23	
+265 0888 846 543	CHECKED BY: G. KACHIWALA		DATE: 07 - 06 - 2019	TIME: 13:30	
sabelli@geoconsult.cc	APPROVED BY: M. SABELLI		DATE: 07 - 06 - 2019	TIME: 15:00	

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

SIEVE ANALYSIS (GRADATION) STANDARD: TRH14:1985

SIEVE	MASS	PERCENTAGE			GRADATION SPECIFICATION			ZONE
(mm)	RETAINED	RETAINED	PASSING		BASE	SUBBASE	SL SEAL	
75.000								
50.000								
37.500								
28.000								
25.000								
20.000								
14.000								
12.500								
10.000								
6.300								
5.000	0.00	0.00	100.00	100				
2.360	5.50	0.59	99.41	99				
1.180	30.50	3.28	96.72	97				
0.600	105.00	11.30	88.70	89				
0.425	177.00	19.04	80.96	81				
0.300	255.50	27.49	72.51	73				
0.150	379.50	40.83	59.17	59				
0.075	412.50	44.38	55.62	56				
0 pan	517.00	55.62						
TOTAL (g)	929.50							



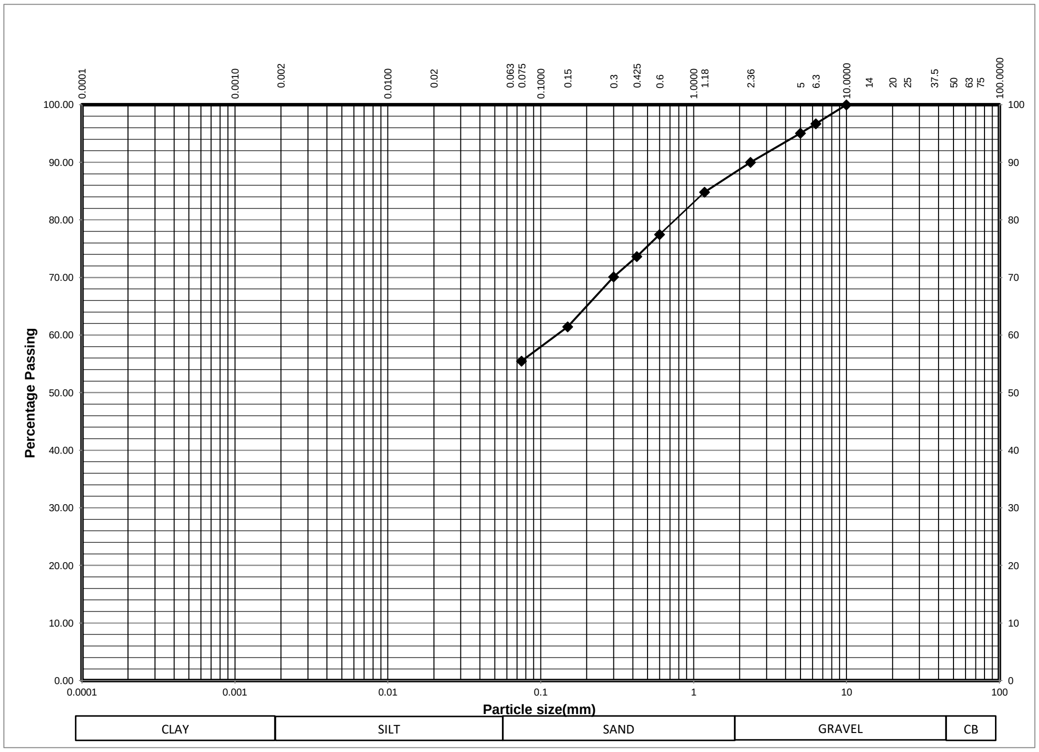
REMARKS: SAMPLED FROM TRIAL PIT 15 @ 0.100-0.600M. **SOLAR PV SITE INVESTIGATION** **PAGE No.**

GEOCONSULT	LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP015 / G043 / 02MAY19	
	SAMPLED BY: GEOCONSULT LAB TEAM		DATE: 02 / 05 / 2019	TIME: 10:34
	LOCATION:	EASTING	NORTHING	ELEVATION (m) / DEPTH (m)
	GOLOMOTI - SOLAR PV	0 672 616	8 403 213	0.600-2.500
	TYPE OF MATERIAL: MOIST BROWN REDDISH SANDY SILTY CLAY			
	TESTED BY: C. NDALAMA		DATE: 28 - 05 - 2019	TIME: 14:10
+265 0888 846 543	CHECKED BY: G. KACHIWALA		DATE: 07 - 06 - 2019	TIME: 13:30
sabelli@geoconsult.cc	APPROVED BY: M. SABELLI		DATE: 07 - 06 - 2019	TIME: 15:00

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

SIEVE ANALYSIS (GRADATION) STANDARD: TRH14:1985

SIEVE	MASS	PERCENTAGE			GRADATION SPECIFICATION			ZONE
(mm)	RETAINED	RETAINED	PASSING		BASE	SUBBASE	SL SEAL	
75.000								
50.000								
37.500								
28.000								
25.000								
20.000								
14.000								
12.500								
10.000	0.00	0.00	100.00	100				
6.300	15.00	3.30	96.70	97				
5.000	22.50	4.95	95.05	95				
2.360	45.50	10.00	90.00	90				
1.180	69.00	15.16	84.84	85				
0.600	102.50	22.53	77.47	77				
0.425	120.00	26.37	73.63	74				
0.300	136.00	29.89	70.11	70				
0.150	175.50	38.57	61.43	61				
0.075	202.50	44.51	55.49	55				
0 pan	252.50	55.49						
TOTAL (g)	455.00							



REMARKS: SAMPLED FROM TRIAL PIT 15 @ 0.600-2.500M. **SOLAR PV SITE INVESTIGATION** **PAGE No.**

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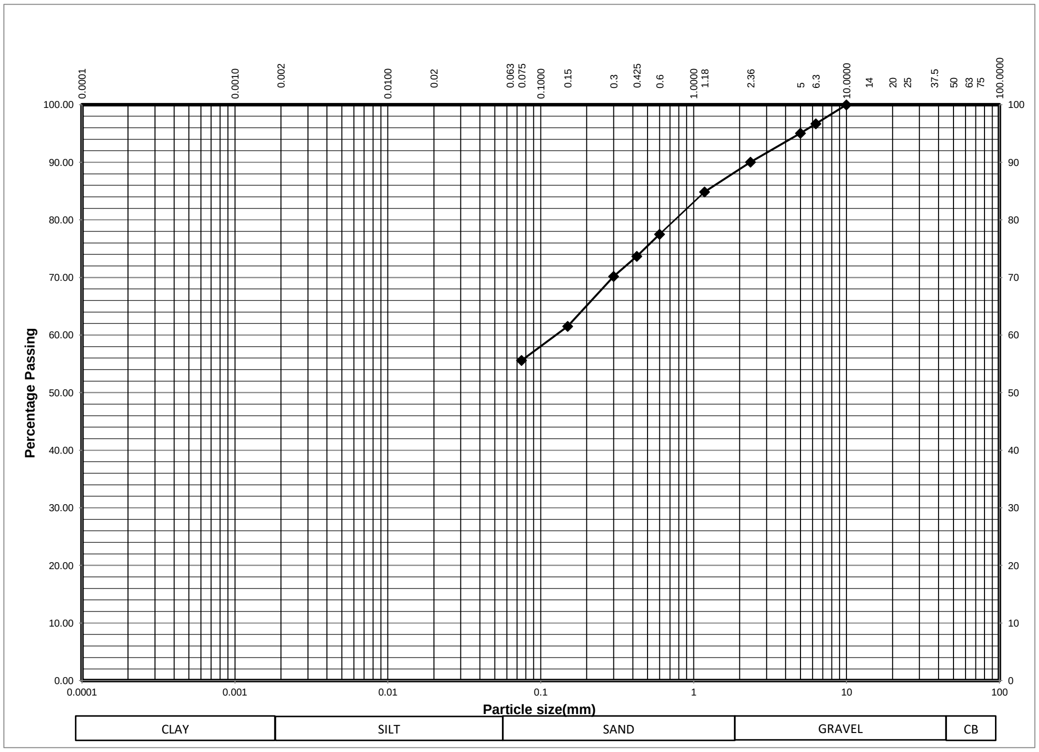
LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP015 / G045 / 02MAY19		
SAMPLED BY: GEOCONSULT LAB TEAM		DATE: 02 / 05 / 2019	TIME: 11:15	
LOCATION:	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 672 616	8 403 794	(m)	2.500-4.300
TYPE OF MATERIAL: MOIST BROWN REDDISH GRAVELLY SANDY SILTY CLAY				
TESTED BY: C. NDALAMA		DATE: 28 - 05 - 2019	TIME: 14:10	
CHECKED BY: G. KACHIWALA		DATE: 07 - 06 - 2019	TIME: 13:30	
APPROVED BY: M. SABELLI		DATE: 07 - 06 - 2019	TIME: 15:00	

PROJECT: GOLOMOTI SOLAR PV | **CLIENT:** JCM

SIEVE ANALYSIS (GRADATION) STANDARD: TRH14:1985

SIEVE	MASS	PERCENTAGE			GRADATION SPECIFICATION			ZONE
(mm)	RETAINED	RETAINED	PASSING		BASE	SUBBASE	SL SEAL	
75.000								
50.000								
37.500								
28.000								
25.000								
20.000								
14.000								
12.500								
10.000	0.00	0.00	100.00	100				
6.300	15.00	3.29	96.71	97				
5.000	22.50	4.93	95.07	95				
2.360	45.50	9.98	90.02	90				
1.180	69.00	15.13	84.87	85				
0.600	102.50	22.48	77.52	78				
0.425	120.00	26.32	73.68	74				
0.300	136.00	29.82	70.18	70				
0.150	175.50	38.49	61.51	62				
0.075	202.50	44.41	55.59	56				
0 pan	253.50	55.59						
TOTAL (g)	456.00							



REMARKS: SAMPLED FROM TRIAL PIT 15 @ 2.500-4.300M. **SOLAR PV SITE INVESTIGATION** | **PAGE No.**

GEOCONSULT	LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP015 / NMC042 / 02MAY19		
	SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 02 - 05 - 2019	TIME: 10:34	
	LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
	GOLOMOTI - SOLAR PV	0 672 384	8 402 794	(m)	0.100-0.600
	TYPE OF MATERIAL: MOIST DARK BROWN SANDY SILTY CLAY				
	TESTED BY: C. NDALAMA		DATE: 06 - 05 - 2019	TIME: 14:38	
+265 0888 846 543	CHECKED BY: G. KACHIWALA		DATE: 07 - 05 - 2019	TIME: 09:00	
sabelli@geoconsult.cc	APPROVED BY: M. SABELLI		DATE: 07 - 05 - 2019	TIME: 13:00	

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

NATURAL MOISTURE CONTENT - OVEN DRYING METHOD STANDARD: ASTM D7263

MASS OF WET SOIL + CONTAINER (g)		281.0	
MASS OF DRY SOIL AND CONTAINER (g)		254.0	
CONTAINER No.		GC21	
MASS OF CONTAINER (g)		49.5	
MASS OF DRY SOIL (g)		204.5	
MASS OF WATER (g)		27.0	
MOISTURE CONTENT %		13.2	
AVERAGE MOISTURE CONTENT %		**13.2**	

REMARKS: SAMPLED FROM TRIAL PIT 15 @0.100-0.600M. **SOLAR PV SITE INVESTIGATION** **PAGE No.**

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LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP015 / NMC043 / 02MAY19		
SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 02 - 05 - 2019	TIME: 11:15	
LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 672 384	8 402 794	(m)	0.600-2.500
TYPE OF MATERIAL: MOIST BROWN REDDISH SANDY SILTY CLAY				
TESTED BY: C. NDALAMA		DATE: 06 - 05 - 2019	TIME: 14:38	
CHECKED BY: G. KACHIWALA		DATE: 07 - 05 - 2019	TIME: 09:00	
APPROVED BY: M. SABELLI		DATE: 07 - 05 - 2019	TIME: 13:00	

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

NATURAL MOISTURE CONTENT - OVEN DRYING METHOD STANDARD: ASTM D7263

MASS OF WET SOIL + CONTAINER (g)		268.0	
MASS OF DRY SOIL AND CONTAINER (g)		244.0	
CONTAINER No.		GC5	
MASS OF CONTAINER (g)		49.5	
MASS OF DRY SOIL (g)		194.5	
MASS OF WATER (g)		24.0	
MOISTURE CONTENT %		12.3	
AVERAGE MOISTURE CONTENT %		**12.3**	

REMARKS: SAMPLED FROM TRIAL PIT 15 @0.600-2.500M. **SOLAR PV SITE INVESTIGATION** **PAGE No.**

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LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP015 / NMC044 / 02MAY19		
SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 02 - 05 - 2019	TIME: 11:15	
LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 672 384	8 402 794	(m)	2.500-4.300
TYPE OF MATERIAL: MOIST BROWN REDDISH GRAVELLY SANDY SILTY CLAY				
TESTED BY: C. NDALAMA		DATE: 06 - 05 - 2019	TIME: 14:38	
CHECKED BY: G. KACHIWALA		DATE: 07 - 05 - 2019	TIME: 09:00	
APPROVED BY: M. SABELLI		DATE: 07 - 05 - 2019	TIME: 13:00	

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

NATURAL MOISTURE CONTENT - OVEN DRYING METHOD STANDARD: ASTM D7263

MASS OF WET SOIL + CONTAINER (g)		268.0	
MASS OF DRY SOIL AND CONTAINER (g)		248.0	
CONTAINER No.		GC5	
MASS OF CONTAINER (g)		49.5	
MASS OF DRY SOIL (g)		198.5	
MASS OF WATER (g)		20.0	
MOISTURE CONTENT %		10.1	
AVERAGE MOISTURE CONTENT %		**10.1**	

REMARKS: SAMPLED FROM TRIAL PIT 15 @2.500-4.300M. **SOLAR PV SITE INVESTIGATION** **PAGE No.**

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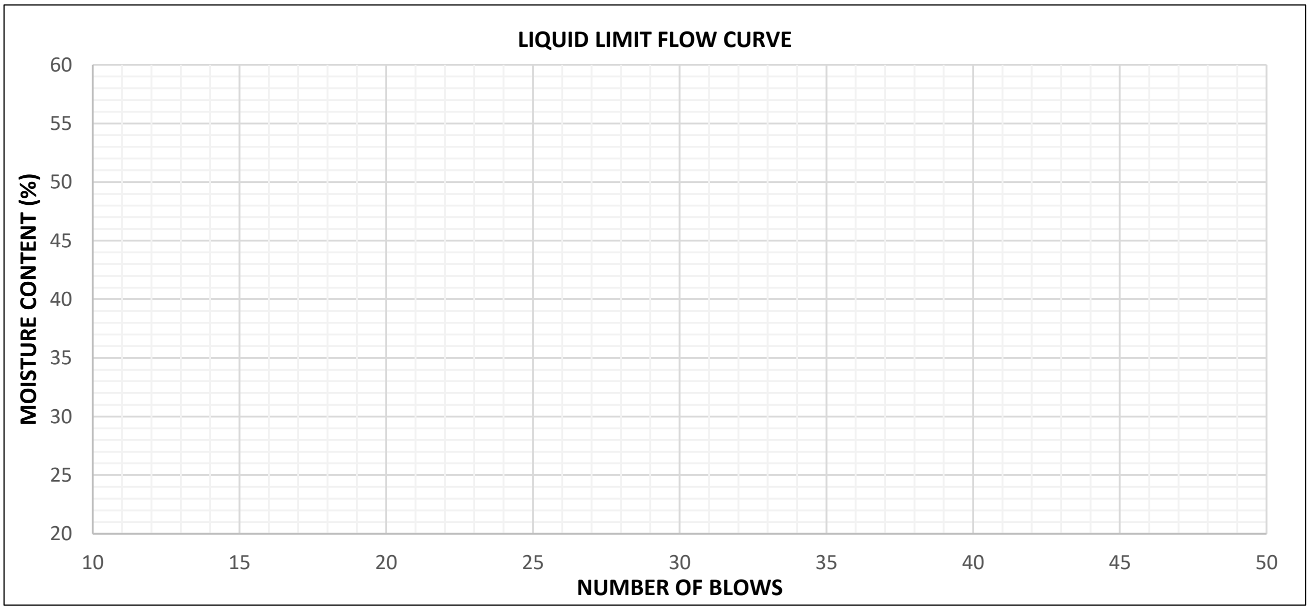
LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP15 / AL042 / 01MAY19		
SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 01 - 05 - 2019	TIME: 10:34	
LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 672 384	8 402 794	(m)	0.000-0.600
TYPE OF MATERIAL: MOIST DARK BROWN SANDY SILTY CLAY				
TESTED BY: M. MILANZI		DATE: 06 - 06 - 2019	TIME: 13:35	
CHECKED BY: G. KACHIWALA		DATE: 12 - 06 - 2019	TIME: 09:40	
APPROVED BY: M. SABELLI		DATE: 12 - 06 - 2019	TIME: 14:28	

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

ATTERBURG LIMITS STANDARD: BS 1377, 2 (C)

TYPE OF TEST	**LIQUID LIMITS (LL)**				**PLASTIC LIMITS (PL)**		
TEST No.	1	2	3	4	1	2	3
CONTAINER No.	C4		C1		K2	C11	R12
MASS OF WET SOIL + CONTAINER(g)	50.5		50.5		40.0	42.0	42.5
MASS OF DRY SOIL + CONTAINER(g)	45.5		46.5		38.5	40.5	40.5
MASS OF CONTAINER (g)	25		35		28	30	27
MASS OF DRY SOIL (g)	20.5		11.5		10.5	10.5	13.5
MASS OF WATER (g)	5.00		4.00		1.50	1.50	2.00
MOISTURE CONTENT %	24.4	24.4	34.8	33.4	14.3	14.3	14.8
No. BLOWS	25		17			14.5	

LINEAR SHRINKAGE	5
INITIAL LENGTH OF SPECIMEN (cm)	14.0
LENGTH OF OVERN DRY SPECIMEN (cm)	13.1
LINEAR SHRINKAGE %	6.9
LIQUID LIMIT (LL) %	28.9
PLASTIC LIMIT (PL) %	14.5
PLASTICITY INDEX (PI)	**14**
NATURAL MOISTURE CONTENT %	13.2
FINENESS INDEX	784



REMARKS: SAMPLED FROM TRIAL PIT 15 @ 0.100-0.600M. SOLAR PV SITE INVESTIGATION

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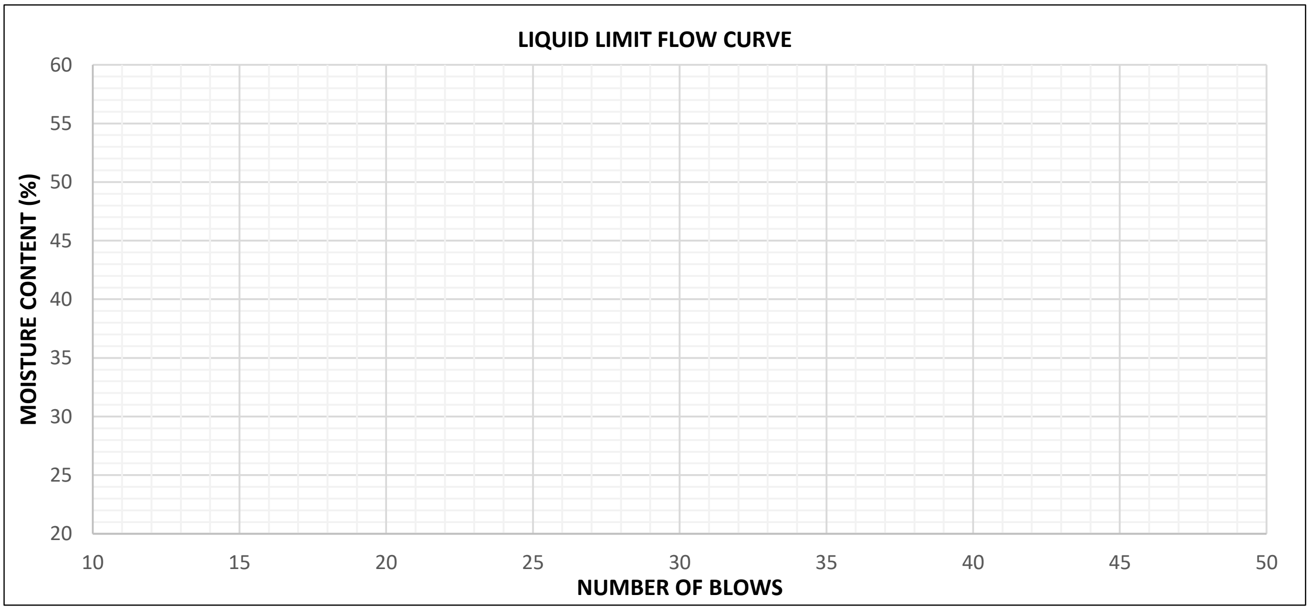
LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP15 / AL043 / 01MAY19		
SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 01 - 05 - 2019	TIME: 10:38	
LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 672 384	8 402 794	(m)	0.600-2.500
TYPE OF MATERIAL: MOIST BROWN REDDISH SANDY SILTY CLAY				
TESTED BY: M. MILANZI		DATE: 06 - 06 - 2019	TIME: 13:35	
CHECKED BY: G. KACHIWALA		DATE: 12 - 06 - 2019	TIME: 09:40	
APPROVED BY: M. SABELLI		DATE: 12 - 06 - 2019	TIME: 14:28	

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

ATTERBURG LIMITS STANDARD: BS 1377, 2 (C)

TYPE OF TEST	LIQUID LIMITS (LL)				PLASTIC LIMITS (PL)		
TEST No.	1	2	3	4	1	2	3
CONTAINER No.	C15		C18		R20	C4	R9
MASS OF WET SOIL + CONTAINER(g)	48.0		50.5		35.0	35.5	36.5
MASS OF DRY SOIL + CONTAINER(g)	42.5		44.5		34.0	34.5	35.5
MASS OF CONTAINER (g)	26.5		30		28	28.5	29.5
MASS OF DRY SOIL (g)	16.0		14.5		6.0	6.0	6.0
MASS OF WATER (g)	5.50		6.00		1.00	1.00	1.00
MOISTURE CONTENT %	34.4	34.7	41.4	40.1	16.7	16.7	16.7
No. BLOWS	28		18			16.7	

LINEAR SHRINKAGE	16
INITIAL LENGTH OF SPECIMEN (cm)	14.0
LENGTH OF OVERN DRY SPECIMEN (cm)	12.6
LINEAR SHRINKAGE %	11.1
LIQUID LIMIT (LL) %	37.4
PLASTIC LIMIT (PL) %	16.7
PLASTICITY INDEX (PI)	**21**
NATURAL MOISTURE CONTENT %	12.3
FINENESS INDEX	1155



REMARKS: SAMPLED FROM TRIAL PIT 15 @ 0.600-2.500M. SOLAR PV SITE INVESTIGATION

	Triaxial test - UU **BS 1377 part 7, 1377 part 8**	
	Site : GOLOMOTI SOLAR PV	Levy date : 12-Jun-19
	Technicien's name :	Date of test : 12-Jun-19
GEOCONSULT LIMITED	File N° : 8	Survey depth (m) : 1.000
P.O. BOX 40 LILONGWE	Survey N° : 15	Level of water (m) :
	Kind of soil : MOIST BROWN REDDISH SANDY SILTY CLAY	

Identification of samples :

σvo, Total stress of the soil in situ (kPa) :	0.000	Uo, Pore pressure of the soil in situ (kPa) :	0.000
Category of soil :	Steep/Strongly overconsolidated	Kind of drainage :	Without lateral drain
ρs, Grain density (kg/m³) :	0.000		
Sm :	☐	Sd :	☐

Samples before test :

Samples after saturation :

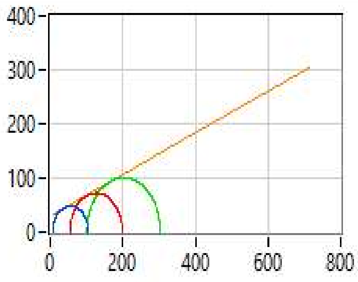
	N°	Hi (mm)	Di (mm)	mi (g)	ρi (kg/m³)	ρdi (kg/m³)	wi (%)	ei	Sri (%)	Ucp (kPa)	ΔVsat. (mm³)	B (%)
🟦	1	75.00	38	151.0	1775	1464	21.29	-1.000	-0.000		0.000	0.000
🟥	2	75.00	38	166.0	1952	1593	22.51	-1.000	-0.000		0.000	0.000
🟩	3	76.00	38	158.5	1839	1491	23.35	-1.000	-0.000		0.000	0.000

Samples after consolidation :

Samples after shearing

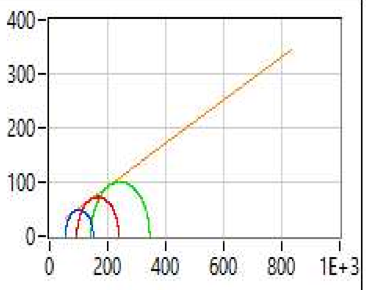
	N°	Hs (mm)	Ds (mm)	ΔVs (mm³)	T100 (min)	Vmax (µm/min)	σ'c (kPa)	Hf (mm)	Df (mm)	mf (g)	md (g)	wf (%)	ρdf (kg/m³)	ef	Srf (%)
🟦	1	75.00	38.00	0.000	0.000	0.000	0.000	75.00	38.00	150.5	124.5	20.88	1464	-1.000	-0.000
🟥	2	75.00	38.00	0.000	0.000	0.000	0.000	75.00	38.00	164.0	135.5	21.03	1593	-1.000	-0.000
🟩	3	76.00	38.00	0.000	0.000	0.000	0.000	76.00	38.00	156.5	128.5	21.79	1491	-1.000	-0.000

Total stress :



	Mohr
C (kPa)	29.34
φ (°)	21.01

Effective stress :



	Mohr	Lambe
C' (kPa)	11.83	10.98
φ' (°)	21.75	20.33

Comments :

Visa :

p.1/3

GEOCONSULT LIMITED

P.O. BOX 40 LILONGWE

Triaxial test - UU
BS 1377 part 7, 1377 part 8

Site :	GOLOMOTI SOLAR PV	Levy date :	10-Jun-19
Technicien's name :		Date of test :	10-Jun-19
File N° :	3	Survey depth (m) :	2.000
Survey N° :	BH 15	Level of water (m) :	
Kind of soil :			Moist Brown Reddish Sandy Silty CLAY

Identification of samples :

σvo, Total stress of the soil in situ (kPa) :	0.000	Uo, Pore pressure of the soil in situ (kPa) :	0.000
Category of soil :	Steep/Strongly overconsolidated	Kind of drainage :	Without lateral drain
ρs, Grain density (kg/m³) :	0.000		
Sm :	☐	Sd :	☐

Samples before test :

Samples after saturation :

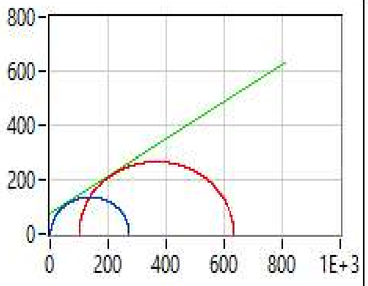
	N°	Hi (mm)	Di (mm)	mi (g)	ρi (kg/m³)	ρdi (kg/m³)	wi (%)	ei	Sri (%)	Ucp (kPa)	ΔVsat. (mm³)	B (%)
🟦	1	76.00	38	157.0	1821	1549	17.60	-1.000	-0.000		0.000	0.000
🟥	2	76.00	38	163.5	1897	1589	19.34	-1.000	-0.000		0.000	0.000

Samples after consolidation :

Samples after shearing

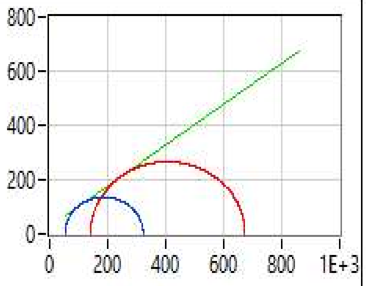
	N°	Hs (mm)	Ds (mm)	ΔVs (mm³)	T100 (min)	Vmax (µm/min)	σ'c (kPa)	Hf (mm)	Df (mm)	mf (g)	md (g)	wf (%)	ρdf (kg/m³)	ef	Srf (%)
🟦	1	76.00	38.00	0.000	0.000	0.000	0.000	76.00	38.00	157.0	133.5	17.60	1549	-1.000	-0.000
🟥	2	76.00	38.00	0.000	0.000	0.000	0.000	76.00	38.00	163.5	137.0	19.34	1589	-1.000	-0.000

Total stress :



	Mohr
C (kPa)	69.25
φ (°)	34.86

Effective stress :



	Mohr	Lambe
C' (kPa)	29.02	23.25
φ' (°)	36.76	30.90

Comments :

Visa :	p.1/3

3.19 Trial Pit 16

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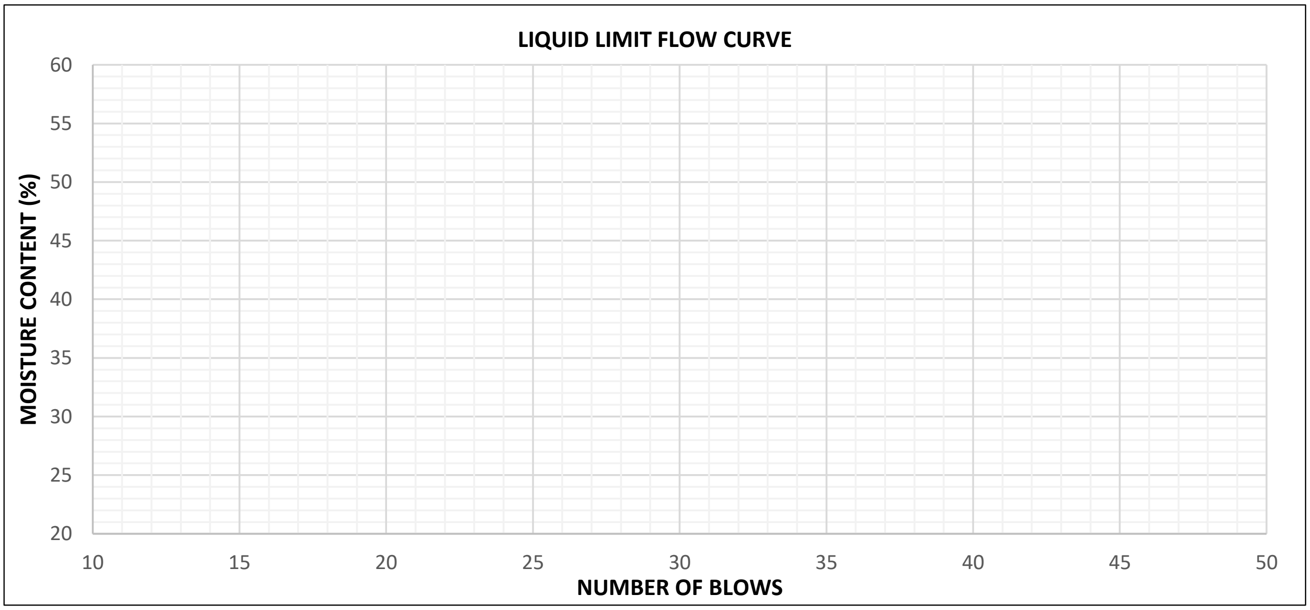
LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP16 / AL046 / 01MAY19		
SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 01 - 05 - 2019	TIME: 16:15	
LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 672 342	8 402 660	(m)	1.000 -3.000
TYPE OF MATERIAL: MOIST BROWN HARD SANDY SILTY CLAYEY LATERITE GRAVEL				
TESTED BY: M. MILANZI		DATE: 24 - 05 - 2019	TIME: 15:25	
CHECKED BY: G. KACHIWALA		DATE: 12 - 06 - 2019	TIME: 10:40	
APPROVED BY: M. SABELLI		DATE: 12 - 06 - 2019	TIME: 14:28	

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

ATTERBURG LIMITS STANDARD: BS 1377, 2 (C)

TYPE OF TEST	**LIQUID LIMITS (LL)**				**PLASTIC LIMITS (PL)**		
TEST No.	1	2	3	4	1	2	3
CONTAINER No.	R22		C20		R11	C26	R21
MASS OF WET SOIL + CONTAINER(g)	50.5		55.5		48.5	50.5	44.5
MASS OF DRY SOIL + CONTAINER(g)	45.0		48.5		45.5	47.5	42.0
MASS OF CONTAINER (g)	29		30.5		29.5	31.5	29
MASS OF DRY SOIL (g)	16.0		18.0		16.0	16.0	13.0
MASS OF WATER (g)	5.50		7.00		3.00	3.00	2.50
MOISTURE CONTENT %	34.4	35.1	38.9	37.7	18.8	18.8	19.2
No. BLOWS	30		18			18.9	

LINEAR SHRINKAGE	6
INITIAL LENGTH OF SPECIMEN (cm)	14.0
LENGTH OF OVERN DRY SPECIMEN (cm)	13.1
LINEAR SHRINKAGE %	6.9
LIQUID LIMIT (LL) %	36.4
PLASTIC LIMIT (PL) %	18.9
PLASTICITY INDEX (PI)	**17**
NATURAL MOISTURE CONTENT %	5.5
FINENESS INDEX	663



REMARKS: SAMPLED FROM TRIAL PIT 16 @ 3.000-4.000M. SOLAR PV SITE INVESTIGATION

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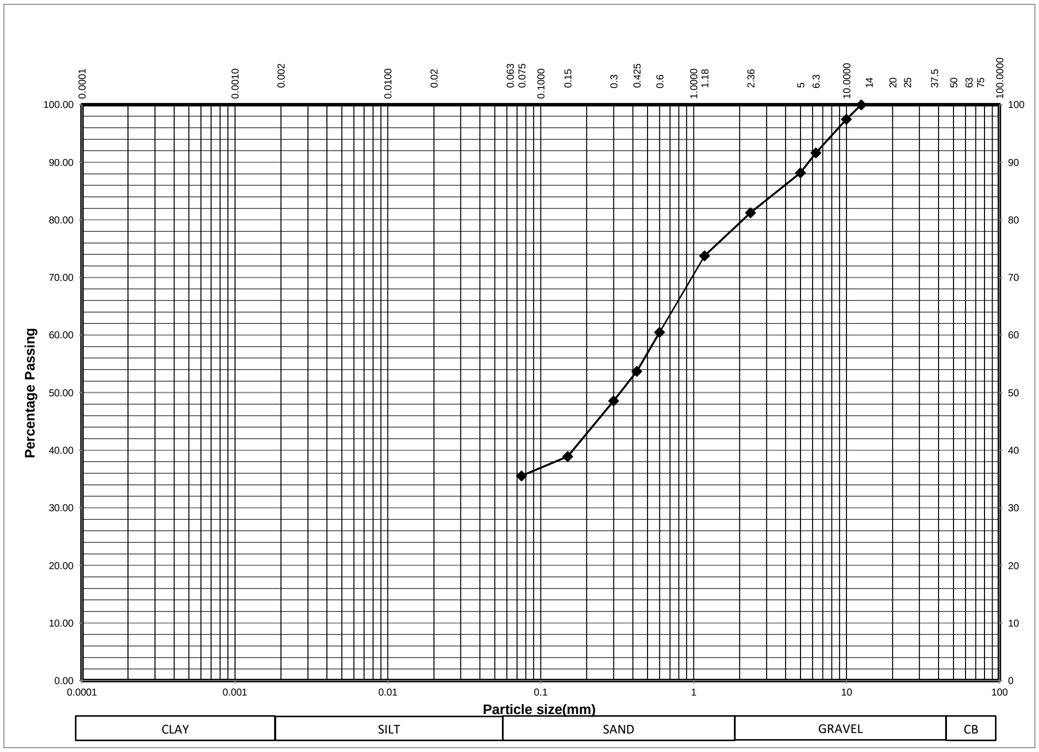
LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP016 / G045 / 02MAY19		
SAMPLED BY: GEOCONSULT LAB TEAM		DATE: 02 / 05 / 2019	TIME: 11:15	
LOCATION:	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 672 342	8 402 660	(m)	0.300-1.000
TYPE OF MATERIAL: MOIST BROWN MOLTLED SANDY SILTY CLAY				
TESTED BY: C. NDALAMA		DATE: 28 - 05 - 2019	TIME: 14:10	
CHECKED BY: G. KACHIWALA		DATE: 07 - 06 - 2019	TIME: 13:30	
APPROVED BY: M. SABELLI		DATE: 07 - 06 - 2019	TIME: 15:00	

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

SIEVE ANALYSIS (GRADATION) STANDARD: TRH14:1985

SIEVE	MASS	PERCENTAGE			GRADATION SPECIFICATION			ZONE
(mm)	RETAINED	RETAINED	PASSING		BASE	SUBBASE	SL SEAL	
75.000								
50.000								
37.500								
28.000								
25.000								
20.000								
14.000								
12.500	0.00	0.00	100.00	100				
10.000	10.50	2.51	97.49	97				
6.300	35.00	8.35	91.65	92				
5.000	49.50	11.81	88.19	88				
2.360	78.50	18.74	81.26	81				
1.180	110.00	26.25	73.75	74				
0.600	165.50	39.50	60.50	61				
0.425	194.00	46.30	53.70	54				
0.300	215.50	51.43	48.57	49				
0.150	256.00	61.10	38.90	39				
0.075	270.00	64.44	35.56	36				
0 pan	149.00	35.56						
TOTAL (g)	419.00							



REMARKS: SAMPLED FROM TRIAL PIT 16 @ 0.300-1.000M. **SOLAR PV SITE INVESTIGATION**

PAGE No.

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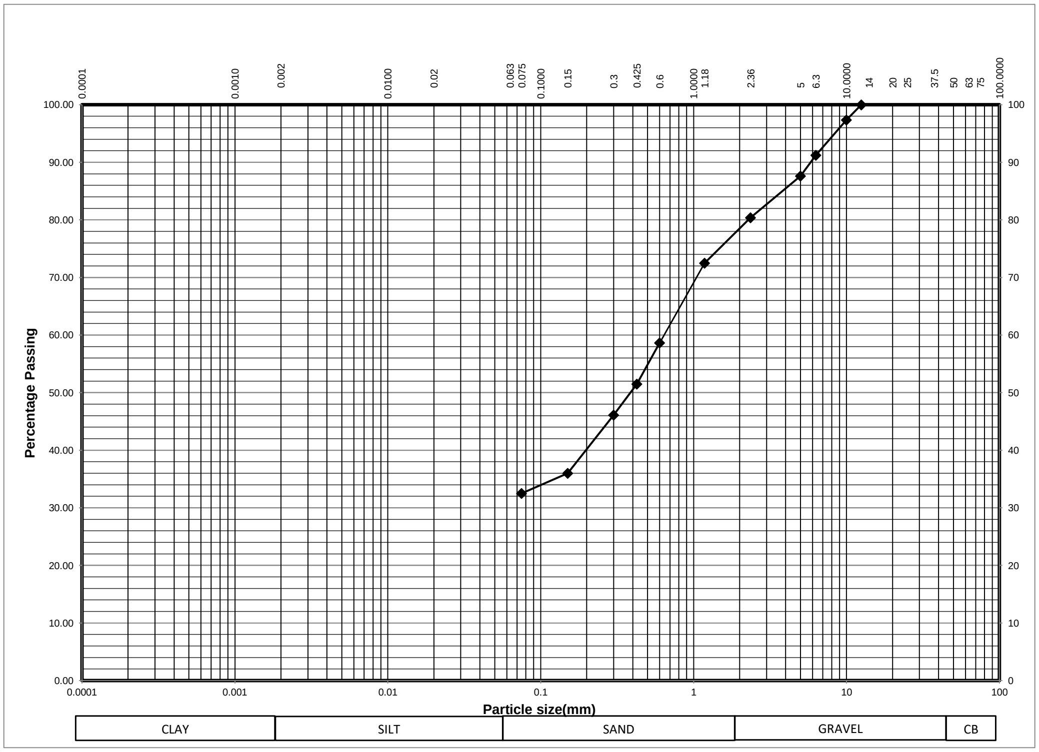
LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP016 / G046 / 02MAY19		
SAMPLED BY: GEOCONSULT LAB TEAM		DATE: 02 / 05 / 2019	TIME: 11:15	
LOCATION:	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 672 342	8 402 660	(m)	1.000-3.000
TYPE OF MATERIAL: MOIST BROWN REDDISH SANDY SILTY CLAYEY LATERITE GRAVEL				
TESTED BY: C. NDALAMA		DATE: 28 - 05 - 2019	TIME: 14:10	
CHECKED BY: G. KACHIWALA		DATE: 07 - 06 - 2019	TIME: 13:30	
APPROVED BY: M. SABELLI		DATE: 07 - 06 - 2019	TIME: 15:00	

PROJECT: GOLOMOTI SOLAR PV

CLIENT: JCM

SIEVE ANALYSIS (GRADATION) STANDARD: TRH14:1985

SIEVE	MASS	PERCENTAGE			GRADATION SPECIFICATION			ZONE
(mm)	RETAINED	RETAINED	PASSING		BASE	SUBBASE	SL SEAL	
75.000								
50.000								
37.500								
28.000								
25.000								
20.000								
14.000								
12.500	0.00	0.00	100.00	100				
10.000	10.50	2.63	97.38	97				
6.300	35.00	8.75	91.25	91				
5.000	49.50	12.38	87.63	88				
2.360	78.50	19.63	80.38	80				
1.180	110.00	27.50	72.50	73				
0.600	165.50	41.38	58.63	59				
0.425	194.00	48.50	51.50	52				
0.300	215.50	53.88	46.13	46				
0.150	256.00	64.00	36.00	36				
0.075	270.00	67.50	32.50	33				
0 pan	130.00	32.50						
TOTAL (g)	400.00							



REMARKS: SAMPLED FROM TRIAL PIT 16 @ 1.000-3.000M. **SOLAR PV SITE INVESTIGATION**

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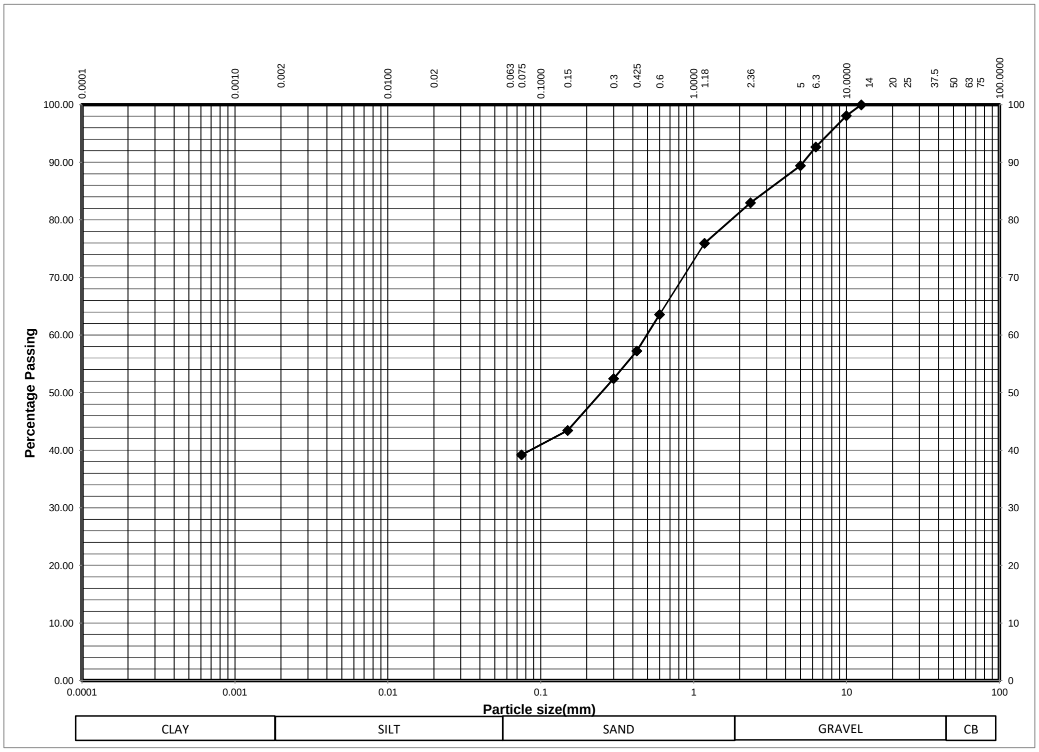
LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP016 / G047 / 02MAY19		
SAMPLED BY: GEOCONSULT LAB TEAM		DATE: 02 / 05 / 2019	TIME: 11:15	
LOCATION:	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 672 342	8 402 660	(m)	3.000-4.100
TYPE OF MATERIAL: MOIST BROWN HARD SANDY SILTY CLAYEY LATERITE GRAVEL				
TESTED BY: C. NDALAMA		DATE: 28 - 05 - 2019	TIME: 14:10	
CHECKED BY: G. KACHIWALA		DATE: 07 - 06 - 2019	TIME: 13:30	
APPROVED BY: M. SABELLI		DATE: 07 - 06 - 2019	TIME: 15:00	

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

SIEVE ANALYSIS (GRADATION) STANDARD: TRH14:1985

SIEVE	MASS	PERCENTAGE			GRADATION SPECIFICATION			ZONE
(mm)	RETAINED	RETAINED	PASSING		BASE	SUBBASE	SL SEAL	
75.000								
50.000								
37.500								
28.000								
25.000								
20.000								
14.000								
12.500	0.00	0.00	100.00	100				
10.000	8.50	1.89	98.11	98				
6.300	33.00	7.35	92.65	93				
5.000	47.50	10.58	89.42	89				
2.360	76.50	17.04	82.96	83				
1.180	108.00	24.05	75.95	76				
0.600	163.50	36.41	63.59	64				
0.425	192.00	42.76	57.24	57				
0.300	213.50	47.55	52.45	52				
0.150	254.00	56.57	43.43	43				
0.075	273.00	60.80	39.20	39				
0 pan	176.00	39.20						
TOTAL (g)	449.00							



REMARKS: SAMPLED FROM TRIAL PIT 16 @ 3.000-4.100M. **SOLAR PV SITE INVESTIGATION** **PAGE No.**

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LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP016 / NMC045 / 02MAY19		
SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 02 - 05 - 2019	TIME: 16:15	
LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 672 342	8 402 660	(m)	0.300-1.000
TYPE OF MATERIAL: MOIST BROWN MOLTLED SANDY SILTY CLAY				
TESTED BY: C. NDALAMA		DATE: 06 - 05 - 2019	TIME: 14:38	
CHECKED BY: G. KACHIWALA		DATE: 07 - 05 - 2019	TIME: 09:00	
APPROVED BY: M. SABELLI		DATE: 07 - 05 - 2019	TIME: 13:00	

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

NATURAL MOISTURE CONTENT - OVEN DRYING METHOD STANDARD: ASTM D7263

MASS OF WET SOIL + CONTAINER (g)		374.0	
MASS OF DRY SOIL AND CONTAINER (g)		355.0	
CONTAINER No.		GC9	
MASS OF CONTAINER (g)		66.5	
MASS OF DRY SOIL (g)		288.5	
MASS OF WATER (g)		19.0	
MOISTURE CONTENT %		6.6	
AVERAGE MOISTURE CONTENT %		**6.6**	

REMARKS: SAMPLED FROM TRIAL PIT 16 @0.300-3.000M. **SOLAR PV SITE INVESTIGATION** **PAGE No.**

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LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP016 / NMC045 / 02MAY19		
SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 02 - 05 - 2019	TIME: 16:15	
LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 672 342	8 402 660	(m)	1.000-3.000
TYPE OF MATERIAL: MOIST BROWN REDDISH SANDY SILTY CLAYEY LATERITE GRAVEL				
TESTED BY: C. NDALAMA		DATE: 06 - 05 - 2019	TIME: 14:38	
CHECKED BY: G. KACHIWALA		DATE: 07 - 05 - 2019	TIME: 09:00	
APPROVED BY: M. SABELLI		DATE: 07 - 05 - 2019	TIME: 13:00	

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

NATURAL MOISTURE CONTENT - OVEN DRYING METHOD STANDARD: ASTM D7263

MASS OF WET SOIL + CONTAINER (g)		370.5	
MASS OF DRY SOIL AND CONTAINER (g)		335.5	
CONTAINER No.		GC17	
MASS OF CONTAINER (g)		50.5	
MASS OF DRY SOIL (g)		285.0	
MASS OF WATER (g)		35.0	
MOISTURE CONTENT %		12.3	
AVERAGE MOISTURE CONTENT %		**12.3**	

REMARKS: SAMPLED FROM TRIAL PIT 16 @1.000-3.000M. **SOLAR PV SITE INVESTIGATION** **PAGE No.**

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LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP016 / NMC046 / 02MAY19		
SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 02 - 05 - 2019	TIME: 16:15	
LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 672 342	8 402 660	(m)	3.000-4.100
TYPE OF MATERIAL: MOIST BROWN HARD SANDY SILTY CLAYEY LATERITE GRAVEL				
TESTED BY: C. NDALAMA		DATE: 06 - 05 - 2019	TIME: 14:38	
CHECKED BY: G. KACHIWALA		DATE: 07 - 05 - 2019	TIME: 09:00	
APPROVED BY: M. SABELLI		DATE: 07 - 05 - 2019	TIME: 13:00	

PROJECT: GOLOMOTI SOLAR PV

CLIENT: JCM

NATURAL MOISTURE CONTENT - OVEN DRYING METHOD   STANDARD: ASTM D7263

MASS OF WET SOIL + CONTAINER (g)		418.0	
MASS OF DRY SOIL AND CONTAINER (g)		400.0	
CONTAINER No.		GC2B	
MASS OF CONTAINER (g)		73.0	
MASS OF DRY SOIL (g)		327.0	
MASS OF WATER (g)		18.0	
MOISTURE CONTENT %		5.5	
AVERAGE MOISTURE CONTENT %		**5.5**	

REMARKS: SAMPLED FROM TRIAL PIT 16 @3.000-4.100M. **SOLAR PV SITE INVESTIGATION**

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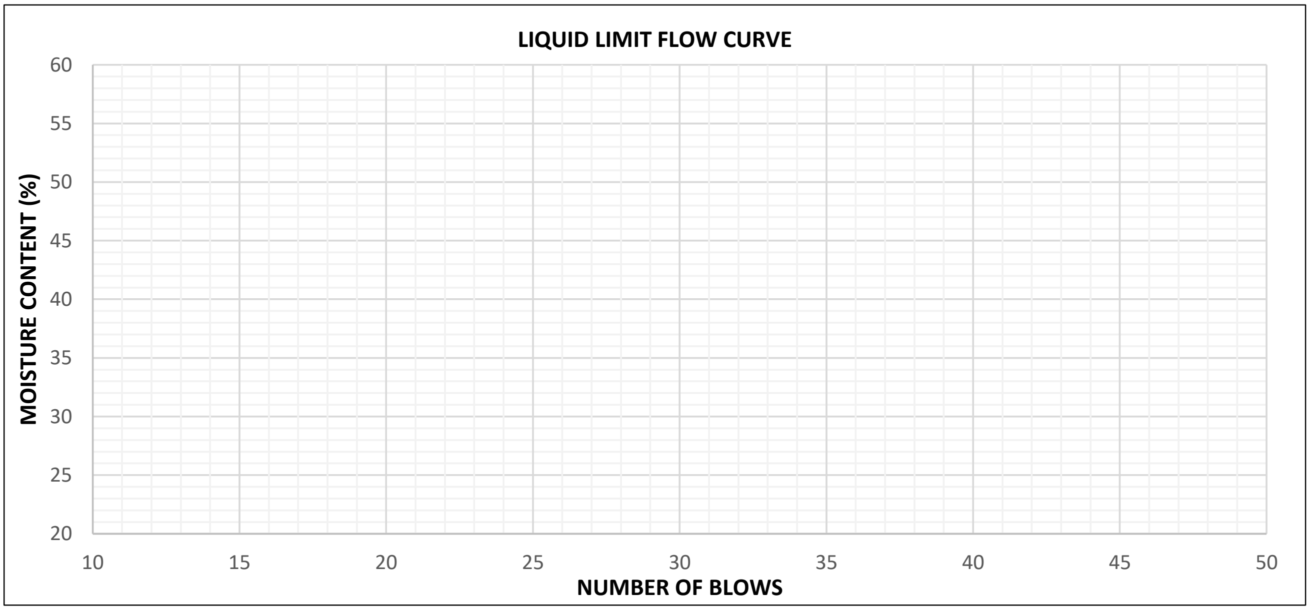
LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP16 / AL045/ 01MAY19		
SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 01 - 05 - 2019	TIME: 16:15	
LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 672 342	8 402 660	(m)	0.300-1.000
TYPE OF MATERIAL: MOIST BROWN MOLTLED SANDY SILTY CLAY				
TESTED BY: M. MILANZI		DATE: 24 - 05 - 2019	TIME: 15:02	
CHECKED BY: G. KACHIWALA		DATE: 12 - 06 - 2019	TIME: 09:40	
APPROVED BY: M. SABELLI		DATE: 12 - 06 - 2019	TIME: 14:28	

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

ATTERBURG LIMITS STANDARD: BS 1377, 2 (C)

TYPE OF TEST	LIQUID LIMITS (LL)				PLASTIC LIMITS (PL)		
TEST No.	1	2	3	4	1	2	3
CONTAINER No.	R18		C16		R19	C24	R21
MASS OF WET SOIL + CONTAINER(g)	50.0		54.0		47.5	49.5	44.0
MASS OF DRY SOIL + CONTAINER(g)	45.0		48.0		45.0	46.5	42.0
MASS OF CONTAINER (g)	29.5		28.5		33	32	32
MASS OF DRY SOIL (g)	15.5		19.5		12.0	14.5	10.0
MASS OF WATER (g)	5.00		6.00		2.50	3.00	2.00
MOISTURE CONTENT %	32.3	32.6	30.8	29.5	20.8	20.7	20.0
No. BLOWS	27		16			20.5	

LINEAR SHRINKAGE	4
INITIAL LENGTH OF SPECIMEN (cm)	14.0
LENGTH OF OVERN DRY SPECIMEN (cm)	13.2
LINEAR SHRINKAGE %	6.1
LIQUID LIMIT (LL) %	31.1
PLASTIC LIMIT (PL) %	20.5
PLASTICITY INDEX (PI)	**11**
NATURAL MOISTURE CONTENT %	6.6
FINENESS INDEX	396



REMARKS: SAMPLED FROM TRIAL PIT 16 @ 0.300-1.000M. SOLAR PV SITE INVESTIGATION

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LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP16 / AL046 / 01MAY19		
SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 01 - 05 - 2019	TIME: 16:15	
LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 672 342	8 402 660	(m)	1.000 -3.000
TYPE OF MATERIAL: MOIST BROWN REDDISH SANDY SILTY CLAYEY LATERITE GRAVEL				
TESTED BY: M. MILANZI		DATE: 24 - 05 - 2019	TIME: 15:25	
CHECKED BY: G. KACHIWALA		DATE: 12 - 06 - 2019	TIME: 10:40	
APPROVED BY: M. SABELLI		DATE: 12 - 06 - 2019	TIME: 14:28	

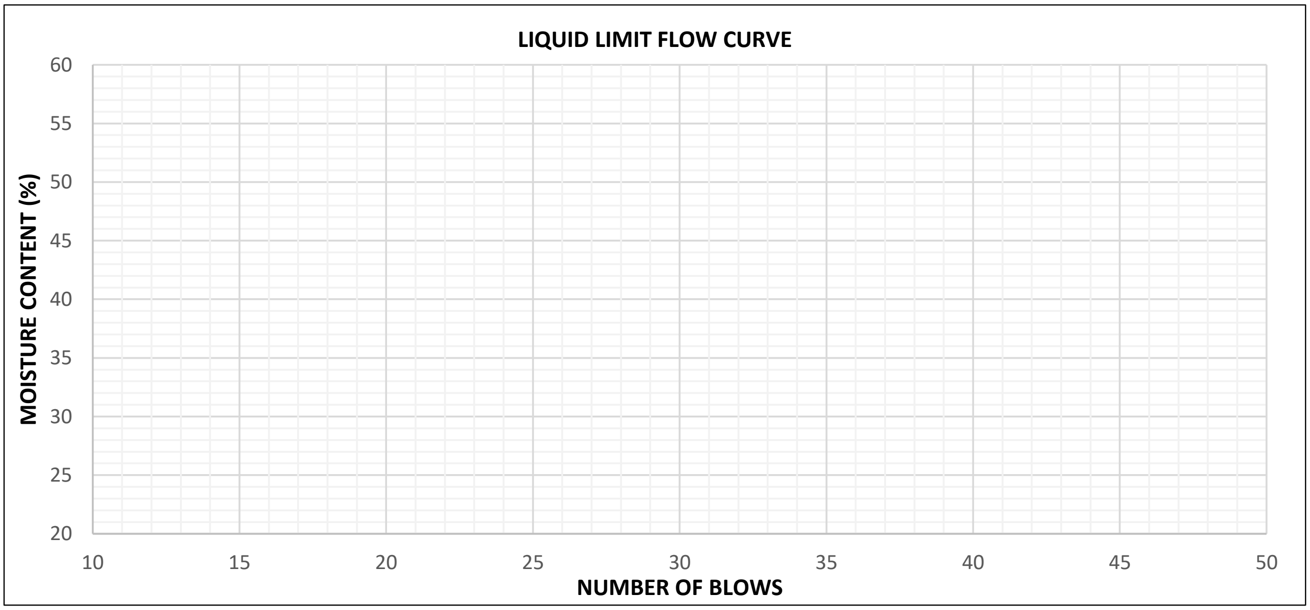
PROJECT: GOLOMOTI SOLAR PV

CLIENT: JCM

ATTERBURG LIMITS STANDARD: BS 1377, 2 (C)

TYPE OF TEST	LIQUID LIMITS (LL)				PLASTIC LIMITS (PL)		
TEST No.	1	2	3	4	1	2	3
CONTAINER No.	R20		C18		R16	C20	R20
MASS OF WET SOIL + CONTAINER(g)	50.5		54.5		48.0	49.5	44.0
MASS OF DRY SOIL + CONTAINER(g)	45.5		47.5		45.0	47.0	41.5
MASS OF CONTAINER (g)	30		28		28	32.5	27.5
MASS OF DRY SOIL (g)	15.5		19.5		17.0	14.5	14.0
MASS OF WATER (g)	5.00		7.00		3.00	2.50	2.50
MOISTURE CONTENT %	32.3	32.6	35.9	34.5	17.6	17.2	17.9
No. BLOWS	29		17			17.6	

LINEAR SHRINKAGE	5
INITIAL LENGTH OF SPECIMEN (cm)	14.0
LENGTH OF OVERN DRY SPECIMEN (cm)	12.9
LINEAR SHRINKAGE %	8.5
LIQUID LIMIT (LL) %	33.5
PLASTIC LIMIT (PL) %	17.6
PLASTICITY INDEX (PI)	**16**
NATURAL MOISTURE CONTENT %	12.3
FINENESS INDEX	528



REMARKS: SAMPLED FROM TRIAL PIT 16 @ 1.000-3.000M. SOLAR PV SITE INVESTIGATION

	Triaxial test - UU **BS 1377 part 7, 1377 part 8**			
	Site :	GOLOMOTI SOLAR PV	Levy date :	14-Jun-19
	Technicien's name :		Date of test :	14-Jun-19
GEOCONSULT LIMITED	File N° :	12	Survey depth (m) :	2.000
P.O. BOX 40 LILONGWE	Survey N° :	TRIAL PIT No. 16	Level of water (m) :	
	Kind of soil :			Moist Brown Reddish Sandy Clayey LATERITE GRAVEL

Identification of samples :

σvo, Total stress of the soil in situ (kPa) : 0.000	Uo, Pore pressure of the soil in situ (kPa) : 0.000
Category of soil : Steep/Strongly overconsolidated	Kind of drainage : Without lateral drain
ρs, Grain density (kg/m^3) : 0.000	
Sm : ☐	Sd : ☐

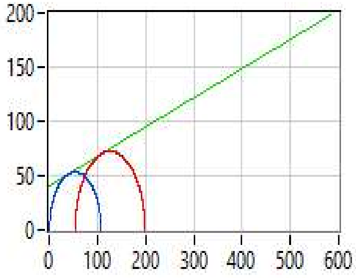
Samples before test : / Samples after saturation :

	N°	Hi (mm)	Di (mm)	mi (g)	ρi (kg/m^3)	ρdi (kg/m^3)	wi (%)	ei	Sri (%)	Ucp (kPa)	ΔVsat. (mm^3)	B (%)
🟦	1	76.00	38	142.5	1653	1613	2.518	-1.000	-0.000		0.010	0.000
🟥	2	75.00	38	166.0	1952	1593	22.51	-1.000	-0.000		0.000	0.000

Samples after consolidation : / Samples after shearing

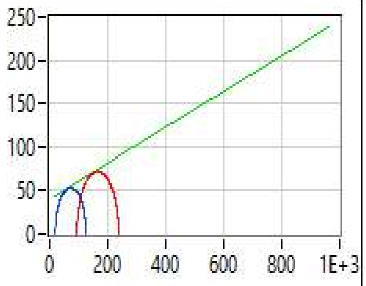
	N°	Hs (mm)	Ds (mm)	ΔVs (mm^3)	T100 (min)	Vmax (µm/min)	σ'c (kPa)	Hf (mm)	Df (mm)	mf (g)	md (g)	wf (%)	ρdf (kg/m^3)	ef	Srf (%)
🟦	1	76.00	38.00	0.000	0.000	0.000	0.000	76.00	38.00	142.0	139.0	2.158	1613	-1.000	-0.000
🟥	2	75.00	38.00	0.000	0.000	0.000	0.000	75.00	38.00	164.0	135.5	21.03	1593	-1.000	-0.000

Total stress :



	Mohr
C (kPa)	40.61
φ (°)	15.15

Effective stress :



	Mohr	Lambe
C' (kPa)	39.76	38.95
φ' (°)	11.62	11.39

Comments :

Visa :

p.1/3

3.20 Trial Pit 17

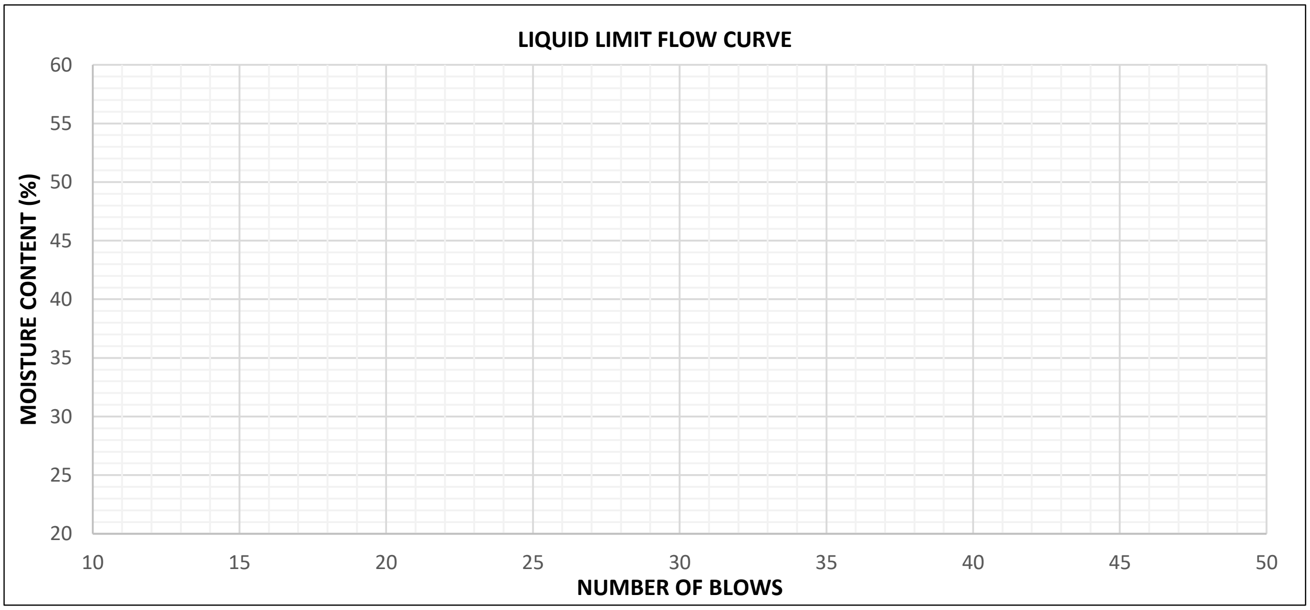
GEOCONSULT	LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP17 / AL050 / 02MAY19			
	SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 02 - 05 - 2019	TIME: 16:15		
	LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)	
	GOLOMOTI - SOLAR PV	0 672 016	8 402 656	(m)	2.500 -4.100	
	TYPE OF MATERIAL: MOIST BROWN REDDISH STIFF LATERITE GRAVELLY SANDY SILTY CLAY					
	TESTED BY: M. MILANZI		DATE: 08 - 06 - 2019	TIME: 11:01		
+265 0888 846 543	CHECKED BY: G. KACHIWALA		DATE: 12 - 06 - 2019	TIME: 10:40		
sabelli@geoconsult.cc	APPROVED BY: M. SABELLI		DATE: 12 - 06 - 2019	TIME: 14:28		

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

ATTERBURG LIMITS STANDARD: BS 1377, 2 (C)

TYPE OF TEST	LIQUID LIMITS (LL)				PLASTIC LIMITS (PL)		
TEST No.	1	2	3	4	1	2	3
CONTAINER No.	R4		R21		R27	R30	C17
MASS OF WET SOIL + CONTAINER(g)	57.0		56.0		47.5	48.0	47.0
MASS OF DRY SOIL + CONTAINER(g)	52.5		50.0		44.5	45.0	44.0
MASS OF CONTAINER (g)	32.5		27		22.5	22	22
MASS OF DRY SOIL (g)	20.0		23.0		22.0	23.0	22.0
MASS OF WATER (g)	4.50		6.00		3.00	3.00	3.00
MOISTURE CONTENT %	22.5	22.5	26.1	25.0	13.6	13.0	13.6
No. BLOWS	26		16			13.4	

LINEAR SHRINKAGE	7
INITIAL LENGTH OF SPECIMEN (cm)	14.0
LENGTH OF OVERN DRY SPECIMEN (cm)	13.2
LINEAR SHRINKAGE %	6.1
LIQUID LIMIT (LL) %	23.8
PLASTIC LIMIT (PL) %	13.4
PLASTICITY INDEX (PI)	**10**
NATURAL MOISTURE CONTENT %	
FINENESS INDEX	



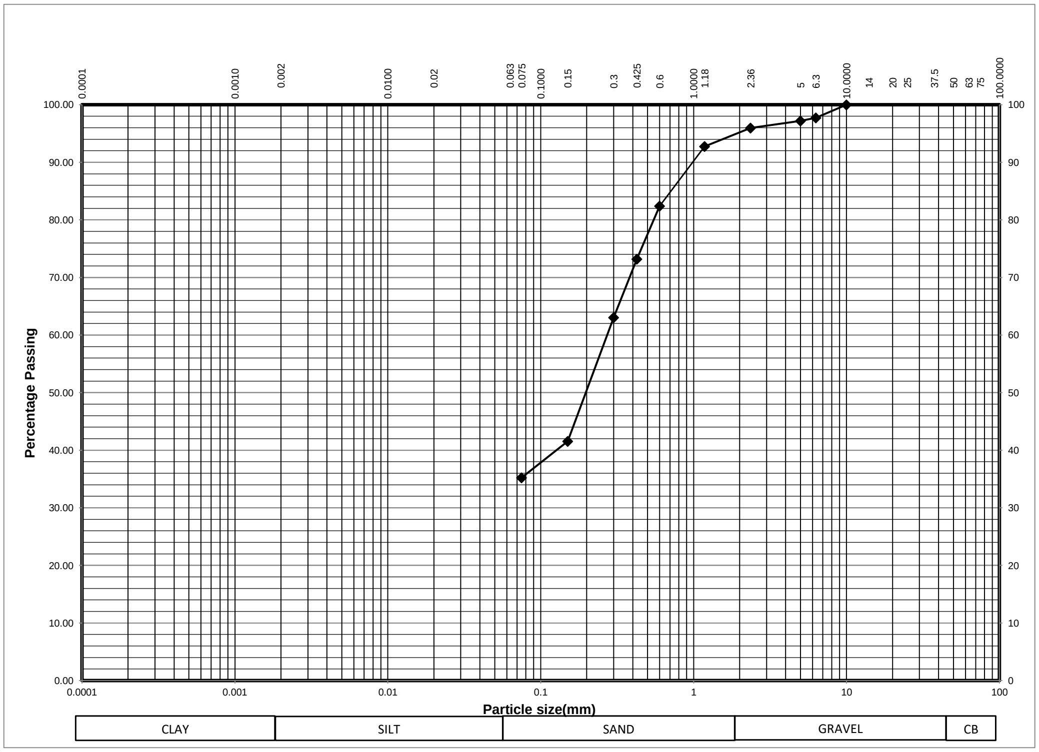
REMARKS: SAMPLED FROM TRIAL PIT 17 @ 2.500-4.100M. SOLAR PV SITE INVESTIGATION

GEOCONSULT	LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP017 / G048 / 02MAY19		
	SAMPLED BY: GEOCONSULT LAB TEAM		DATE: 02 / 05 / 2019	TIME: 17:41	
	LOCATION:	EASTING	NORTHING	ELEVATION	DEPTH (m)
	GOLOMOTI - SOLAR PV	0 672 016	8 402 656	(m)	0.100-0.600
	TYPE OF MATERIAL: MOIST DARK BROWN SANDY SILTY CLAY				
	TESTED BY: C. NDALAMA		DATE: 03 - 06 - 2019	TIME: 10:02	
+265 0888 846 543	CHECKED BY: G. KACHIWALA		DATE: 07 - 06 - 2019	TIME: 13:30	
sabelli@geoconsult.cc	APPROVED BY: M. SABELLI		DATE: 07 - 06 - 2019	TIME: 15:00	

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

SIEVE ANALYSIS (GRADATION) STANDARD: TRH14:1985

SIEVE	MASS	PERCENTAGE			GRADATION SPECIFICATION			ZONE
(mm)	RETAINED	RETAINED	PASSING		BASE	SUBBASE	SL SEAL	
75.000								
50.000								
37.500								
28.000								
25.000								
20.000								
14.000								
12.500								
10.000	0.00	0.00	100.00	100				
6.300	19.00	2.26	97.74	98				
5.000	23.50	2.79	97.21	97				
2.360	34.00	4.04	95.96	96				
1.180	61.00	7.25	92.75	93				
0.600	148.00	17.59	82.41	82				
0.425	225.50	26.80	73.20	73				
0.300	311.00	36.96	63.04	63				
0.150	492.00	58.47	41.53	42				
0.075	545.00	64.77	35.23	35				
0 pan	296.50	35.23						
TOTAL (g)	841.50							



REMARKS: SAMPLED FROM TRIAL PIT 17 @ 0.100-0.600M. **SOLAR PV SITE INVESTIGATION** **PAGE No.**

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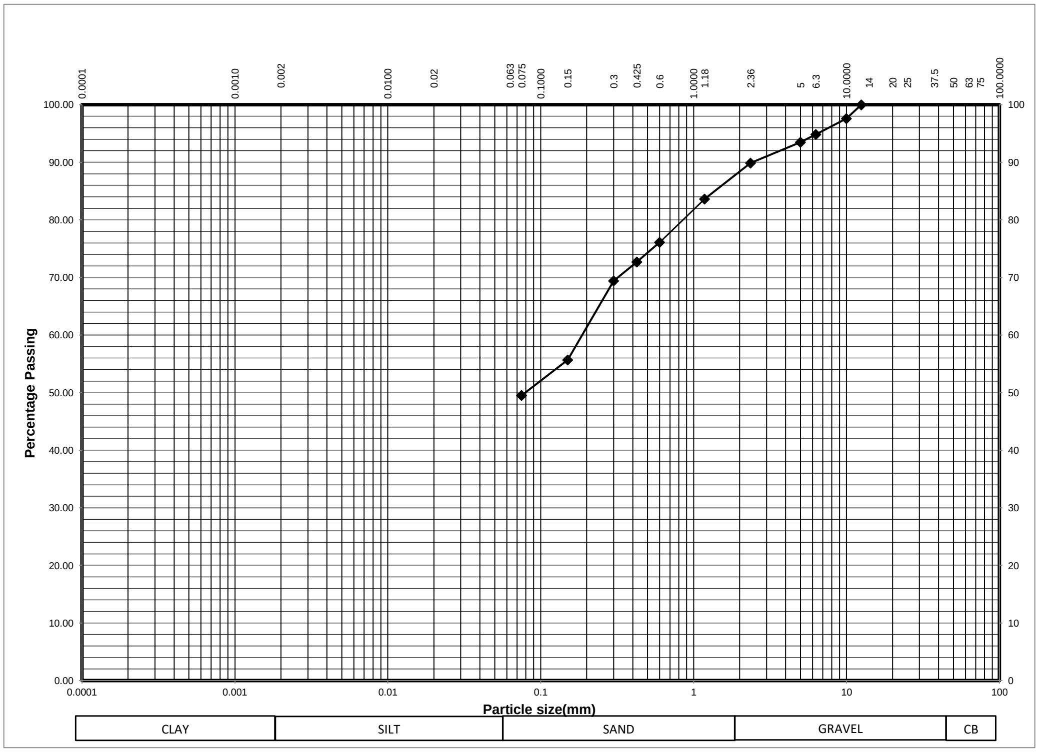
LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP017 / G049 / 02MAY19		
SAMPLED BY: GEOCONSULT LAB TEAM		DATE: 02 / 05 / 2019	TIME: 17:41	
LOCATION:	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 672 016	8 402 656	(m)	0.600-2.500
TYPE OF MATERIAL: MOIST DARK GRAVELLY SANDY SILTY CLAY				
TESTED BY: C. NDALAMA		DATE: 03 - 06 - 2019	TIME: 11:30	
CHECKED BY: G. KACHIWALA		DATE: 07 - 06 - 2019	TIME: 13:30	
APPROVED BY: M. SABELLI		DATE: 07 - 06 - 2019	TIME: 15:00	

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

SIEVE ANALYSIS (GRADATION) STANDARD: TRH14:1985

SIEVE	MASS	PERCENTAGE			GRADATION SPECIFICATION			ZONE
(mm)	RETAINED	RETAINED	PASSING		BASE	SUBBASE	SL SEAL	
75.000								
50.000								
37.500								
28.000								
25.000								
20.000								
14.000								
12.500	0.00	0.00	100.00	100				
10.000	21.00	2.38	97.62	98				
6.300	45.50	5.16	94.84	95				
5.000	57.50	6.52	93.48	93				
2.360	89.50	10.14	89.86	90				
1.180	144.50	16.37	83.63	84				
0.600	211.00	23.91	76.09	76				
0.425	241.00	27.31	72.69	73				
0.300	270.00	30.59	69.41	69				
0.150	391.00	44.31	55.69	56				
0.075	445.50	50.48	49.52	50				
0 pan	437.00	49.52						
TOTAL (g)	882.50							



REMARKS: SAMPLED FROM TRIAL PIT 17 @ 0.600-2.500M. **SOLAR PV SITE INVESTIGATION**

PAGE No.

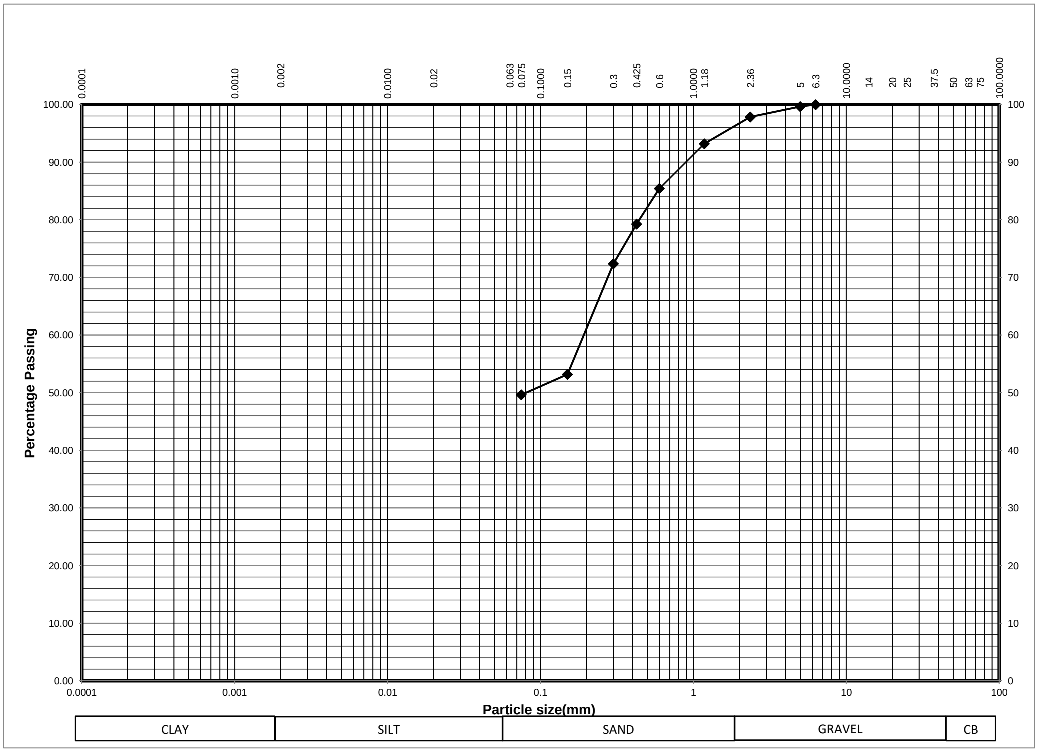
GEOCONSULT	LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP017 / G050 / 02MAY19		
	SAMPLED BY: GEOCONSULT LAB TEAM		DATE: 02 / 05 / 2019	TIME: 17:41	
	LOCATION:	EASTING	NORTHING	ELEVATION	DEPTH (m)
	GOLOMOTI - SOLAR PV	0 672 016	8 402 656	(m)	2.500-4.100
	TYPE OF MATERIAL: MOIST DARK BROWN REDDISH STIFF GRAVELLY SANDY SILTY CLAY				
	TESTED BY: C. NDALAMA		DATE: 30 - 05 - 2019	TIME: 14:15	
+265 0888 846 543	CHECKED BY: G. KACHIWALA		DATE: 07 - 06 - 2019	TIME: 13:30	
sabelli@geoconsult.cc	APPROVED BY: M. SABELLI		DATE: 07 - 06 - 2019	TIME: 15:00	

PROJECT: GOLOMOTI SOLAR PV

CLIENT: JCM

SIEVE ANALYSIS (GRADATION) STANDARD: TRH14:1985

SIEVE	MASS	PERCENTAGE			GRADATION SPECIFICATION			ZONE
(mm)	RETAINED	RETAINED	PASSING		BASE	SUBBASE	SL SEAL	
75.000								
50.000								
37.500								
28.000								
25.000								
20.000								
14.000								
12.500								
10.000								
6.300	0.00	0.00	100.00	100				
5.000	8.00	0.36	99.64	100				
2.360	48.00	2.17	97.83	98				
1.180	150.50	6.79	93.21	93				
0.600	323.00	14.57	85.43	85				
0.425	459.00	20.71	79.29	79				
0.300	612.00	27.61	72.39	72				
0.150	1038.00	46.83	53.17	53				
0.075	1116.50	50.37	49.63	50				
0 pan	1100.00	49.63						
TOTAL (g)	2216.50							



REMARKS: SAMPLED FROM TRIAL PIT 17 @2.500-4.100M. **SOLAR PV SITE INVESTIGATION**

PAGE No.

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LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP017 / NMC048 / 02MAY19		
SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 02 - 05 - 2019	TIME: 17:41	
LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 672 016	8 402 656	(m)	0.100-0.600
TYPE OF MATERIAL: MOIST DARK BROWN SANDY SILTY CLAY				
TESTED BY: C. NDALAMA		DATE: 06 - 05 - 2019	TIME: 10:02	
CHECKED BY: G. KACHIWALA		DATE: 07 - 05 - 2019	TIME: 09:00	
APPROVED BY: M. SABELLI		DATE: 07 - 05 - 2019	TIME: 13:00	

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

NATURAL MOISTURE CONTENT - OVEN DRYING METHOD STANDARD: ASTM D7263

MASS OF WET SOIL + CONTAINER (g)		297.0	
MASS OF DRY SOIL AND CONTAINER (g)		266.5	
CONTAINER No.		GC19	
MASS OF CONTAINER (g)		47.5	
MASS OF DRY SOIL (g)		219.0	
MASS OF WATER (g)		30.5	
MOISTURE CONTENT %		13.9	
AVERAGE MOISTURE CONTENT %		**13.9**	

REMARKS: SAMPLED FROM TRIAL PIT 17 @0.100-0.600M. **SOLAR PV SITE INVESTIGATION** **PAGE No.**

GEOCONSULT +265 0888 846 543 sabelli@geoconsult.cc	LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP017 / NMC048 / 02MAY19		
	SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 02 - 05 - 2019	TIME: 17:41	
	LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
	GOLOMOTI - SOLAR PV	0 672 016	8 402 660	(m)	0.600-2.500
	TYPE OF MATERIAL: MOIST BROWN GRAVELLY SANDY SILTY CLAY				
	TESTED BY: C. NDALAMA		DATE: 06 - 05 - 2019	TIME: 14:38	
	CHECKED BY: G. KACHIWALA		DATE: 07 - 05 - 2019	TIME: 09:00	
	APPROVED BY: M. SABELLI		DATE: 07 - 05 - 2019	TIME: 13:00	

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

NATURAL MOISTURE CONTENT - OVEN DRYING METHOD STANDARD: ASTM D7263

MASS OF WET SOIL + CONTAINER (g)		334.0	
MASS OF DRY SOIL AND CONTAINER (g)		305.0	
CONTAINER No.		GC10	
MASS OF CONTAINER (g)		66.0	
MASS OF DRY SOIL (g)		239.0	
MASS OF WATER (g)		29.0	
MOISTURE CONTENT %		12.1	
AVERAGE MOISTURE CONTENT %		**12.1**	

REMARKS: SAMPLED FROM TRIAL PIT 17 @0.600-2.500M. **SOLAR PV SITE INVESTIGATION** **PAGE No.**

GEOCONSULT +265 0888 846 543 sabelli@geoconsult.cc	LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP017 / NMC049 / 02MAY19	
	SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 02 - 05 - 2019	TIME: 17:41
	LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
	GOLOMOTI - SOLAR PV	0 672 016	8 402 656	(m)	2.500-4.100
	TYPE OF MATERIAL: MOIST BROWN REDDISH STIFF LATERITE GRAVELLY SANDY SILTY CLAY				
	TESTED BY: C. NDALAMA		DATE: 06 - 05 - 2019	TIME: 14:38
	CHECKED BY: G. KACHIWALA		DATE: 07 - 05 - 2019	TIME: 09:00
	APPROVED BY: M. SABELLI		DATE: 07 - 05 - 2019	TIME: 13:00

PROJECT: GOLOMOTI SOLAR PV

CLIENT: JCM

NATURAL MOISTURE CONTENT - OVEN DRYING METHOD   STANDARD: ASTM D7263

MASS OF WET SOIL + CONTAINER (g)		366.0	
MASS OF DRY SOIL AND CONTAINER (g)		336.0	
CONTAINER No.		GC9	
MASS OF CONTAINER (g)		66.5	
MASS OF DRY SOIL (g)		269.5	
MASS OF WATER (g)		30.0	
MOISTURE CONTENT %		11.1	
AVERAGE MOISTURE CONTENT %		**11.1**	

REMARKS: SAMPLED FROM TRIAL PIT 17 @2.500-4.100M. **SOLAR PV SITE INVESTIGATION**

PAGE No.

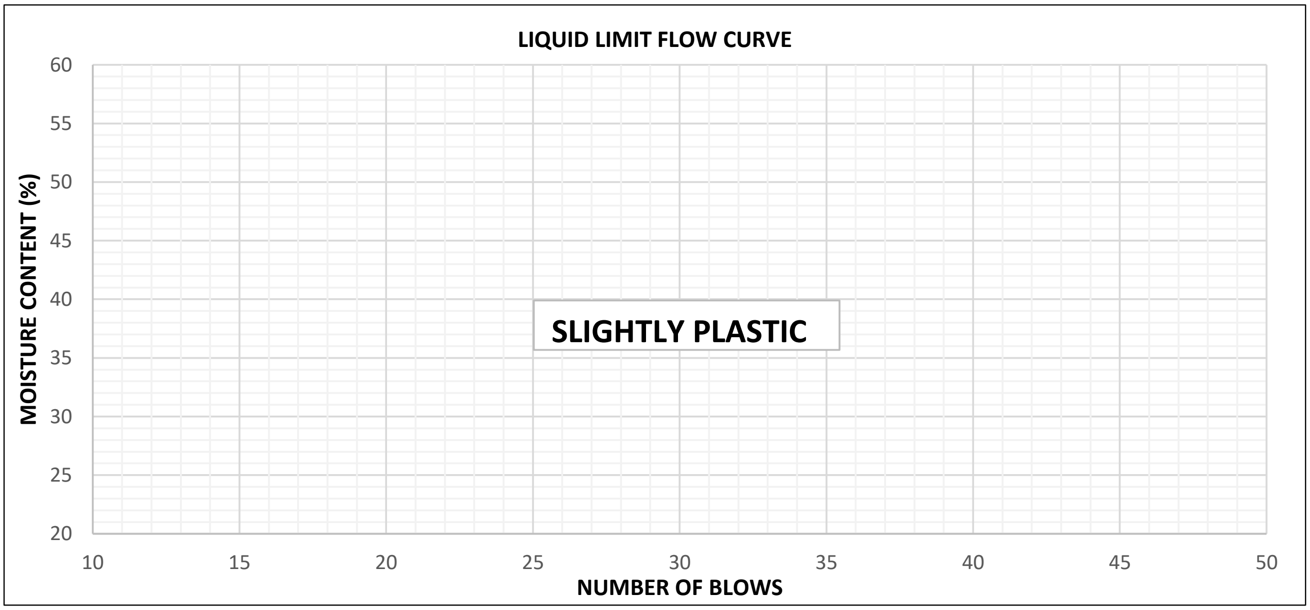
GEOCONSULT	LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP17 / AL047 / 02MAY19		
	SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 02 - 05 - 2019	TIME: 17:41	
	LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
	GOLOMOTI - SOLAR PV	0 672 016	8 402 656	(m)	0.100 -0.600
	TYPE OF MATERIAL: MOIST DARK BROWN SANDY SILTY CLAY				
	TESTED BY: S. MATCHADO		DATE: 10 - 06 - 2019	TIME: 10:44	
+265 0888 846 543	CHECKED BY: G. KACHIWALA		DATE: 12 - 06 - 2019	TIME: 10:40	
sabelli@geoconsult.cc	APPROVED BY: M. SABELLI		DATE: 12 - 06 - 2019	TIME: 14:28	

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

ATTERBURG LIMITS STANDARD: BS 1377, 2 (C)

TYPE OF TEST	**LIQUID LIMITS (LL)**				**PLASTIC LIMITS (PL)**		
TEST No.	1	2	3	4	1	2	3
CONTAINER No.	SP	SP	SP	SP	SP	SP	SP
MASS OF WET SOIL + CONTAINER(g)							
MASS OF DRY SOIL + CONTAINER(g)							
MASS OF CONTAINER (g)							
MASS OF DRY SOIL (g)							
MASS OF WATER (g)							
MOISTURE CONTENT %							
No. BLOWS							

LINEAR SHRINKAGE	3
INITIAL LENGTH OF SPECIMEN (cm)	14.0
LENGTH OF OVERN DRY SPECIMEN (cm)	13.7
LINEAR SHRINKAGE %	2.2
LIQUID LIMIT (LL) %	0.0
PLASTIC LIMIT (PL) %	0.0
PLASTICITY INDEX (PI)	**0**
NATURAL MOISTURE CONTENT %	13.9
FINENESS INDEX	



REMARKS: SAMPLED FROM TRIAL PIT 17 @ 0.100-0.600M. SOLAR PV SITE INVESTIGATION

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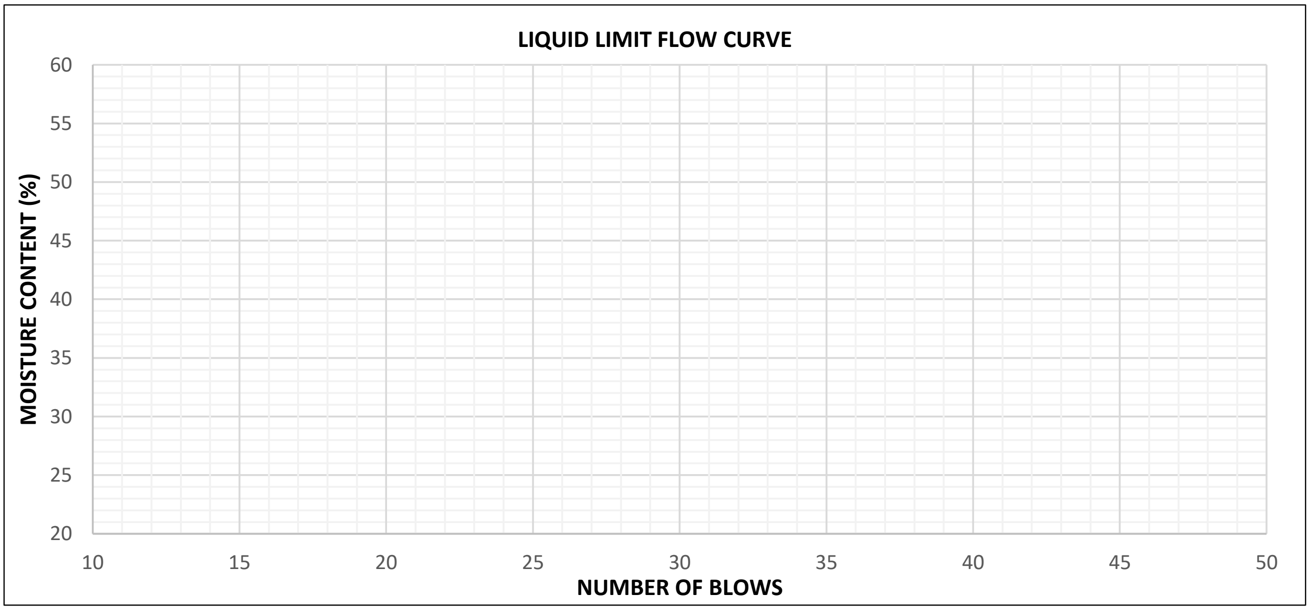
LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP17 / AL049 / 02MAY19		
SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 02 - 05 - 2019	TIME: 16:15	
LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 672 016	8 402 656	(m)	0.600 -2.500
TYPE OF MATERIAL: MOIST BROWN GRAVELLY SANDY SILTY CLAY				
TESTED BY: M. MILANZI		DATE: 24 - 05 - 2019	TIME: 15:25	
CHECKED BY: G. KACHIWALA		DATE: 12 - 06 - 2019	TIME: 10:40	
APPROVED BY: M. SABELLI		DATE: 12 - 06 - 2019	TIME: 14:28	

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

ATTERBURG LIMITS STANDARD: BS 1377, 2 (C)

TYPE OF TEST	**LIQUID LIMITS (LL)**				**PLASTIC LIMITS (PL)**		
TEST No.	1	2	3	4	1	2	3
CONTAINER No.	C12		C24		R11	C31	R26
MASS OF WET SOIL + CONTAINER(g)	65.0		60.0		47.5	43.5	46.0
MASS OF DRY SOIL + CONTAINER(g)	56.0		52.5		43.5	41.0	43.5
MASS OF CONTAINER (g)	28		32.5		25.5	30	32.5
MASS OF DRY SOIL (g)	28.0		20.0		18.0	11.0	11.0
MASS OF WATER (g)	9.00		7.50		4.00	2.50	2.50
MOISTURE CONTENT %	32.1	32.1	37.5	36.0	22.2	22.7	22.7
No. BLOWS	25		17			22.6	

LINEAR SHRINKAGE	15
INITIAL LENGTH OF SPECIMEN (cm)	14.0
LENGTH OF OVERN DRY SPECIMEN (cm)	13.3
LINEAR SHRINKAGE %	5.3
LIQUID LIMIT (LL) %	34.1
PLASTIC LIMIT (PL) %	22.6
PLASTICITY INDEX (PI)	**12**
NATURAL MOISTURE CONTENT %	12.1
FINENESS INDEX	600



REMARKS: SAMPLED FROM TRIAL PIT 17 @ 0.600-2.500M. SOLAR PV SITE INVESTIGATION

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P.O. BOX 40 LILONGWE

Triaxial test - UU
BS 1377 part 7, 1377 part 8

Site :	GOLOMOTI SOLAR PV	Levy date :	11-Jun-19
Technicien's name :		Date of test :	11-Jun-19
File N° :	4	Survey depth (m) :	1.000
Survey N° :	BH 17	Level of water (m) :	
Kind of soil :			Moist Brown Gravelley Sandy Silty CLAY

Identification of samples :

σvo, Total stress of the soil in situ (kPa) :	0.000	Uo, Pore pressure of the soil in situ (kPa) :	0.000
Category of soil :	Steep/Strongly overconsolidated	Kind of drainage :	Without lateral drain
ρs, Grain density (kg/m³) :	0.000		
Sm :	☐	Sd :	☐

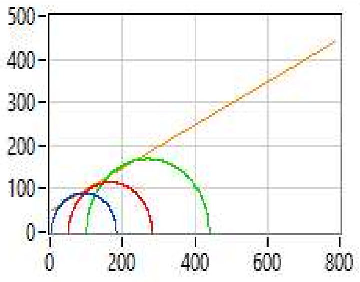
Samples before test : / Samples after saturation :

	N°	Hi (mm)	Di (mm)	mi (g)	ρi (kg/m³)	ρdi (kg/m³)	wi (%)	ei	Sri (%)	Ucp (kPa)	ΔVsat. (mm³)	B (%)
🟦	1	76.00	38	144.5	1676	1456	15.14	-1.000	-0.000		0.010	0.000
🟥	2	76.00	38	132.5	1537	1346	14.22	-1.000	-0.000		0.000	0.002
🟩	3	76.00	38	143.5	1665	1450	14.80	-1.000	-0.000		0.000	0.000

Samples after consolidation : / Samples after shearing

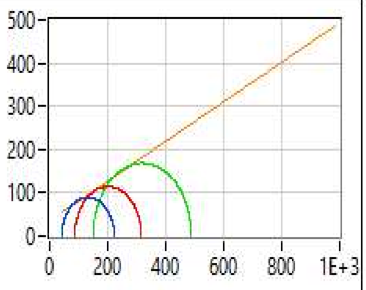
	N°	Hs (mm)	Ds (mm)	ΔVs (mm³)	T100 (min)	Vmax (µm/min)	σ'c (kPa)	Hf (mm)	Df (mm)	mf (g)	md (g)	wf (%)	ρdf (kg/m³)	ef	Srf (%)
🟦	1	76.00	38.00	0.000	0.000	0.000	0.000	76.00	38.00	143.5	125.5	14.34	1456	-1.000	-0.000
🟥	2	76.00	38.00	0.000	0.000	0.000	0.000	76.00	38.00	132.0	116.0	13.79	1346	-1.000	-0.000
🟩	3	76.00	38.00	0.000	0.000	0.000	0.000	76.00	38.00	143.5	125.0	14.80	1450	-1.000	-0.000

Total stress :



	Mohr
C (kPa)	48.92
φ (°)	26.33

Effective stress :



	Mohr	Lambe
C' (kPa)	35.95	31.65
φ' (°)	24.63	23.18

Comments :

Visa : p.1/3

GEOCONSULT LIMITED

P.O. BOX 40 LILONGWE

Triaxial test - UU
BS 1377 part 7, 1377 part 8

Site :	GOLOMOTI SOLAR PV	Levy date :	12-Jun-19
Technicien's name :		Date of test :	12-Jun-19
File N° :	7	Survey depth (m) :	2.000
Survey N° :	BH 17	Level of water (m) :	
Kind of soil :	Moist Brown Gravelley Sandy Silty CLAY		

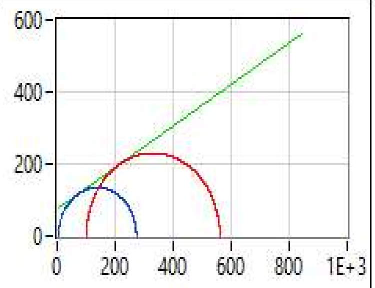
Identification of samples :

σvo, Total stress of the soil in situ (kPa) :	0.000	Uo, Pore pressure of the soil in situ (kPa) :	0.000
Category of soil :	Steep/Strongly overconsolidated	Kind of drainage :	Without lateral drain
ρs, Grain density (kg/m^3) :	0.000		
Sm :	☐	Sd :	☐

		Samples before test :								Samples after saturation :		
	N°	Hi (mm)	Di (mm)	mi (g)	ρi (kg/m^3)	ρdi (kg/m^3)	wi (%)	ei	Sri (%)	Ucp (kPa)	ΔVsat. (mm^3)	B (%)
🟦	1	76.00	38	156.0	1810	1578	14.71	-1.000	-0.000		0.000	0.000
🟥	2	76.00	38	161.0	1868	1630	14.59	-1.000	-0.000		0.000	0.000

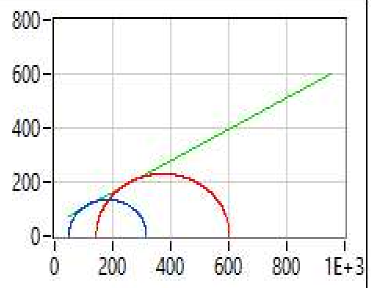
		Samples after consolidation :						Samples after shearing							
	N°	Hs (mm)	Ds (mm)	ΔVs (mm^3)	T100 (min)	Vmax (µm/min)	$\sigma'c$ (kPa)	Hf (mm)	Df (mm)	mf (g)	md (g)	wf (%)	ρdf (kg/m^3)	ef	Srf (%)
🟦	1	76.00	38.00	0.000	0.000	0.000	0.000	76.00	38.00	156.0	136.0	14.71	1578	-1.000	-0.000
🟥	2	76.00	38.00	0.000	0.000	0.000	0.000	76.00	38.00	161.0	140.5	14.59	1630	-1.000	-0.000

Total stress :



	Mohr
C (kPa)	74.69
φ (°)	29.97

Effective stress :



	Mohr	Lambe
C' (kPa)	49.85	43.13
φ' (°)	30.10	26.63

Comments :

Visa :

p.1/3

3.21 Trial Pit 18

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LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP18 / AL053 / 03MAY19		
SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 03 - 05 - 2019	TIME: 10:36	
LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 671 938	8 402 608	(m)	2.000 -4.000
TYPE OF MATERIAL: MOIST BROWN REDDISH LATERITE GRAVELLY SANDY SILTY CLAY				
TESTED BY: M. MILANZI		DATE: 11 - 06 - 2019	TIME: 15:25	
CHECKED BY: G. KACHIWALA		DATE: 12 - 06 - 2019	TIME: 10:40	
APPROVED BY: M. SABELLI		DATE: 12 - 06 - 2019	TIME: 14:28	

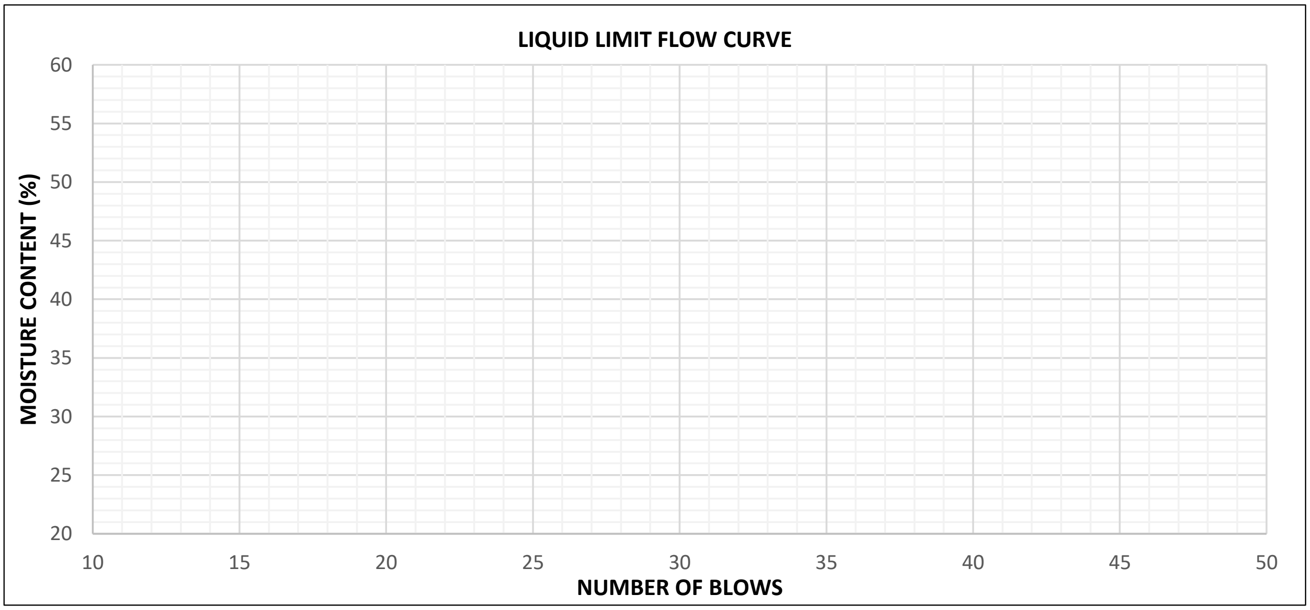
PROJECT: GOLOMOTI SOLAR PV

CLIENT: JCM

ATTERBURG LIMITS STANDARD: BS 1377, 2 (C)

TYPE OF TEST	**LIQUID LIMITS (LL)**				**PLASTIC LIMITS (PL)**		
TEST No.	1	2	3	4	1	2	3
CONTAINER No.	C12		R30		C1	R26	R19
MASS OF WET SOIL + CONTAINER(g)	61.0		63.5		52.0	47.5	47.0
MASS OF DRY SOIL + CONTAINER(g)	53.0		55.0		49.5	45.5	45.0
MASS OF CONTAINER (g)	28		30.5		34.5	33.5	33
MASS OF DRY SOIL (g)	25.0		24.5		15.0	12.0	12.0
MASS OF WATER (g)	8.00		8.50		2.50	2.00	2.00
MOISTURE CONTENT %	32.0	32.6	34.7	33.7	16.7	16.7	16.7
No. BLOWS	30		19			16.7	

LINEAR SHRINKAGE	18
INITIAL LENGTH OF SPECIMEN (cm)	14.0
LENGTH OF OVERN DRY SPECIMEN (cm)	12.9
LINEAR SHRINKAGE %	8.5
LIQUID LIMIT (LL) %	33.1
PLASTIC LIMIT (PL) %	16.7
PLASTICITY INDEX (PI)	**16**
NATURAL MOISTURE CONTENT %	13.2
FINENESS INDEX	1024



REMARKS: SAMPLED FROM TRIAL PIT 18 @ 2.000-4.000M. SOLAR PV SITE INVESTIGATION

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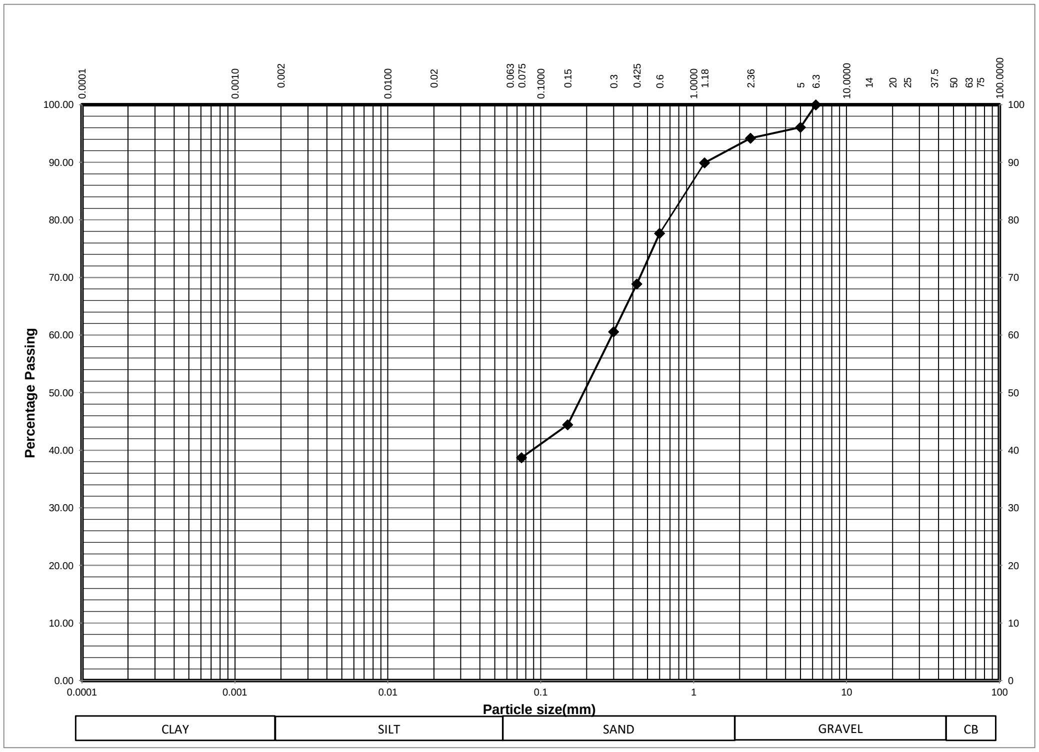
LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP018 / G051 / 03MAY19		
SAMPLED BY: GEOCONSULT LAB TEAM		DATE: 03 / 05 / 2019	TIME: 10:27	
LOCATION:	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 671 938	8 402 608	(m)	0.200-0.500
TYPE OF MATERIAL: MOIST LIGHT BROWN SANDY SILTY CLAY				
TESTED BY: C. NDALAMA		DATE: 10 - 06 - 2019	TIME: 11:00	
CHECKED BY: G. KACHIWALA		DATE: 11 - 06 - 2019	TIME: 13:30	
APPROVED BY: M. SABELLI		DATE: 11 - 06 - 2019	TIME: 15:00	

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

SIEVE ANALYSIS (GRADATION) STANDARD: TRH14:1985

SIEVE	MASS	PERCENTAGE			GRADATION SPECIFICATION			ZONE
(mm)	RETAINED	RETAINED	PASSING		BASE	SUBBASE	SL SEAL	
75.000								
50.000								
37.500								
28.000								
25.000								
20.000								
14.000								
12.500								
10.000								
6.300	0.00	0.00	100.00	100				
5.000	16.50	3.92	96.08	96				
2.360	24.50	5.82	94.18	94				
1.180	42.50	10.10	89.90	90				
0.600	94.00	22.33	77.67	78				
0.425	131.00	31.12	68.88	69				
0.300	166.00	39.43	60.57	61				
0.150	234.00	55.58	44.42	44				
0.075	258.00	61.28	38.72	39				
0 pan	163.00	38.72						
TOTAL (g)	421.00							



REMARKS: SAMPLED FROM TRIAL PIT 18 @0.200-0.500M. **SOLAR PV SITE INVESTIGATION**

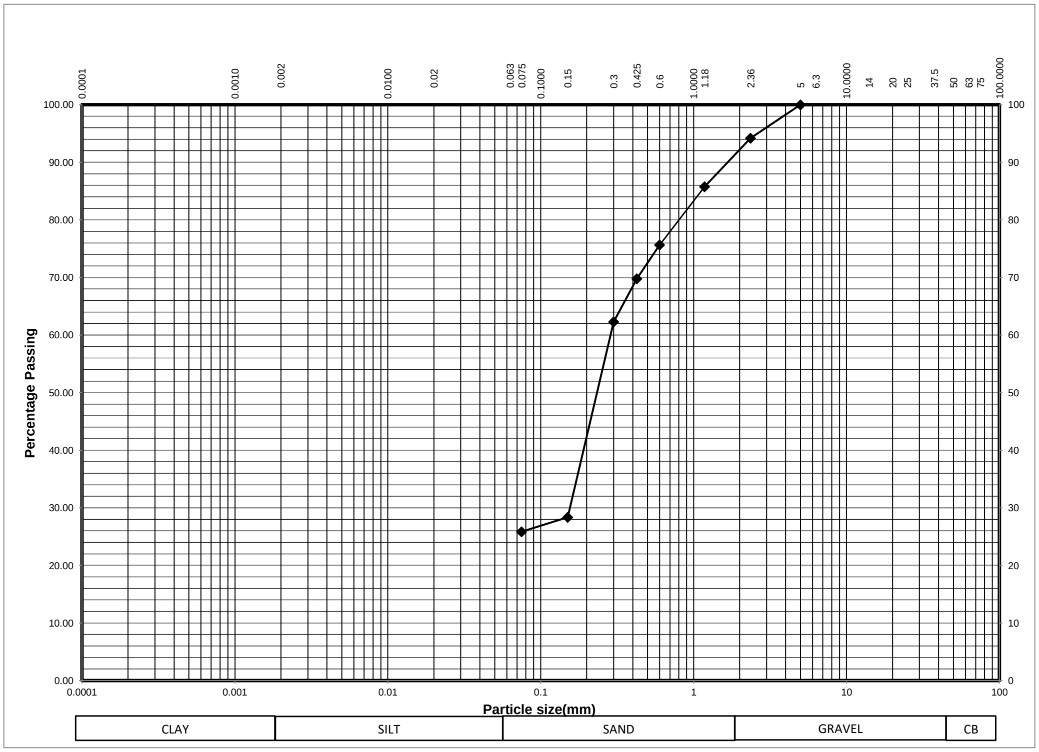
PAGE No.

GEOCONSULT	LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP018 / G052 / 03MAY19		
	SAMPLED BY: GEOCONSULT LAB TEAM		DATE: 03 / 05 / 2019	TIME: 10:27	
	LOCATION:	EASTING	NORTHING	ELEVATION	DEPTH (m)
	GOLOMOTI - SOLAR PV	0 671 938	8 402 608	(m)	0.500-2.000
	TYPE OF MATERIAL: MOIST BROWN SOFT SANDY SILTY CLAYEY LATERITE GRAVEL				
	TESTED BY: C. NDALAMA		DATE: 10 - 06 - 2019	TIME: 11:20	
+265 0888 846 543	CHECKED BY: G. KACHIWALA		DATE: 11 - 06 - 2019	TIME: 13:30	
sabelli@geoconsult.cc	APPROVED BY: M. SABELLI		DATE: 11 - 06 - 2019	TIME: 15:00	

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

SIEVE ANALYSIS (GRADATION) STANDARD: TRH14:1985

SIEVE	MASS	PERCENTAGE			GRADATION SPECIFICATION			ZONE
(mm)	RETAINED	RETAINED	PASSING		BASE	SUBBASE	SL SEAL	
75.000								
50.000								
37.500								
28.000								
25.000								
20.000								
14.000								
12.500								
10.000								
6.300								
5.000	0.00	0.00	100.00	100				
2.360	52.00	5.81	94.19	94				
1.180	127.50	14.24	85.76	86				
0.600	218.00	24.34	75.66	76				
0.425	270.50	30.21	69.79	70				
0.300	337.50	37.69	62.31	62				
0.150	641.50	71.64	28.36	28				
0.075	664.00	74.15	25.85	26				
0 pan	231.50	25.85						
TOTAL (g)	895.50							



REMARKS: SAMPLED FROM TRIAL PIT 18 @0.500-2.000M. **SOLAR PV SITE INVESTIGATION** | **PAGE No.**

LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP018 / G053 / 03MAY19		
SAMPLED BY: GEOCONSULT LAB TEAM		DATE: 03 / 05 / 2019	TIME: 10:27	
LOCATION:	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 671 938	8 402 608	(m)	2.000-4.000
TYPE OF MATERIAL: MOIST BROWN REDDISH SANDY SILTY CLAYEY LATERITE GRAVEL				
TESTED BY: C. NDALAMA		DATE: 10 - 06 - 2019	TIME: 11:20	
CHECKED BY: G. KACHIWALA		DATE: 11 - 06 - 2019	TIME: 13:30	
APPROVED BY: M. SABELLI		DATE: 11 - 06 - 2019	TIME: 15:00	

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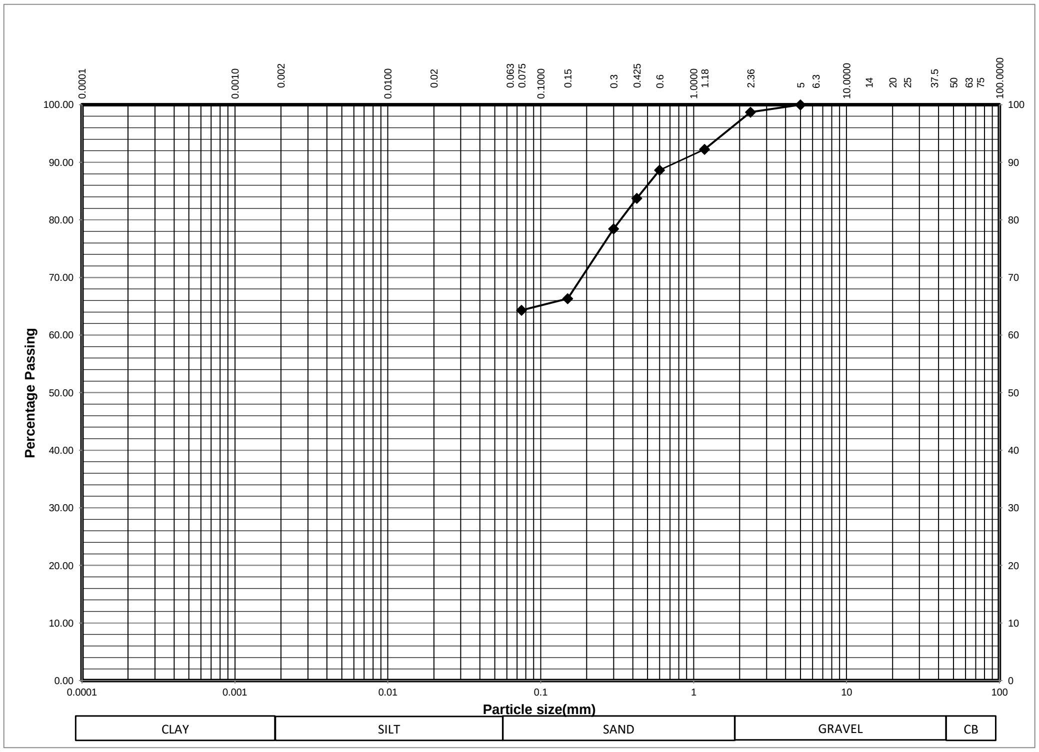
PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

SIEVE ANALYSIS (GRADATION) STANDARD: TRH14:1985

SIEVE	MASS	PERCENTAGE			GRADATION SPECIFICATION			ZONE
(mm)	RETAINED	RETAINED	PASSING		BASE	SUBBASE	SL SEAL	
75.000								
50.000								
37.500								
28.000								
25.000								
20.000								
14.000								
12.500								
10.000								
6.300								
5.000	0.00	0.00	100.00	100				
2.360	43.50	1.31	98.69	99				
1.180	258.00	7.75	92.25	92				
0.600	378.00	11.35	88.65	89				
0.425	541.50	16.26	83.74	84				
0.300	718.00	21.56	78.44	78				
0.150	1121.00	33.66	66.34	66				
0.075	1188.50	35.69	64.31	64				
0 pan	2141.50	64.31						
TOTAL (g)	3330.00							



REMARKS: SAMPLED FROM TRIAL PIT 18 @2.000-4.000M. **SOLAR PV SITE INVESTIGATION**

PAGE No.

GEOCONSULT +265 0888 846 543 sabelli@geoconsult.cc	LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP018 / NMC051 / 02MAY19		
	SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 02 - 05 - 2019	TIME: 09:35	
	LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
	GOLOMOTI - SOLAR PV	0 671 938	8 402 608	(m)	0.200-0.500
	TYPE OF MATERIAL: MOIST LIGHT BROWN SANDY SILTY CLAY				
	TESTED BY: C. NDALAMA		DATE: 06 - 05 - 2019	TIME: 14:38	
	CHECKED BY: G. KACHIWALA		DATE: 07 - 05 - 2019	TIME: 09:00	
	APPROVED BY: M. SABELLI		DATE: 07 - 05 - 2019	TIME: 13:00	

PROJECT: GOLOMOTI SOLAR PV

CLIENT: JCM

NATURAL MOISTURE CONTENT - OVEN DRYING METHOD STANDARD: ASTM D7263

MASS OF WET SOIL + CONTAINER (g)		292.0	
MASS OF DRY SOIL AND CONTAINER (g)		280.5	
CONTAINER No.		GC12	
MASS OF CONTAINER (g)		50.0	
MASS OF DRY SOIL (g)		230.5	
MASS OF WATER (g)		11.5	
MOISTURE CONTENT %		5.0	
AVERAGE MOISTURE CONTENT %		**5.0**	

REMARKS: SAMPLED FROM TRIAL PIT 18 @0.200-0.500M. **SOLAR PV SITE INVESTIGATION**

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LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP018 / NMC052 / 02MAY19		
SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 02 - 05 - 2019	TIME: 17:41	
LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 671 938	8 402 608	(m)	0.500-2.000
TYPE OF MATERIAL: MOIST BROWN SOFT SANDY SILTY CLAYEY LATERITE GRAVEL				
TESTED BY: C. NDALAMA		DATE: 06 - 05 - 2019	TIME: 14:38	
CHECKED BY: G. KACHIWALA		DATE: 07 - 05 - 2019	TIME: 09:00	
APPROVED BY: M. SABELLI		DATE: 07 - 05 - 2019	TIME: 13:00	

PROJECT: GOLOMOTI SOLAR PV

CLIENT: JCM

NATURAL MOISTURE CONTENT - OVEN DRYING METHOD STANDARD: ASTM D7263

MASS OF WET SOIL + CONTAINER (g)		292.0	
MASS OF DRY SOIL AND CONTAINER (g)		279.5	
CONTAINER No.		GC19	
MASS OF CONTAINER (g)		55.5	
MASS OF DRY SOIL (g)		224.0	
MASS OF WATER (g)		12.5	
MOISTURE CONTENT %		5.6	
AVERAGE MOISTURE CONTENT %		**5.6**	

REMARKS: SAMPLED FROM TRIAL PIT 18 @0.500-2.000M. **SOLAR PV SITE INVESTIGATION**

PAGE No.

GEOCONSULT	LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP018 / NMC053 / 02MAY19	
	SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 02 - 05 - 2019	TIME: 17:41
	LOCATION: 36 L UTM GOLOMOTI - SOLAR PV	EASTING 0 671 938	NORTHING 8 402 608	ELEVATION (m)
				DEPTH (m) 2.000-4.000
	TYPE OF MATERIAL: MOIST BROWN REDDISH SANDY SILTY CLAYEY LATERITE GRAVEL			
	TESTED BY: C. NDALAMA		DATE: 06 - 05 - 2019	TIME: 14:38
+265 0888 846 543	CHECKED BY: G. KACHIWALA		DATE: 07 - 05 - 2019	TIME: 09:00
sabelli@geoconsult.cc	APPROVED BY: M. SABELLI		DATE: 07 - 05 - 2019	TIME: 13:00

PROJECT: GOLOMOTI SOLAR PV

CLIENT: JCM

NATURAL MOISTURE CONTENT - OVEN DRYING METHOD STANDARD: ASTM D7263

MASS OF WET SOIL + CONTAINER (g)		207.0	
MASS OF DRY SOIL AND CONTAINER (g)		190.5	
CONTAINER No.		GC22	
MASS OF CONTAINER (g)		65.5	
MASS OF DRY SOIL (g)		125.0	
MASS OF WATER (g)		16.5	
MOISTURE CONTENT %		13.2	
AVERAGE MOISTURE CONTENT %		**13.2**	

REMARKS: SAMPLED FROM TRIAL PIT 18 @2.000-4.000M. **SOLAR PV SITE INVESTIGATION**

PAGE No.

GEOCONSULT +265 0888 846 543 sabelli@geoconsult.cc	LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP18 / AL050 / 02MAY19		
	SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 03 - 05 - 2019	TIME: 16:15	
	LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
	GOLOMOTI - SOLAR PV	0 671 938	8 402 608	(m)	0.200 -0.500
	TYPE OF MATERIAL: MOIST LIGHT BROWN SANDY SILTY CLAY				
	TESTED BY: M. MILANZI		DATE: 28 - 05 - 2019	TIME: 09:25	
	CHECKED BY: G. KACHIWALA		DATE: 17 - 06 - 2019	TIME: 10:40	
	APPROVED BY: M. SABELLI		DATE: 17 - 06 - 2019	TIME: 14:28	

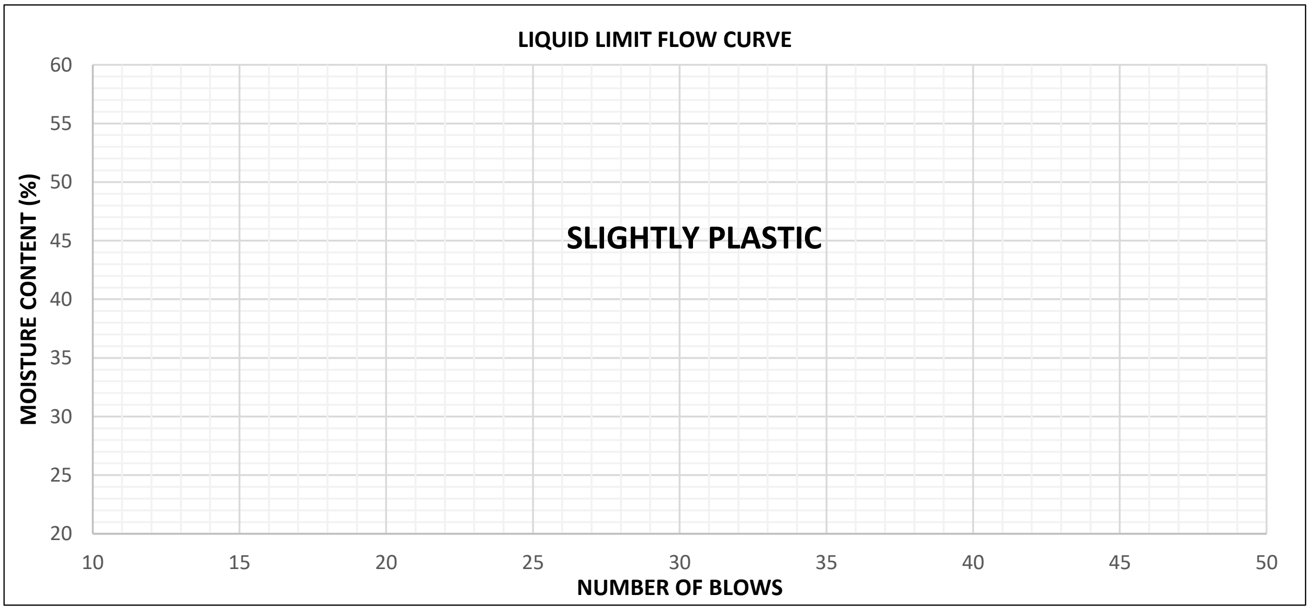
PROJECT: GOLOMOTI SOLAR PV

CLIENT: JCM

ATTERBURG LIMITS STANDARD: BS 1377, 2 (C)

TYPE OF TEST	**LIQUID LIMITS (LL)**				**PLASTIC LIMITS (PL)**		
TEST No.	1	2	3	4	1	2	3
CONTAINER No.	SP	SP	SP	SP	SP	SP	SP
MASS OF WET SOIL + CONTAINER(g)							
MASS OF DRY SOIL + CONTAINER(g)							
MASS OF CONTAINER (g)							
MASS OF DRY SOIL (g)							
MASS OF WATER (g)							
MOISTURE CONTENT %							
No. BLOWS							

LINEAR SHRINKAGE	15
INITIAL LENGTH OF SPECIMEN (cm)	14.0
LENGTH OF OVERN DRY SPECIMEN (cm)	13.7
LINEAR SHRINKAGE %	2.2
LIQUID LIMIT (LL) %	0.0
PLASTIC LIMIT (PL) %	0.0
PLASTICITY INDEX (PI)	**0**
NATURAL MOISTURE CONTENT %	5.0
FINENESS INDEX	



REMARKS: SAMPLED FROM TRIAL PIT 18 @ 0.200-0.500M. SOLAR PV SITE INVESTIGATION

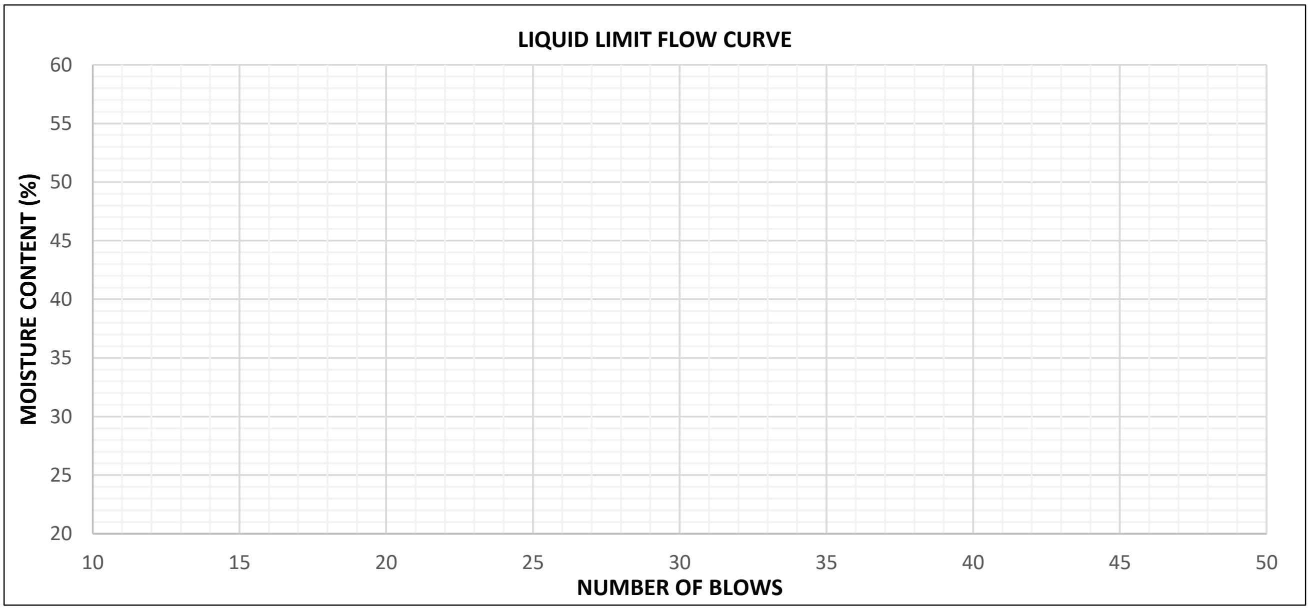
GEOCONSULT	LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP18 / AL052 / 03MAY19		
	SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 03 - 05 - 2019	TIME: 10:32	
	LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
	GOLOMOTI - SOLAR PV	0 671 938	8 402 608	(m)	0.500 -2.000
	TYPE OF MATERIAL: MOIST BROWN SOFT SANDY SILTY CLAYEY LATERITE GRAVEL				
	TESTED BY: M. MILANZI		DATE: 24 - 05 - 2019	TIME: 15:25	
+265 0888 846 543	CHECKED BY: G. KACHIWALA		DATE: 12 - 06 - 2019	TIME: 10:40	
sabelli@geoconsult.cc	APPROVED BY: M. SABELLI		DATE: 12 - 06 - 2019	TIME: 14:28	

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

ATTERBURG LIMITS STANDARD: BS 1377, 2 (C)

TYPE OF TEST	**LIQUID LIMITS (LL)**				**PLASTIC LIMITS (PL)**		
TEST No.	1	2	3	4	1	2	3
CONTAINER No.	C14		R17		C27	C16	C3
MASS OF WET SOIL + CONTAINER(g)	46.5		60.5		38.5	41.0	38.0
MASS OF DRY SOIL + CONTAINER(g)	42.5		52.5		37.0	38.5	35.5
MASS OF CONTAINER (g)	30.5		30.5		29.5	26.5	23
MASS OF DRY SOIL (g)	12.0		22.0		7.5	12.0	12.5
MASS OF WATER (g)	4.00		8.00		1.50	2.50	2.50
MOISTURE CONTENT %	33.3	34.0	36.4	35.3	20.0	20.8	20.0
No. BLOWS	30		18			20.3	

LINEAR SHRINKAGE	5
INITIAL LENGTH OF SPECIMEN (cm)	14.0
LENGTH OF OVERN DRY SPECIMEN (cm)	13.2
LINEAR SHRINKAGE %	6.1
LIQUID LIMIT (LL) %	34.6
PLASTIC LIMIT (PL) %	20.3
PLASTICITY INDEX (PI)	**14**
NATURAL MOISTURE CONTENT %	5.6
FINENESS INDEX	364



REMARKS: SAMPLED FROM TRIAL PIT 18 @ 0.500-2.000M. SOLAR PV SITE INVESTIGATION

	Triaxial test - UU BS 1377 part 7, 1377 part 8			
	Site :	GOLOMOTI SOLAR PV	Levy date :	11-Jun-19
	Technicien's name :		Date of test :	11-Jun-19
GEOCONSULT LIMITED	File N° :	5	Survey depth (m) :	1.000
P.O. BOX 40 LILONGWE	Survey N° :	TP 18	Level of water (m) :	
	Kind of soil :	Moist Brown Soft Sandy Silty Clayey LATERITE GRAVEL		

Identification of samples :

σvo, Total stress of the soil in situ (kPa) : 0.000

Uo, Pore pressure of the soil in situ (kPa) : 0.000

Category of soil : Steep/Strongly overconsolidated

Kind of drainage : Without lateral drain

ρs, Grain density (kg/m^3) : 0.000

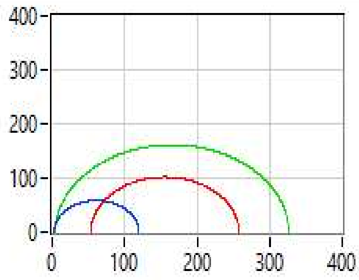
Sm : ☐

Sd : ☐

Samples before test :									Samples after saturation :		
N°	Hi (mm)	Di (mm)	mi (g)	ρi (kg/m^3)	ρdi (kg/m^3)	wi (%)	ei	Sri (%)	Ucp (kPa)	ΔVsat. (mm^3)	B (%)
🟦 1	76.00	38	173.5	2013	1729	16.44	-1.000	-0.000		0.000	0.000
🟥 2	76.00	38	174.5	2025	1734	16.72	-1.000	-0.000		0.000	0.000
🟩 3	75.00	38	170.0	1999	1734	15.25	-1.000	-0.000		0.000	0.000

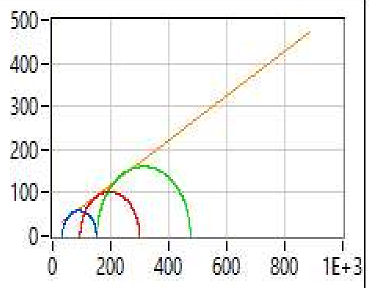
Samples after consolidation :							Samples after shearing							
N°	Hs (mm)	Ds (mm)	ΔVs (mm^3)	T100 (min)	Vmax (µm/min)	σ'c (kPa)	Hf (mm)	Df (mm)	mf (g)	md (g)	wf (%)	ρdf (kg/m^3)	ef	Srf (%)
🟦 1	76.00	38.00	0.000	0.000	0.000	0.000	76.00	38.00	173.0	149.0	16.11	1729	-1.000	-0.000
🟥 2	76.00	38.00	0.000	0.000	0.000	0.000	76.00	38.00	174.0	149.5	16.39	1734	-1.000	-0.000
🟩 3	75.00	38.00	0.000	0.000	0.000	0.000	75.00	38.00	169.0	147.5	14.58	1734	-1.000	-0.000

Total stress :



	Mohr
C (kPa)	NaN
φ (°)	NaN

Effective stress :



	Mohr	Lambe
C' (kPa)	14.95	14.53
φ' (°)	27.43	24.79

Comments :

Visa :

p.1/3

	Triaxial test - UU **BS 1377 part 7, 1377 part 8**			
	Site :	GOLOMOTI SOLAR PV	Levy date :	10-Jun-19
	Technicien's name :		Date of test :	10-Jun-19
GEOCONSULT LIMITED	File N° :	2	Survey depth (m) :	2.000
P.O. BOX 40 LILONGWE	Survey N° :	TRIAL PIT No. 18	Level of water (m) :	
	Kind of soil :	Moist Brown Reddish Sandy Silty Clayey LATERITE GRAVEL		

Identification of samples :

σvo, Total stress of the soil in situ (kPa) :	0.000	Uo, Pore pressure of the soil in situ (kPa) :	0.000
Category of soil :	Steep/Strongly overconsolidated	Kind of drainage :	Without lateral drain
ρs, Grain density (kg/m³) :	0.000		
Sm :	☐	Sd :	☐

Samples before test :

	N°	Hi (mm)	Di (mm)	mi (g)	ρi (kg/m³)	ρdi (kg/m³)	wi (%)	ei	Sri (%)
🟦	1	76.00	38	157.0	1821	1584	15.02	-1.000	-0.000
🟥	2	76.00	38	157.5	1827	1601	14.13	-1.000	-0.000
🟩	3	76.00	38	165.5	1920	1671	14.93	-1.000	-0.000

Samples after saturation :

Ucp (kPa)	ΔVsat. (mm³)	B (%)
	0.000	0.000
	0.000	0.000
	0.000	0.000

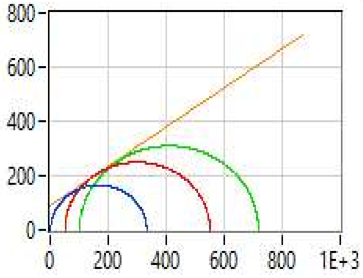
Samples after consolidation :

	N°	Hs (mm)	Ds (mm)	ΔVs (mm³)	T100 (min)	Vmax (µm/min)	σ'c (kPa)
🟦	1	76.00	38.00	0.000	0.000	0.000	0.000
🟥	2	76.00	38.00	0.000	0.000	0.000	0.000
🟩	3	76.00	38.00	0.000	0.000	0.000	0.000

Samples after shearing

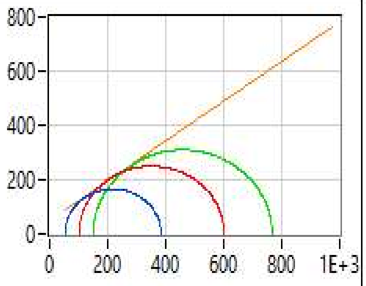
Hf (mm)	Df (mm)	mf (g)	md (g)	wf (%)	ρdf (kg/m³)	ef	Srf (%)
76.00	38.00	157.0	136.5	15.02	1584	-1.000	-0.000
76.00	38.00	157.5	138.0	14.13	1601	-1.000	-0.000
76.00	38.00	165.0	144.0	14.58	1671	-1.000	-0.000

Total stress :



	Mohr
C (kPa)	88.25
φ (°)	35.94

Effective stress :



	Mohr	Lambe
C' (kPa)	50.70	37.90
φ' (°)	36.30	30.75

Comments :

Visa :

p.1/3

3.22 Trial Pit 19

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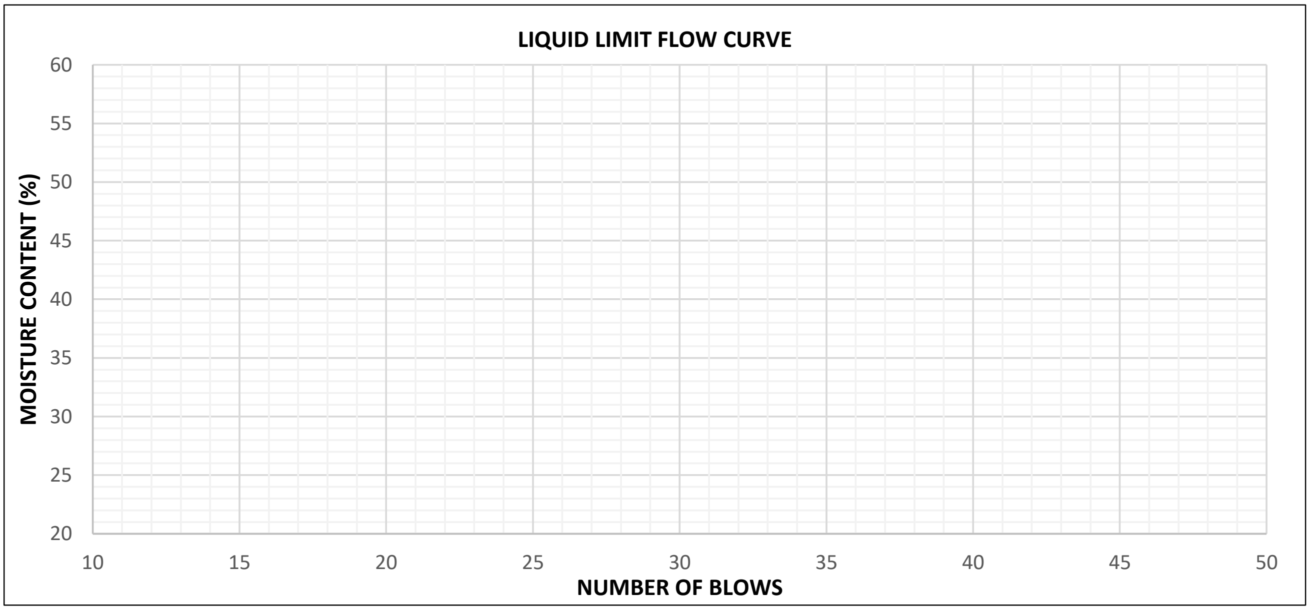
LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP19 / AL056 / 03MAY19		
SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 03 - 05 - 2019	TIME: 14:56	
LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 671 989	8 402 554	(m)	2.000 -4.100
TYPE OF MATERIAL: MOIST BROWN REDDISH GRAVELLY SANDY SILTY CLAY				
TESTED BY: M. MILANZI		DATE: 11 - 06 - 2019	TIME: 09:30	
CHECKED BY: G. KACHIWALA		DATE: 12 - 06 - 2019	TIME: 10:40	
APPROVED BY: M. SABELLI		DATE: 12 - 06 - 2019	TIME: 14:28	

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

ATTERBURG LIMITS STANDARD: BS 1377, 2 (C)

TYPE OF TEST	**LIQUID LIMITS (LL)**				**PLASTIC LIMITS (PL)**		
TEST No.	1	2	3	4	1	2	3
CONTAINER No.	K2		C2		C21	C19	R4
MASS OF WET SOIL + CONTAINER(g)	68.0		41.5		39.5	41.0	41.5
MASS OF DRY SOIL + CONTAINER(g)	58.0		38.5		38.5	38.5	40.0
MASS OF CONTAINER (g)	28		30.5		33	25	32
MASS OF DRY SOIL (g)	30.0		8.0		5.5	13.5	8.0
MASS OF WATER (g)	10.00		3.00		1.00	2.50	1.50
MOISTURE CONTENT %	33.3	33.7	37.5	37.1	18.2	18.5	18.8
No. BLOWS	29		24			18.5	

LINEAR SHRINKAGE	17
INITIAL LENGTH OF SPECIMEN (cm)	14.0
LENGTH OF OVERN DRY SPECIMEN (cm)	13.0
LINEAR SHRINKAGE %	7.7
LIQUID LIMIT (LL) %	35.4
PLASTIC LIMIT (PL) %	18.5
PLASTICITY INDEX (PI)	**17**
NATURAL MOISTURE CONTENT %	11.2
FINENESS INDEX	918



REMARKS: SAMPLED FROM TRIAL PIT 19 @ 2.000-4.100M. SOLAR PV SITE INVESTIGATION

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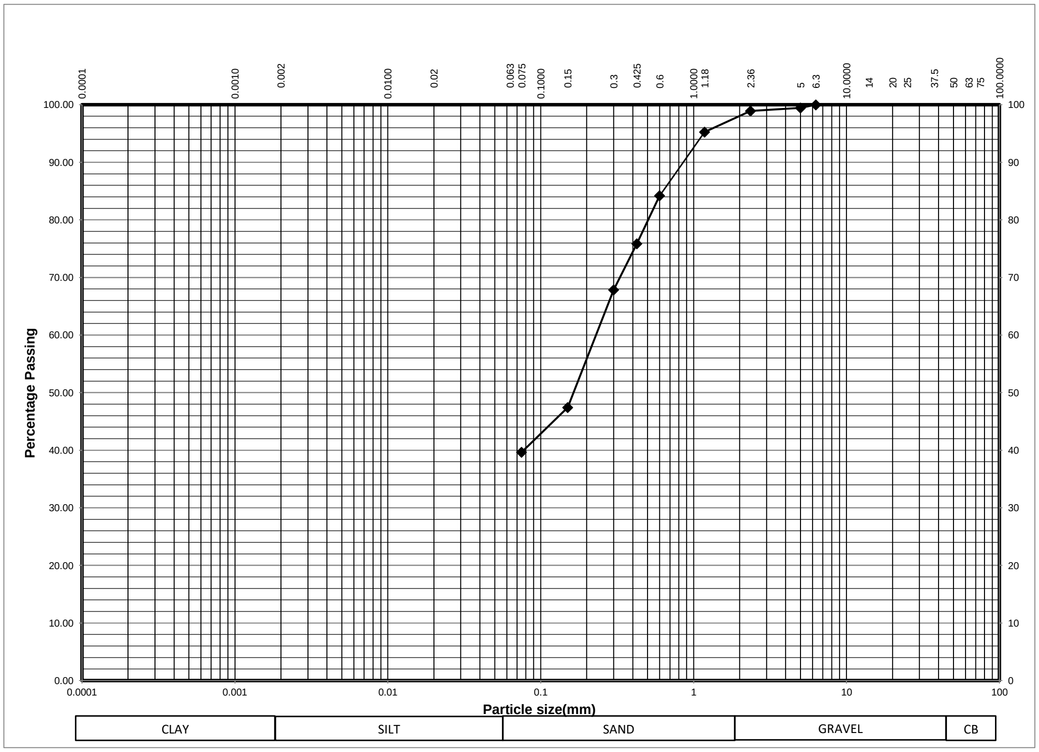
LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP018 / G054 / 03MAY19		
SAMPLED BY: GEOCONSULT LAB TEAM		DATE: 02 / 05 / 2019	TIME: 14:05	
LOCATION:	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 671 989	8 402 554	(m)	0.100-0.500
TYPE OF MATERIAL: MOIST DARK BROWN SANDY SILTY CLAY				
TESTED BY: C. NDALAMA		DATE: 10 - 06 - 2019	TIME: 13:20	
CHECKED BY: G. KACHIWALA		DATE: 11 - 06 - 2019	TIME: 10:30	
APPROVED BY: M. SABELLI		DATE: 11 - 06 - 2019	TIME: 11:00	

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

SIEVE ANALYSIS (GRADATION) STANDARD: TRH14:1985

SIEVE	MASS	PERCENTAGE			GRADATION SPECIFICATION			ZONE
(mm)	RETAINED	RETAINED	PASSING		BASE	SUBBASE	SL SEAL	
75.000								
50.000								
37.500								
28.000								
25.000								
20.000								
14.000								
12.500								
10.000								
6.300	0.00	0.00	100.00	100				
5.000	3.50	0.53	99.47	99				
2.360	7.00	1.07	98.93	99				
1.180	31.00	4.74	95.26	95				
0.600	103.50	15.81	84.19	84				
0.425	158.00	24.14	75.86	76				
0.300	210.50	32.16	67.84	68				
0.150	344.00	52.56	47.44	47				
0.075	395.00	60.35	39.65	40				
0 pan	259.50	39.65						
TOTAL (g)	654.50							



REMARKS: SAMPLED FROM TRIAL PIT 19 @0.100-0.500M. **SOLAR PV SITE INVESTIGATION**

PAGE No.

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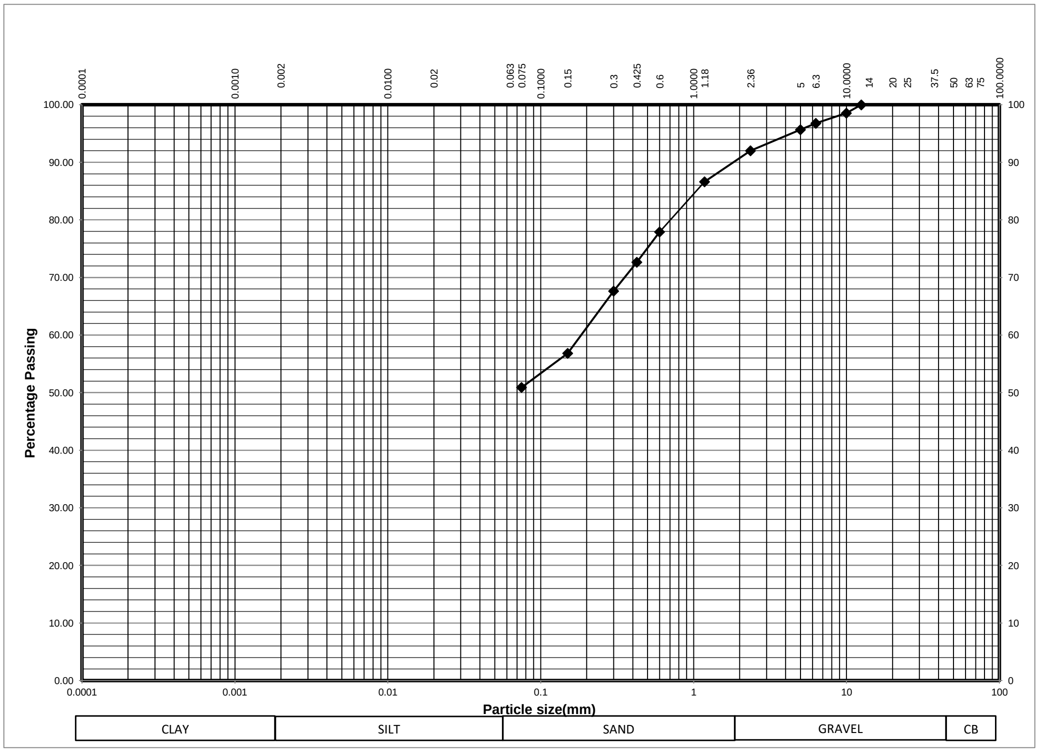
LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP019 / G055 / 02MAY19		
SAMPLED BY: GEOCONSULT LAB TEAM		DATE: 02 / 05 / 2019	TIME: 14:05	
LOCATION:	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 671 989	8 402 554	(m)	0.500-2.000
TYPE OF MATERIAL: MOIST BROWN REDDISH SANDY SILTY CLAY				
TESTED BY: C. NDALAMA		DATE: 10 - 06 - 2019	TIME: 13:35	
CHECKED BY: G. KACHIWALA		DATE: 11 - 06 - 2019	TIME: 10:30	
APPROVED BY: M. SABELLI		DATE: 11 - 06 - 2019	TIME: 11:00	

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

SIEVE ANALYSIS (GRADATION) STANDARD: TRH14:1985

SIEVE	MASS	PERCENTAGE			GRADATION SPECIFICATION			ZONE
(mm)	RETAINED	RETAINED	PASSING		BASE	SUBBASE	SL SEAL	
75.000								
50.000								
37.500								
28.000								
25.000								
20.000								
14.000								
12.500	0.00	0.00	100.00	100				
10.000	13.00	1.46	98.54	99				
6.300	28.50	3.20	96.80	97				
5.000	38.50	4.33	95.67	96				
2.360	71.00	7.98	92.02	92				
1.180	119.00	13.37	86.63	87				
0.600	196.50	22.08	77.92	78				
0.425	243.50	27.36	72.64	73				
0.300	288.00	32.36	67.64	68				
0.150	384.00	43.15	56.85	57				
0.075	437.00	49.10	50.90	51				
0 pan	453.00	50.90						
TOTAL (g)	890.00							



REMARKS: SAMPLED FROM TRIAL PIT 19 @0.500-2.000M. **SOLAR PV SITE INVESTIGATION**

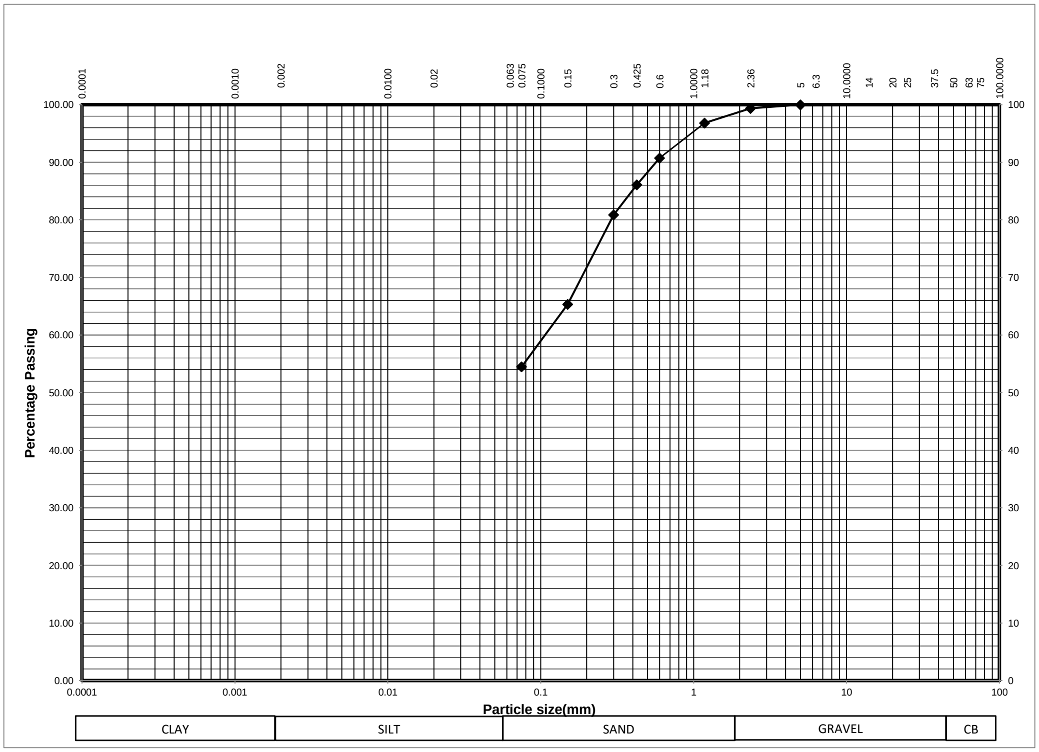
PAGE No.

GEOCONSULT	LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP019 / G055 / 02MAY19		
	SAMPLED BY: GEOCONSULT LAB TEAM		DATE: 02 / 05 / 2019	TIME: 14:05	
	LOCATION:	EASTING	NORTHING	ELEVATION	DEPTH (m)
	GOLOMOTI - SOLAR PV	0 671 989	8 402 554	(m)	2.000-4.100
	TYPE OF MATERIAL: MOIST BROWN REDDISH GRAVELLY SANDY SILTY CLAY				
	TESTED BY: C. NDALAMA		DATE: 10 - 06 - 2019	TIME: 13:35	
+265 0888 846 543	CHECKED BY: G. KACHIWALA		DATE: 11 - 06 - 2019	TIME: 10:30	
sabelli@geoconsult.cc	APPROVED BY: M. SABELLI		DATE: 11 - 06 - 2019	TIME: 11:00	

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

SIEVE ANALYSIS (GRADATION) STANDARD: TRH14:1985

SIEVE	MASS	PERCENTAGE			GRADATION SPECIFICATION			ZONE
(mm)	RETAINED	RETAINED	PASSING		BASE	SUBBASE	SL SEAL	
75.000								
50.000								
37.500								
28.000								
25.000								
20.000								
14.000								
12.500								
10.000								
6.300								
5.000	0.00	0.00	100.00	100				
2.360	4.50	0.64	99.36	99				
1.180	22.50	3.18	96.82	97				
0.600	65.50	9.24	90.76	91				
0.425	98.50	13.90	86.10	86				
0.300	135.50	19.12	80.88	81				
0.150	245.60	34.66	65.34	65				
0.075	322.50	45.52	54.48	54				
0 pan	386.00	54.48						
TOTAL (g)	708.50							



REMARKS: SAMPLED FROM TRIAL PIT 19 @2.0000-4.100M. **SOLAR PV SITE INVESTIGATION** **PAGE No.**

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LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP019 / NMC054 / 02MAY19		
SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 02 - 05 - 2019	TIME: 17:41	
LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 671 989	8 402 554	(m)	0.100-0.500
TYPE OF MATERIAL: MOIST DARK BROWN SANDY SILTY CLAY				
TESTED BY: C. NDALAMA		DATE: 06 - 05 - 2019	TIME: 14:38	
CHECKED BY: G. KACHIWALA		DATE: 07 - 05 - 2019	TIME: 09:00	
APPROVED BY: M. SABELLI		DATE: 07 - 05 - 2019	TIME: 13:00	

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

NATURAL MOISTURE CONTENT - OVEN DRYING METHOD STANDARD: ASTM D7263

MASS OF WET SOIL + CONTAINER (g)		293.0	
MASS OF DRY SOIL AND CONTAINER (g)		280.5	
CONTAINER No.		GC20	
MASS OF CONTAINER (g)		50.0	
MASS OF DRY SOIL (g)		230.5	
MASS OF WATER (g)		12.5	
MOISTURE CONTENT %		5.4	
AVERAGE MOISTURE CONTENT %		**5.4**	

REMARKS: SAMPLED FROM TRIAL PIT 19 @0.100-0.500M. **SOLAR PV SITE INVESTIGATION** **PAGE No.**

GEOCONSULT	LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP019 / NMC055 / 02MAY19		
	SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 02 - 05 - 2019	TIME: 17:41	
	LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
	GOLOMOTI - SOLAR PV	0 671 989	8 402 554	(m)	0.500-2.000
	TYPE OF MATERIAL: MOIST BROWN REDDISH SANDY SILTY CLAY				
	TESTED BY: C. NDALAMA		DATE: 06 - 05 - 2019	TIME: 14:38	
+265 0888 846 543	CHECKED BY: G. KACHIWALA		DATE: 07 - 05 - 2019	TIME: 09:00	
sabelli@geoconsult.cc	APPROVED BY: M. SABELLI		DATE: 07 - 05 - 2019	TIME: 13:00	

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

NATURAL MOISTURE CONTENT - OVEN DRYING METHOD STANDARD: ASTM D7263

MASS OF WET SOIL + CONTAINER (g)		290.0	
MASS OF DRY SOIL AND CONTAINER (g)		266.5	
CONTAINER No.		GC15	
MASS OF CONTAINER (g)		47.5	
MASS OF DRY SOIL (g)		219.0	
MASS OF WATER (g)		23.5	
MOISTURE CONTENT %		10.7	
AVERAGE MOISTURE CONTENT %	**10.7**		

REMARKS: SAMPLED FROM TRIAL PIT 18 @0.500-2.000M. **SOLAR PV SITE INVESTIGATION** **PAGE No.**

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LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP018 / NMC056 / 02MAY19		
SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 02 - 05 - 2019	TIME: 17:41	
LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 671 989	8 402 554	(m)	2.000-4.100
TYPE OF MATERIAL:MOIST BROWN REDDISH GRAVELLY SANDY SILTY CLAY				
TESTED BY: C. NDALAMA		DATE: 06 - 05 - 2019	TIME: 14:38	
CHECKED BY: G. KACHIWALA		DATE: 07 - 05 - 2019	TIME: 09:00	
APPROVED BY: M. SABELLI		DATE: 07 - 05 - 2019	TIME: 13:00	

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

NATURAL MOISTURE CONTENT - OVEN DRYING METHOD STANDARD: ASTM D7263

MASS OF WET SOIL + CONTAINER (g)		290.0	
MASS OF DRY SOIL AND CONTAINER (g)		265.5	
CONTAINER No.		GC16	
MASS OF CONTAINER (g)		47.5	
MASS OF DRY SOIL (g)		218.0	
MASS OF WATER (g)		24.5	
MOISTURE CONTENT %		11.2	
AVERAGE MOISTURE CONTENT %		**11.2**	

REMARKS: SAMPLED FROM TRIAL PIT 19 @2.000-4.100M. **SOLAR PV SITE INVESTIGATION** **PAGE No.**

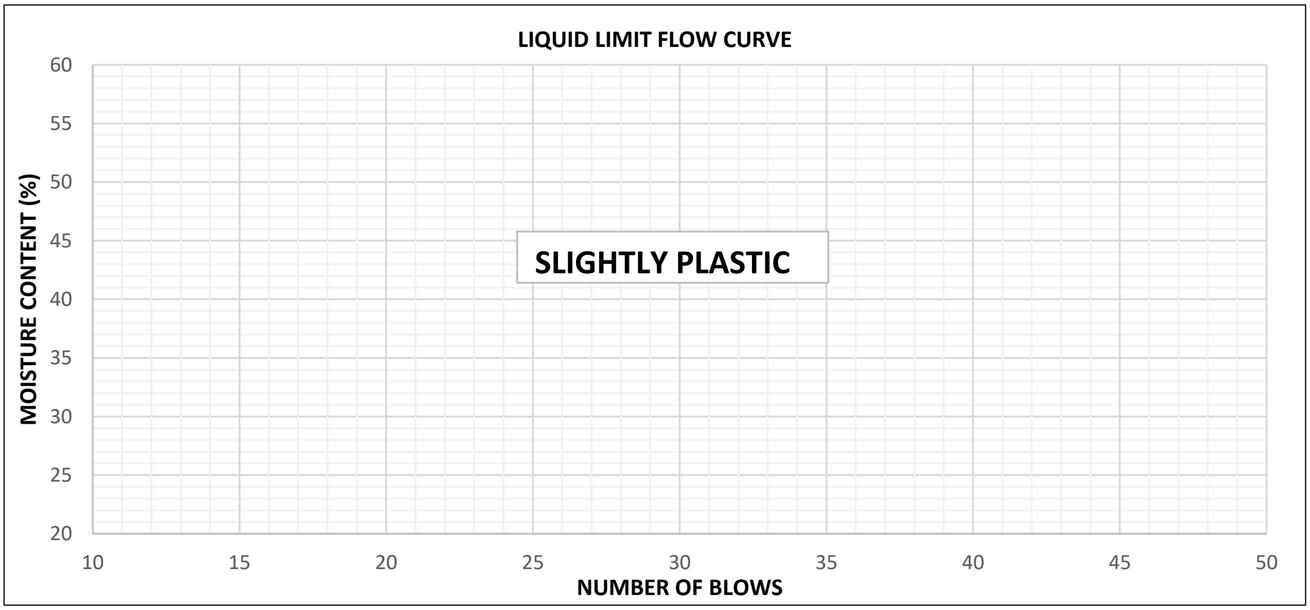
GEOCONSULT	LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP19 / AL054 / 03MAY19		
	SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 03 - 05 - 2019	TIME: 10:36	
	LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
	GOLOMOTI - SOLAR PV	0 671 989	8 402 554	(m)	0.100 -0.500
	TYPE OF MATERIAL: MOIST DARK BROWN SANDY SILTY CLAY				
	TESTED BY: C. NDALAMA		DATE: 10 - 06 - 2019	TIME: 15:25	
+265 0888 846 543	CHECKED BY: G. KACHIWALA		DATE: 12 - 06 - 2019	TIME: 10:40	
sabelli@geoconsult.cc	APPROVED BY: M. SABELLI		DATE: 12 - 06 - 2019	TIME: 14:28	

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

ATTERBURG LIMITS STANDARD: BS 1377, 2 (C)

TYPE OF TEST	LIQUID LIMITS (LL)				PLASTIC LIMITS (PL)		
TEST No.	1	2	3	4	1	2	3
CONTAINER No.	SP	SP	SP	SP	SP	SP	SP
MASS OF WET SOIL + CONTAINER(g)							
MASS OF DRY SOIL + CONTAINER(g)							
MASS OF CONTAINER (g)							
MASS OF DRY SOIL (g)							
MASS OF WATER (g)							
MOISTURE CONTENT %							
No. BLOWS							

LINEAR SHRINKAGE	19
INITIAL LENGTH OF SPECIMEN (cm)	14.0
LENGTH OF OVERN DRY SPECIMEN (cm)	13.8
LINEAR SHRINKAGE %	1.4
LIQUID LIMIT (LL) %	0.0
PLASTIC LIMIT (PL) %	0.0
PLASTICITY INDEX (PI)	**0**
NATURAL MOISTURE CONTENT %	5.4
FINENESS INDEX	



REMARKS: SAMPLED FROM TRIAL PIT 19 @ 0.100-0.500M. SOLAR PV SITE INVESTIGATION

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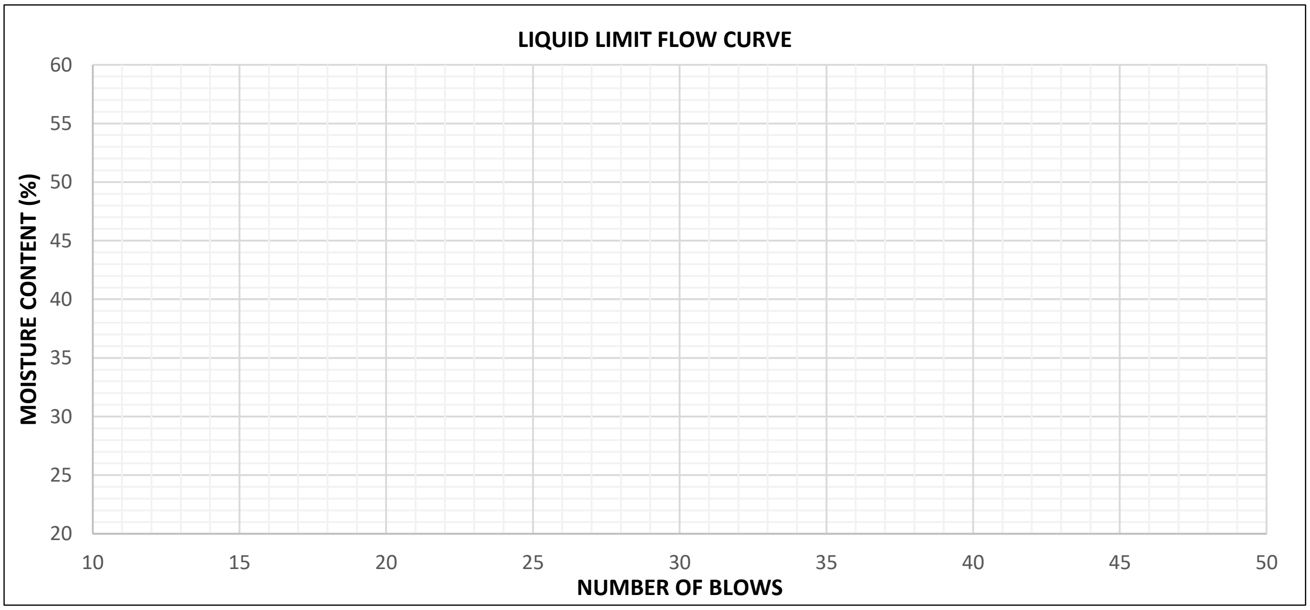
LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP19 / AL055 / 03MAY19			
SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 03 - 05 - 2019	TIME: 14:56		
LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)	
GOLOMOTI - SOLAR PV	0 671 989	8 402 554	(m)	0.500 -2.000	
TYPE OF MATERIAL: MOIST BROWN REDDISH SANDY SILTY CLAY					
TESTED BY: M. MILANZI		DATE: 11 - 06 - 2019	TIME: 15:25		
CHECKED BY: G. KACHIWALA		DATE: 12 - 06 - 2019	TIME: 10:40		
APPROVED BY: M. SABELLI		DATE: 12 - 06 - 2019	TIME: 14:28		

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

ATTERBURG LIMITS STANDARD: BS 1377, 2 (C)

TYPE OF TEST	**LIQUID LIMITS (LL)**				**PLASTIC LIMITS (PL)**		
TEST No.	1	2	3	4	1	2	3
CONTAINER No.	C2		C5		R19	C19	R4
MASS OF WET SOIL + CONTAINER(g)	43.5		48.5		40.0	41.0	41.5
MASS OF DRY SOIL + CONTAINER(g)	39.0		43.5		38.0	38.5	40.0
MASS OF CONTAINER (g)	26		30.5		27	25	32
MASS OF DRY SOIL (g)	13.0		13.0		11.0	13.5	8.0
MASS OF WATER (g)	4.50		5.00		2.00	2.50	1.50
MOISTURE CONTENT %	34.6	35.3	38.5	37.3	18.2	18.5	18.8
No. BLOWS	30		19			18.5	

LINEAR SHRINKAGE	2
INITIAL LENGTH OF SPECIMEN (cm)	14.0
LENGTH OF OVERN DRY SPECIMEN (cm)	12.9
LINEAR SHRINKAGE %	8.5
LIQUID LIMIT (LL) %	36.3
PLASTIC LIMIT (PL) %	18.5
PLASTICITY INDEX (PI)	**18**
NATURAL MOISTURE CONTENT %	10.7
FINENESS INDEX	918



REMARKS: SAMPLED FROM TRIAL PIT 19 @ 0.500-2.000M. SOLAR PV SITE INVESTIGATION

GEOCONSULT LIMITED

P.O. BOX 40 LILONGWE

Triaxial test - UU
BS 1377 part 7, 1377 part 8

Site :	GOLOMOTI SOLAR PV	Levy date :	13-Jun-19
Technicien's name :		Date of test :	13-Jun-19
File N° :	6	Survey depth (m) :	2.000
Survey N° :	TRIAL PIT No. 19	Level of water (m) :	
Kind of soil :	MOIST BROWN REDDISH GRAVELLY SANDY SILTY CLAY		

Identification of samples :

σvo, Total stress of the soil in situ (kPa) :	0.000	Uo, Pore pressure of the soil in situ (kPa) :	0.000
Category of soil :	Steep/Strongly overconsolidated	Kind of drainage :	Without lateral drain
ρs, Grain density (kg/m³) :	0.000		
Sm :	☐	Sd :	☐

Samples before test :

Samples after saturation :

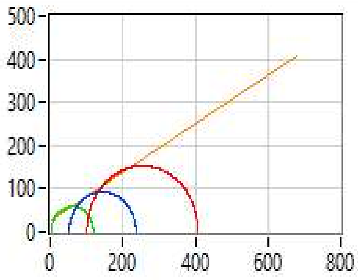
	N°	Hi (mm)	Di (mm)	mi (g)	ρi (kg/m³)	ρdi (kg/m³)	wi (%)	ei	Sri (%)	Ucp (kPa)	ΔVsat. (mm³)	B (%)
🟦	1	76.00	38	157.5	1827	1549	17.98	-1.000	-0.000		0.000	0.000
🟥	2	76.00	38	161.5	1874	1589	17.88	-1.000	-0.000		0.000	0.000
🟩	3	76.00	38	173.5	2013	1729	16.44	-1.000	-0.000		0.000	0.000

Samples after consolidation :

Samples after shearing

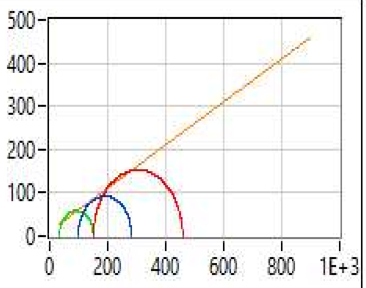
	N°	Hs (mm)	Ds (mm)	ΔVs (mm³)	T100 (min)	Vmax (µm/min)	σ'c (kPa)	Hf (mm)	Df (mm)	mf (g)	md (g)	wf (%)	ρdf (kg/m³)	ef	Srf (%)
🟦	1	76.00	38.00	0.000	0.000	0.000	0.000	76.00	38.00	157.0	133.5	17.60	1549	-1.000	-0.000
🟥	2	76.00	38.00	0.000	0.000	0.000	0.000	76.00	38.00	160.5	137.0	17.15	1589	-1.000	-0.000
🟩	3	76.00	38.00	0.000	0.000	0.000	0.000	76.00	38.00	173.0	149.0	16.11	1729	-1.000	-0.000

Total stress :



	Mohr
C (kPa)	28.04
φ (°)	29.16

Effective stress :



	Mohr	Lambe
C' (kPa)	12.92	14.05
φ' (°)	26.39	24.08

Comments :

Visa :

p.1/3

	Triaxial test - UU BS 1377 part 7, 1377 part 8			
	Site :	GOLOMOTI SOLAR PV	Levy date :	13-Jun-19
	Technicien's name :		Date of test :	13-Jun-19
GEOCONSULT LIMITED	File N° :	6	Survey depth (m) :	2.000
P.O. BOX 40 LILONGWE	Survey N° :	TRIAL PIT No. 19	Level of water (m) :	
	Kind of soil :	MOIST BROWN REDDISH GRAVELLY SANDY SILTY CLAY		

Identification of samples :

σvo, Total stress of the soil in situ (kPa) : 0.000

Uo, Pore pressure of the soil in situ (kPa) : 0.000

Category of soil : Steep/Strongly overconsolidated

Kind of drainage : Without lateral drain

ρs, Grain density (kg/m³) : 0.000

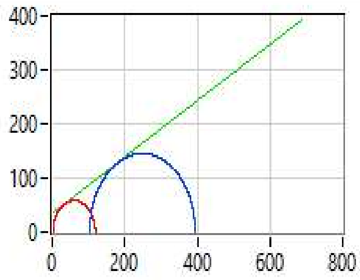
Sm : ☐

Sd : ☐

	Samples before test :									Samples after saturation :		
	N°	Hi (mm)	Di (mm)	mi (g)	ρi (kg/m³)	ρdi (kg/m³)	wi (%)	ei	Sri (%)	Ucp (kPa)	ΔVsat. (mm³)	B (%)
🟦	1	76.00	38	161.0	1868	1584	17.95	-1.000	-0.000		0.000	0.002
🟥	2	76.00	38	173.5	2013	1729	16.44	-1.000	-0.000		0.000	0.000

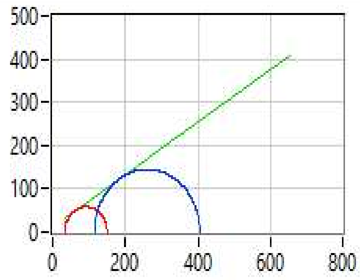
	Samples after consolidation :							Samples after shearing								
	N°	Hs (mm)	Ds (mm)	ΔVs (mm³)	T100 (min)	Vmax (µm/min)	σ'c (kPa)	Hf (mm)	Df (mm)	mf (g)	md (g)	wf (%)	ρdf (kg/m³)	ef	Srf (%)
🟦	1	76.00	38.00	0.000	0.000	0.000	0.000	76.00	38.00	160.5	136.5	17.58	1584	-1.000	-0.000
🟥	2	76.00	38.00	0.000	0.000	0.000	0.000	76.00	38.00	173.0	149.0	16.11	1729	-1.000	-0.000

Total stress :



	Mohr
C (kPa)	33.92
φ (°)	27.60

Effective stress :



	Mohr	Lambe
C' (kPa)	13.28	11.39
φ' (°)	30.98	27.24

Comments :

Visa :

3.23 Trial Pit 20

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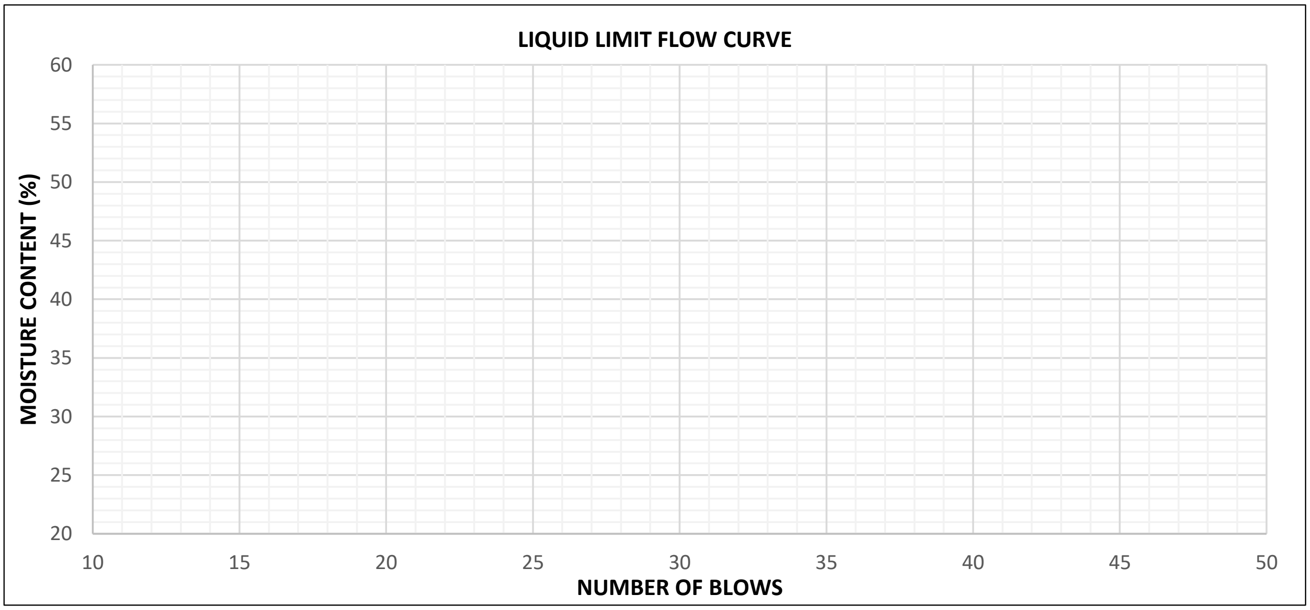
LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP20 / AL059 / 03MAY19		
SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 03 - 05 - 2019	TIME: 16:56	
LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 671 990	8 402 438	(m)	2.000 -4.000
TYPE OF MATERIAL: MOIST BROWN REDDISH LATERITE GRAVELLY SANDY SILTY CLAY				
TESTED BY: M. MILANZI		DATE: 28 - 05 - 2019	TIME: 09:30	
CHECKED BY: G. KACHIWALA		DATE: 29 - 05 - 2019	TIME: 10:40	
APPROVED BY: M. SABELLI		DATE: 29 - 05 - 2019	TIME: 14:28	

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

ATTERBURG LIMITS STANDARD: BS 1377, 2 (C)

TYPE OF TEST	**LIQUID LIMITS (LL)**				**PLASTIC LIMITS (PL)**		
TEST No.	1	2	3	4	1	2	3
CONTAINER No.	R11		14		R12	C6	R20
MASS OF WET SOIL + CONTAINER(g)	47.0		46.0		44.0	45.6	43.0
MASS OF DRY SOIL + CONTAINER(g)	42.5		42.0		42.5	43.8	42.0
MASS OF CONTAINER (g)	28		30		29	28.5	33
MASS OF DRY SOIL (g)	14.5		12.0		13.5	15.3	9.0
MASS OF WATER (g)	4.50		4.00		1.50	1.80	1.00
MOISTURE CONTENT %	31.0	31.3	33.3	32.0	11.1	11.8	11.1
No. BLOWS	28		16			11.3	

LINEAR SHRINKAGE	19
INITIAL LENGTH OF SPECIMEN (cm)	14.0
LENGTH OF OVERN DRY SPECIMEN (cm)	12.6
LINEAR SHRINKAGE %	11.1
LIQUID LIMIT (LL) %	31.7
PLASTIC LIMIT (PL) %	11.3
PLASTICITY INDEX (PI)	**20**
NATURAL MOISTURE CONTENT %	12.4
FINENESS INDEX	940



REMARKS: SAMPLED FROM TRIAL PIT 20 @ 2.000-4.000M. SOLAR PV SITE INVESTIGATION

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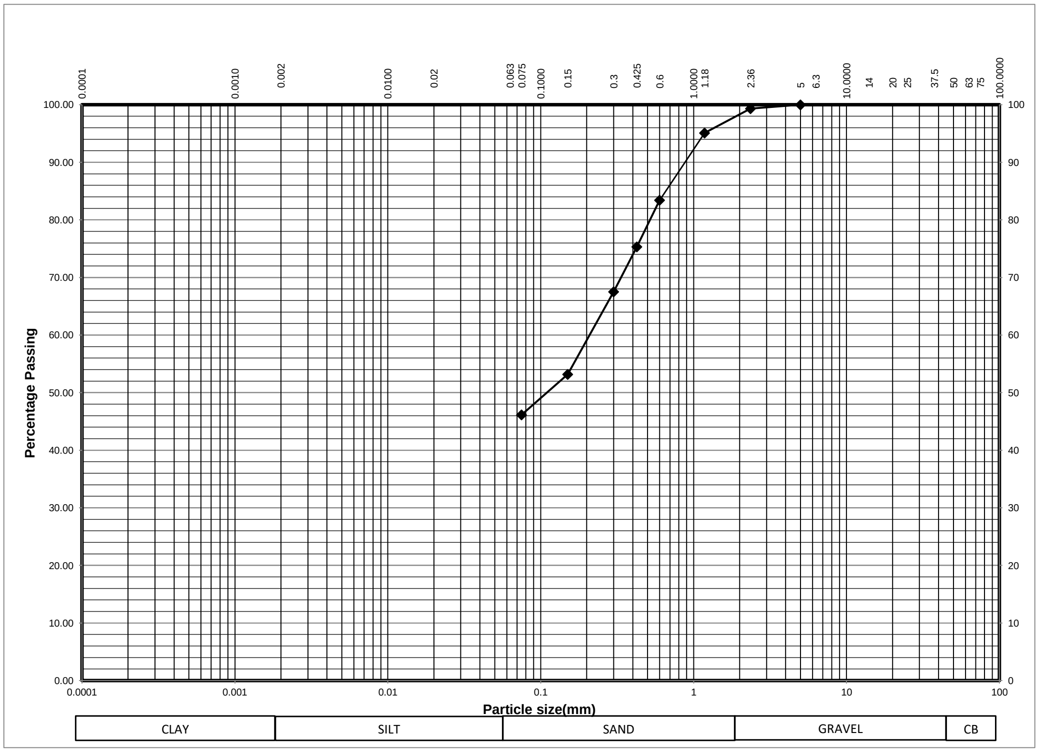
LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP020 / G057 / 03MAY19		
SAMPLED BY: GEOCONSULT LAB TEAM		DATE: 03 / 05 / 2019	TIME: 16:58	
LOCATION:	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 671 990	8 402 438	(m)	0.100-1.000
TYPE OF MATERIAL: MOIST DARK BROWN SANDY SILTY CLAY				
TESTED BY: Y. NANG'OMBA		DATE: 06 - 06 - 2019	TIME: 14:35	
CHECKED BY: G. KACHIWALA		DATE: 11 - 06 - 2019	TIME: 10:30	
APPROVED BY: M. SABELLI		DATE: 11 - 06 - 2019	TIME: 11:00	

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

SIEVE ANALYSIS (GRADATION) STANDARD: TRH14:1985

SIEVE	MASS	PERCENTAGE			GRADATION SPECIFICATION			ZONE
(mm)	RETAINED	RETAINED	PASSING		BASE	SUBBASE	SL SEAL	
75.000								
50.000								
37.500								
28.000								
25.000								
20.000								
14.000								
12.500								
10.000								
6.300								
5.000	0.00	0.00	100.00	100				
2.360	2.50	0.66	99.34	99				
1.180	18.50	4.91	95.09	95				
0.600	62.50	16.58	83.42	83				
0.425	93.00	24.67	75.33	75				
0.300	122.50	32.49	67.51	68				
0.150	176.50	46.82	53.18	53				
0.075	203.00	53.85	46.15	46				
0 pan	174.00	46.15						
TOTAL (g)	377.00							



REMARKS: SAMPLED FROM TRIAL PIT 20 @0.100-1.000M. **SOLAR PV SITE INVESTIGATION**

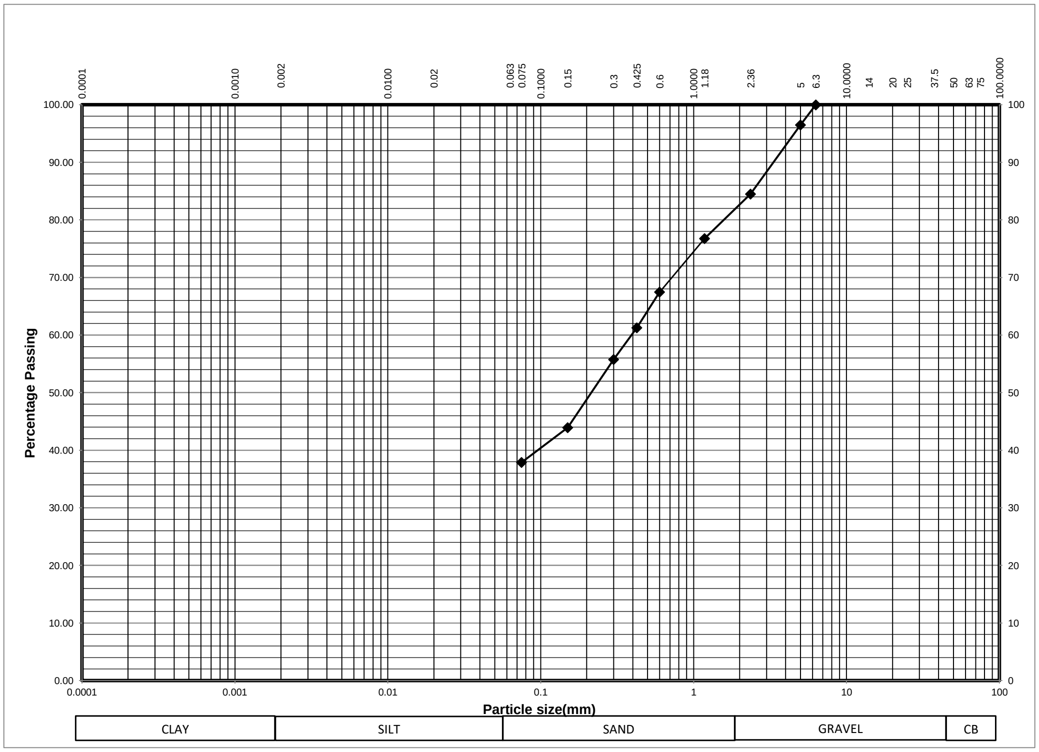
PAGE No.

GEOCONSULT	LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP020 / G058 / 03MAY19	
	SAMPLED BY: GEOCONSULT LAB TEAM		DATE: 03 / 05 / 2019	TIME: 16:58
	LOCATION:	EASTING	NORTHING	ELEVATION (m) / DEPTH (m)
	GOLOMOTI - SOLAR PV	0 671 990	8 402 438	1.000-2.000
	TYPE OF MATERIAL: MOIST BROWN REDDISH GRAVELLY SANDY SILTY CLAY			
	TESTED BY: Y. NANG'OMBA		DATE: 06 - 06 - 2019	TIME: 14:35
+265 0888 846 543	CHECKED BY: G. KACHIWALA		DATE: 11 - 06 - 2019	TIME: 10:30
sabelli@geoconsult.cc	APPROVED BY: M. SABELLI		DATE: 11 - 06 - 2019	TIME: 11:00

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

SIEVE ANALYSIS (GRADATION) STANDARD: TRH14:1985

SIEVE	MASS	PERCENTAGE			GRADATION SPECIFICATION			ZONE
(mm)	RETAINED	RETAINED	PASSING		BASE	SUBBASE	SL SEAL	
75.000								
50.000								
37.500								
28.000								
25.000								
20.000								
14.000								
12.500								
10.000								
6.300	0.00	0.00	100.00	100				
5.000	12.50	3.52	96.48	96				
2.360	55.00	15.49	84.51	85				
1.180	82.50	23.24	76.76	77				
0.600	115.50	32.54	67.46	67				
0.425	137.50	38.73	61.27	61				
0.300	157.00	44.23	55.77	56				
0.150	199.00	56.06	43.94	44				
0.075	220.50	62.11	37.89	38				
0 pan	134.50	37.89						
TOTAL (g)	355.00							



REMARKS: SAMPLED FROM TRIAL PIT 20 @1.0000-2.000M. **SOLAR PV SITE INVESTIGATION** **PAGE No.**

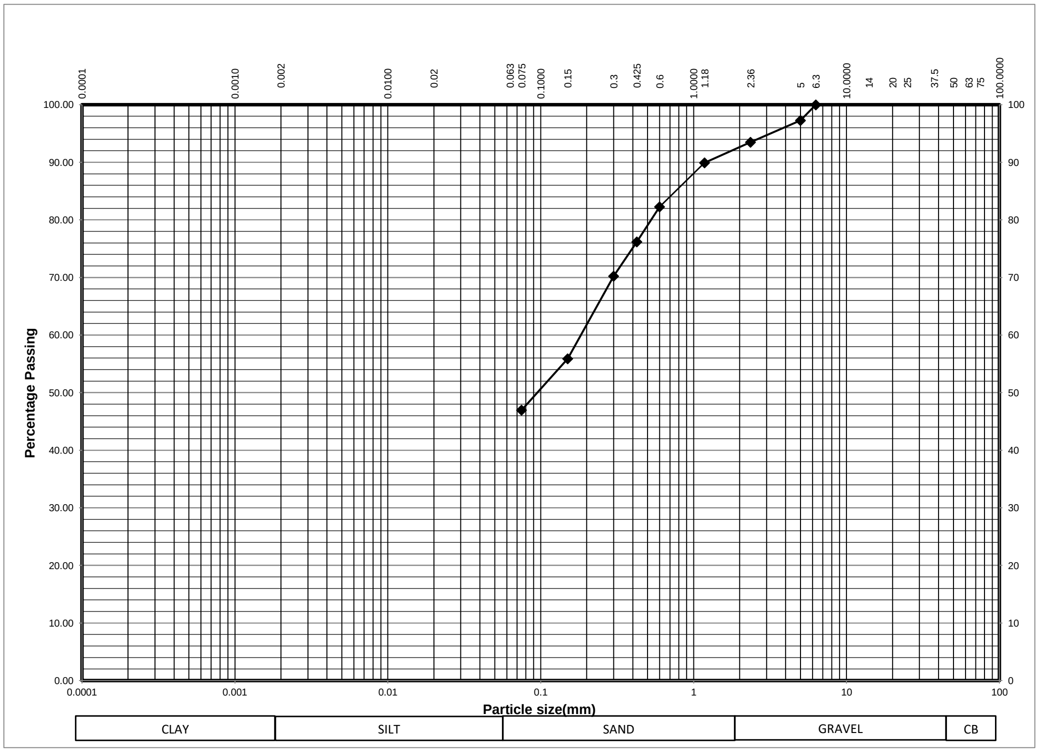
GEOCONSULT	LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP020 / G059 / 03MAY19	
	SAMPLED BY: GEOCONSULT LAB TEAM		DATE: 03 / 05 / 2019	TIME: 16:58
	LOCATION:	EASTING	NORTHING	ELEVATION	DEPTH (m)
	GOLOMOTI - SOLAR PV	0 671 990	8 402 438	(m)	2.000-4.200
	TYPE OF MATERIAL: MOIST BROWN REDDISH LATERITE GRAVELLY SANDY SILTY CLAY				
	TESTED BY: Y. NANG'OMBA		DATE: 06 - 06 - 2019	TIME: 14:35
+265 0888 846 543	CHECKED BY: G. KACHIWALA		DATE: 11 - 06 - 2019	TIME: 10:30
sabelli@geoconsult.cc	APPROVED BY: M. SABELLI		DATE: 11 - 06 - 2019	TIME: 11:00

PROJECT: GOLOMOTI SOLAR PV

CLIENT: JCM

SIEVE ANALYSIS (GRADATION) **STANDARD: TRH14:1985**

SIEVE	MASS	PERCENTAGE			GRADATION SPECIFICATION			ZONE
(mm)	RETAINED	RETAINED	PASSING		BASE	SUBBASE	SL SEAL	
75.000								
50.000								
37.500								
28.000								
25.000								
20.000								
14.000								
12.500								
10.000								
6.300	0.00	0.00	100.00	100				
5.000	13.00	2.73	97.27	97				
2.360	31.00	6.50	93.50	94				
1.180	48.00	10.06	89.94	90				
0.600	84.50	17.71	82.29	82				
0.425	113.50	23.79	76.21	76				
0.300	142.00	29.77	70.23	70				
0.150	210.50	44.13	55.87	56				
0.075	253.00	53.04	46.96	47				
0 pan	224.00	46.96						
TOTAL (g)	477.00							



REMARKS: SAMPLED FROM TRIAL PIT 20 @2.000-4.200M. **SOLAR PV SITE INVESTIGATION**

PAGE No.

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LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP020 / NMC057 / 03MAY19		
SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 03 - 05 - 2019	TIME: 17:41	
LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 671 990	8 402 438	(m)	0.100-1.000
TYPE OF MATERIAL: MOIST DARK BROWN SANDY SILTY CLAY				
TESTED BY: C. NDALAMA		DATE: 06 - 05 - 2019	TIME: 14:38	
CHECKED BY: G. KACHIWALA		DATE: 07 - 05 - 2019	TIME: 09:00	
APPROVED BY: M. SABELLI		DATE: 07 - 05 - 2019	TIME: 13:00	

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

NATURAL MOISTURE CONTENT - OVEN DRYING METHOD STANDARD: ASTM D7263

MASS OF WET SOIL + CONTAINER (g)		287.0	
MASS OF DRY SOIL AND CONTAINER (g)		266.5	
CONTAINER No.		GC10	
MASS OF CONTAINER (g)		55.0	
MASS OF DRY SOIL (g)		211.5	
MASS OF WATER (g)		20.5	
MOISTURE CONTENT %		9.7	
AVERAGE MOISTURE CONTENT %		**9.7**	

REMARKS: SAMPLED FROM TRIAL PIT 20 @0.100-1.000M. **SOLAR PV SITE INVESTIGATION** **PAGE No.**

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LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP020 / NMC058 / 03MAY19		
SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 03 - 05 - 2019	TIME: 17:41	
LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 671 990	8 402 438	(m)	1.000-2.000
TYPE OF MATERIAL: MOIST BROWN REDDISH GRAVELLY SANDY SILTY CLAY				
TESTED BY: C. NDALAMA		DATE: 06 - 05 - 2019	TIME: 14:38	
CHECKED BY: G. KACHIWALA		DATE: 07 - 05 - 2019	TIME: 09:00	
APPROVED BY: M. SABELLI		DATE: 07 - 05 - 2019	TIME: 13:00	

PROJECT: GOLOMOTI SOLAR PV

CLIENT: JCM

NATURAL MOISTURE CONTENT - OVEN DRYING METHOD STANDARD: ASTM D7263

MASS OF WET SOIL + CONTAINER (g)		280.0	
MASS OF DRY SOIL AND CONTAINER (g)		258.5	
CONTAINER No.		GC10	
MASS OF CONTAINER (g)		50.5	
MASS OF DRY SOIL (g)		208.0	
MASS OF WATER (g)		21.5	
MOISTURE CONTENT %		10.3	
AVERAGE MOISTURE CONTENT %		**10.3**	

REMARKS: SAMPLED FROM TRIAL PIT 20 @1.000-2.000M. **SOLAR PV SITE INVESTIGATION**

PAGE No.

GEOCONSULT +265 0888 846 543 sabelli@geoconsult.cc	LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP020 / NMC059 / 03MAY19	
	SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 03 - 05 - 2019	TIME: 17:41
	LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)
	GOLOMOTI - SOLAR PV	0 671 990	8 402 438	(m)	2.000-4.000
	TYPE OF MATERIAL: MOIST BROWN REDDISH LATERITE GRAVELLY SANDY SILTY CLAY				
	TESTED BY: C. NDALAMA		DATE: 06 - 05 - 2019	TIME: 14:38
	CHECKED BY: G. KACHIWALA		DATE: 07 - 05 - 2019	TIME: 09:00
	APPROVED BY: M. SABELLI		DATE: 07 - 05 - 2019	TIME: 13:00

PROJECT: GOLOMOTI SOLAR PV

CLIENT: JCM

NATURAL MOISTURE CONTENT - OVEN DRYING METHOD STANDARD: ASTM D7263

MASS OF WET SOIL + CONTAINER (g)		270.0	
MASS OF DRY SOIL AND CONTAINER (g)		245.5	
CONTAINER No.		GC11	
MASS OF CONTAINER (g)		48.5	
MASS OF DRY SOIL (g)		197.0	
MASS OF WATER (g)		24.5	
MOISTURE CONTENT %		12.4	
AVERAGE MOISTURE CONTENT %		**12.4**	

REMARKS: SAMPLED FROM TRIAL PIT 20 @2.000-4.000M. **SOLAR PV SITE INVESTIGATION**

PAGE No.

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LAB REF: GC499 / 04MAY19 / 15:00			SAMPLE No. GSPV / TP20 / AL057 / 03MAY19		
SAMPLED BY: GEOCONSULT LAB. TEAM			DATE: 03 - 05 - 2019	TIME: 16:56	
LOCATION: 36 L UTM	EASTING		NORTHING	ELEVATION	DEPTH (m)
GOLOMOTI - SOLAR PV	0 671 990		8 402 438	(m)	0.100 -1.000
TYPE OF MATERIAL: MOIST DARK BROWN SANDY SILTY CLAY					
TESTED BY: M. MILANZI			DATE: 28 - 05 - 2019	TIME: 09:30	
CHECKED BY: G. KACHIWALA			DATE: 29 - 05 - 2019	TIME: 10:40	
APPROVED BY: M. SABELLI			DATE: 29 - 05 - 2019	TIME: 14:28	

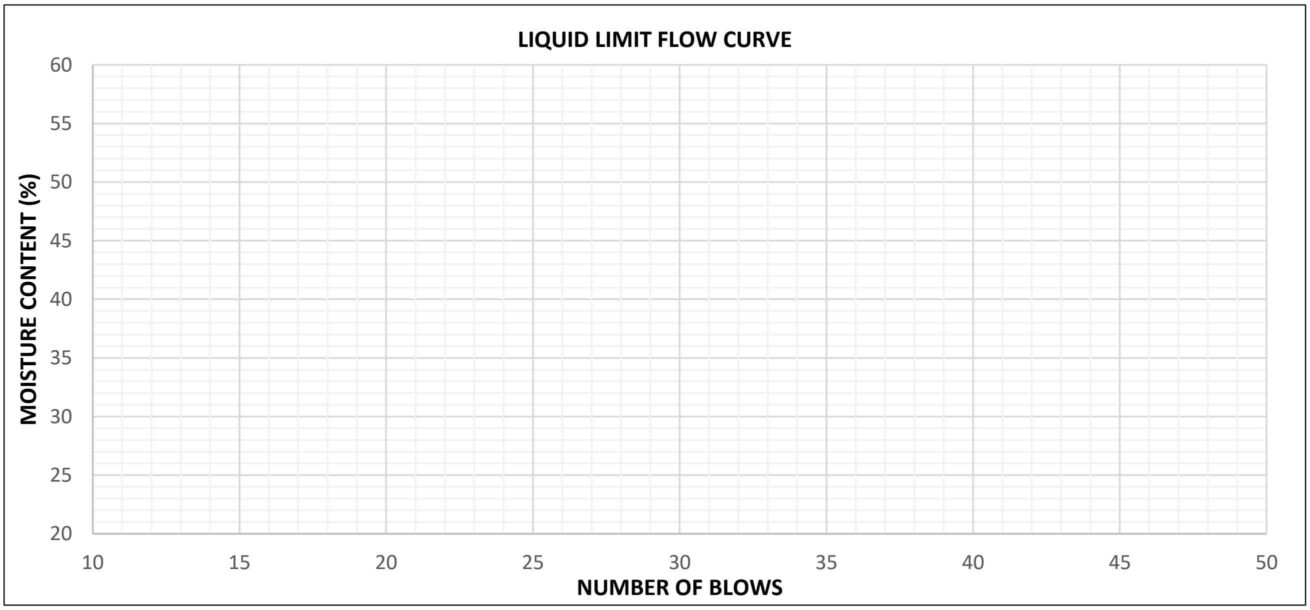
PROJECT: GOLOMOTI SOLAR PV

CLIENT: JCM

ATTERBURG LIMITS STANDARD: BS 1377, 2 (C)

TYPE OF TEST	LIQUID LIMITS (LL)				PLASTIC LIMITS (PL)		
TEST No.	1	2	3	4	1	2	3
CONTAINER No.	R21		R28		R22	C321	R27
MASS OF WET SOIL + CONTAINER(g)	47.0		46.0		44.0	45.6	43.0
MASS OF DRY SOIL + CONTAINER(g)	42.0		41.5		41.5	42.8	41.0
MASS OF CONTAINER (g)	28		30.5		30	30	31.5
MASS OF DRY SOIL (g)	14.0		11.0		11.5	12.8	9.5
MASS OF WATER (g)	5.00		4.50		2.50	2.80	2.00
MOISTURE CONTENT %	35.7	36.1	40.9	38.9	21.7	21.9	21.1
No. BLOWS	27		15			21.6	

LINEAR SHRINKAGE	13
INITIAL LENGTH OF SPECIMEN (cm)	14.0
LENGTH OF OVERN DRY SPECIMEN (cm)	12.8
LINEAR SHRINKAGE %	9.4
LIQUID LIMIT (LL) %	37.5
PLASTIC LIMIT (PL) %	21.6
PLASTICITY INDEX (PI)	**16**
NATURAL MOISTURE CONTENT %	9.7
FINENESS INDEX	736



REMARKS: SAMPLED FROM TRIAL PIT 20 @ 0.100-1.000M. SOLAR PV SITE INVESTIGATION

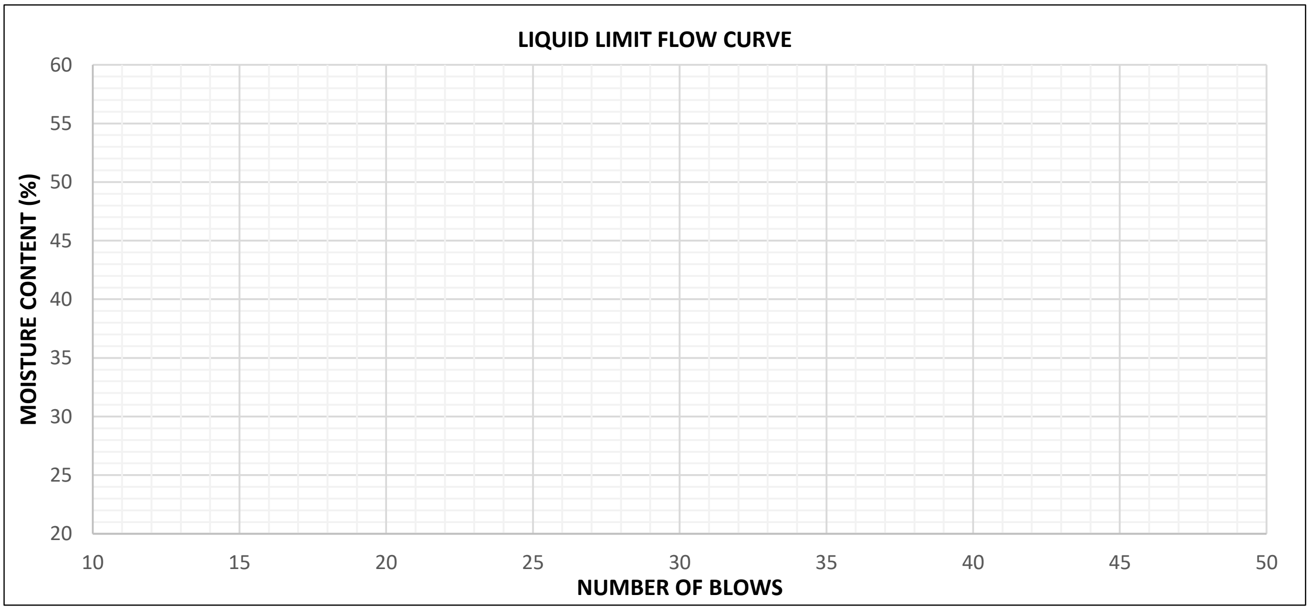
GEOCONSULT	LAB REF: GC499 / 04MAY19 / 15:00		SAMPLE No. GSPV / TP20 / AL058 / 03MAY19			
	SAMPLED BY: GEOCONSULT LAB. TEAM		DATE: 03 - 05 - 2019	TIME: 16:56		
	LOCATION: 36 L UTM	EASTING	NORTHING	ELEVATION	DEPTH (m)	
	GOLOMOTI - SOLAR PV	0 671 990	8 402 438	(m)	1.000 -2.000	
	TYPE OF MATERIAL: MOIST BROWN REDDISH GRAVELLY SANDY SILTY CLAY					
	TESTED BY: M. MILANZI		DATE: 28 - 05 - 2019	TIME: 09:30		
+265 0888 846 543	CHECKED BY: G. KACHIWALA		DATE: 29 - 05 - 2019	TIME: 10:40		
sabelli@geoconsult.cc	APPROVED BY: M. SABELLI		DATE: 29 - 05 - 2019	TIME: 14:28		

PROJECT: GOLOMOTI SOLAR PV **CLIENT:** JCM

ATTERBURG LIMITS STANDARD: BS 1377, 2 (C)

TYPE OF TEST	**LIQUID LIMITS (LL)**				**PLASTIC LIMITS (PL)**		
TEST No.	1	2	3	4	1	2	3
CONTAINER No.	R20		R29		R22	C321	R27
MASS OF WET SOIL + CONTAINER(g)	47.0		46.0		44.0	45.6	43.0
MASS OF DRY SOIL + CONTAINER(g)	42.0		41.5		41.5	42.8	41.0
MASS OF CONTAINER (g)	28		30		30.5	30.5	32
MASS OF DRY SOIL (g)	14.0		11.5		11.0	12.3	9.0
MASS OF WATER (g)	5.00		4.50		2.50	2.80	2.00
MOISTURE CONTENT %	35.7	36.1	39.1	37.6	22.7	22.8	22.2
No. BLOWS	28		16			22.6	

LINEAR SHRINKAGE	16
INITIAL LENGTH OF SPECIMEN (cm)	14.0
LENGTH OF OVERN DRY SPECIMEN (cm)	13.0
LINEAR SHRINKAGE %	7.7
LIQUID LIMIT (LL) %	36.8
PLASTIC LIMIT (PL) %	22.6
PLASTICITY INDEX (PI)	**14**
NATURAL MOISTURE CONTENT %	10.3
FINENESS INDEX	532



REMARKS: SAMPLED FROM TRIAL PIT 20 @ 1.000-2.000M. SOLAR PV SITE INVESTIGATION

	Triaxial test - UU **BS 1377 part 7, 1377 part 8**			
	Site :	GOLOMOTI SOLAR PV	Levy date :	17-Jun-19
	Technicien's name :		Date of test :	17-Jun-19
GEOCONSULT LIMITED	File N° :	17	Survey depth (m) :	1.000
P.O. BOX 40 LILONGWE	Survey N° :	20	Level of water (m) :	
	Kind of soil :	MOIST BROWN REDDISH SANDY SILTY CLAYEY LATERITE GRAVEL		

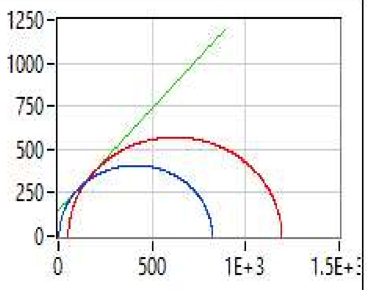
Identification of samples :

σvo, Total stress of the soil in situ (kPa) :	0.000	Uo, Pore pressure of the soil in situ (kPa) :	0.000
Category of soil :	Steep/Strongly overconsolidated	Kind of drainage :	Without lateral drain
ρs, Grain density (kg/m^3) :	0.000		
Sm :	☐	Sd :	☐

	Samples before test :									Samples after saturation :		
	N°	Hi (mm)	Di (mm)	mi (g)	ρi (kg/m^3)	ρdi (kg/m^3)	wi (%)	ei	Sri (%)	Ucp (kPa)	ΔVsat. (mm^3)	B (%)
🟦	1	75.00	38	164.0	1928	1640	17.56	-1.000	-0.000		0.000	0.000
🟥	2	75.00	38	170.0	1999	1728	15.65	-1.000	-0.000		0.000	0.000

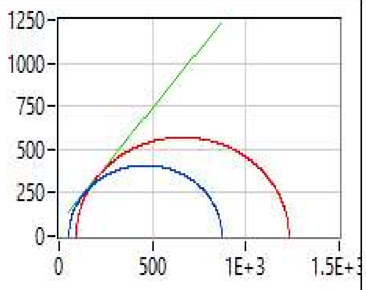
	Samples after consolidation :							Samples after shearing							
	N°	Hs (mm)	Ds (mm)	ΔVs (mm^3)	T100 (min)	Vmax (µm/min)	σ'c (kPa)	Hf (mm)	Df (mm)	mf (g)	md (g)	wf (%)	ρdf (kg/m^3)	ef	Srf (%)
🟦	1	75.00	38.00	0.000	0.000	0.000	0.000	75.00	38.00	163.0	139.5	16.85	1640	-1.000	-0.000
🟥	2	75.00	38.00	0.000	0.000	0.000	0.000	75.00	38.00	170.0	147.0	15.65	1728	-1.000	-0.000

Total stress :



	Mohr
C (kPa)	147.1
φ (°)	49.64

Effective stress :



	Mohr	Lambe
C' (kPa)	64.59	38.40
φ' (°)	53.52	38.80

Comments :

Visa :

p.1/3

GEOCONSULT LIMITED

P.O. BOX 40 LILONGWE

Triaxial test - UU
BS 1377 part 7, 1377 part 8

Site :	GOLOMOTI SOLAR PV	Levy date :	10-Jun-19
Technicien's name :		Date of test :	10-Jun-19
File N° :	1	Survey depth (m) :	2.000
Survey N° :	TRIAL PIT No. 20	Level of water (m) :	
Kind of soil :	Moist Brown Reddish Gravelley Sandy Silty CLAY		

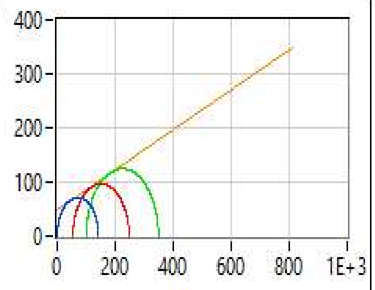
Identification of samples :

σvo, Total stress of the soil in situ (kPa) :	0.000	Uo, Pore pressure of the soil in situ (kPa) :	0.000
Category of soil :	Steep/Strongly overconsolidated	Kind of drainage :	Without lateral drain
ρs, Grain density (kg/m³) :	0.000		
Sm :	☐	Sd :	☐

Samples before test :										Samples after saturation :		
	N°	Hi (mm)	Di (mm)	mi (g)	ρi (kg/m³)	ρdi (kg/m³)	wi (%)	ei	Sri (%)	Ucp (kPa)	ΔVsat. (mm³)	B (%)
🟦	1	76.00	38	158.0	1833	1514	21.07	-1.000	-0.000		0.000	0.000
🟥	2	76.00	38	160.5	1862	1549	20.22	-1.000	-0.000		0.000	0.000
🟩	3	76.00	38	162.5	1885	1560	20.82	-1.000	-0.000		0.000	0.000

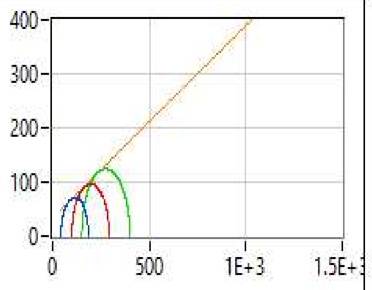
Samples after consolidation :								Samples after shearing								
	N°	Hs (mm)	Ds (mm)	ΔVs (mm³)	T100 (min)	Vmax (µm/min)	σ'c (kPa)	Hf (mm)	Df (mm)	mf (g)	md (g)	wf (%)	ρdf (kg/m³)	ef	Srf (%)
🟦	1	76.00	38.00	0.000	0.000	0.000	0.000	76.00	38.00	158.0	130.5	21.07	1514	-1.000	-0.000
🟥	2	76.00	38.00	0.000	0.000	0.000	0.000	76.00	38.00	160.5	133.5	20.22	1549	-1.000	-0.000
🟩	3	76.00	38.00	0.000	0.000	0.000	0.000	76.00	38.00	163.0	134.5	21.19	1560	-1.000	-0.000

Total stress :



	Mohr
C (kPa)	47.69
φ (°)	20.38

Effective stress :



	Mohr	Lambe
C' (kPa)	34.15	32.92
φ' (°)	19.44	18.38

Comments :

Visa :

p.1/3

APPENDIX D HOUSEHOLD SURVEY REPORT (WWEC)

May 2019

Golomoti ESIA Baseline Field Investigations
Field work report
May 01, 2019

1. INTRODUCTION

JCM Power intends to construct a 20 to 40 megawatt (MW) solar power plant with the option of an energy storage system in the Republic of Malawi. Prior to the commencement of the solar power plant, an Environmental and Social Impact Assessment (ESIA) has to be conducted, as part of a feasibility study, which is being prepared by Power Engineers.

The overall aim of the ESIA is to assess the environmental and social impacts of the proposed project activities; and to develop an environmental and social management plan (ESMP) for enhancing or mitigating the potential positive and negative impacts respectively.

As part of the ESIA a household survey was conducted with the Project Affected Persons (PAPs) and Non PAPs, to gather information on social and economic conditions of the area. The survey covered the areas of agriculture, health, education and income sources, among others.

2. PROJECT AREA

The project will be implemented in Dedza District, in Traditional Authority Kachindamoto. The project area is less than 1 km from Golomoti Trading centre and can be accessed using the M5 road (Salima to Balaka road).

3. METHODOLOGY

According to the Scope Of Work (SOW) document, the project footprint is anticipated to affect land controlled or under use by approximately 135-160 people. Hence, the average between the numbers was considered as the total number of PAPs to be interviewed [(135+160)/2=148 people], this number was rounded up to 150 PAPs. The median was also computed based on the total of 160 people. This median was considered as the approximate maximum number of people to be affected by the project.

As the survey aims at establishing the social and economic status of the area, 20 percent of the 150 PAPs was surveyed as a control. Controls receive no intervention and are used to compare groups and assess the effect of intervention. Therefore, 30 Non-Project Affected Persons (Non PAPs) were interviewed as a control. To minimise the potential of the occurrence of data bias and the collection of non-representative data, the Non PAPs were selected randomly. This was achieved by placing a spacer of 3 households between one household and the next one to be interviewed.

Training enumerators for this survey was conducted on the 27th March 2019 and the household survey was conducted from the 28th March to 1st April 2019. The interviews were done as follows:

Table 1: Number of interviews done per day

Date	Number of interviews	Number of PAPs	Number of Non PAPs
28/03/2019	5	0	5
29/03/2019	29	24	5
30/03/2019	53	42	11
31/03/2019	59	57	2
1/3/2019	35	28	7
Total	181	151	30

4. ISSUES AND OBSERVATIONS

4.1. General observations

- The project area was not cultivated during the 2017/2018 growing season. The community claimed that they were told not to cultivate because the project was soon to be implemented. As a result, food insecurity was experienced by some of the community members, as the did not have alternative land to be utilized for farming.
- Land scarcity is a problem in the community. Hence, some of the PAPs complained that it will be hard for them to secure replacement land in the same village.
- From the field discussions, it was observed that people are expecting to receive high compensation amounts. This is likely the result of the close proximity between Salima and Dedza towns. Hence, sharing of prices between residents of the towns and the project site.

4.2. Agricultural observations

- Both animal and crop husbandry activities are performed in the community. Most of the people depend on farming as a source of income. However, agricultural seems to face challenges because of drought and lack of farm inputs, despite the households having reasonable land sizes. Charts 1 and 2 graphically illustrate the significance of farming as an income generating occupation.

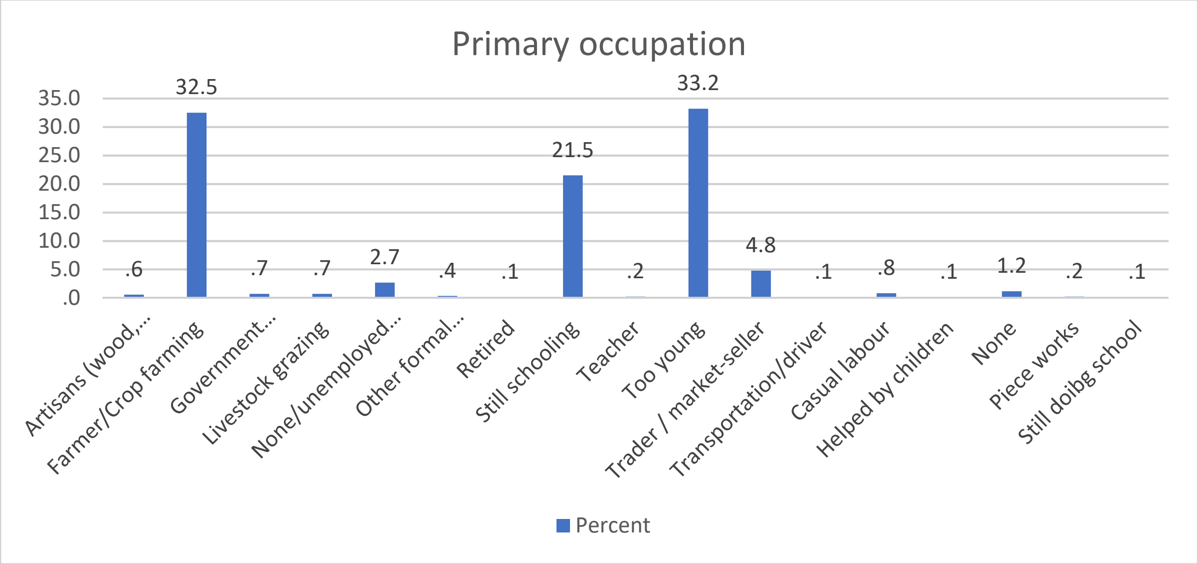


Chart 1: Primary Occupation

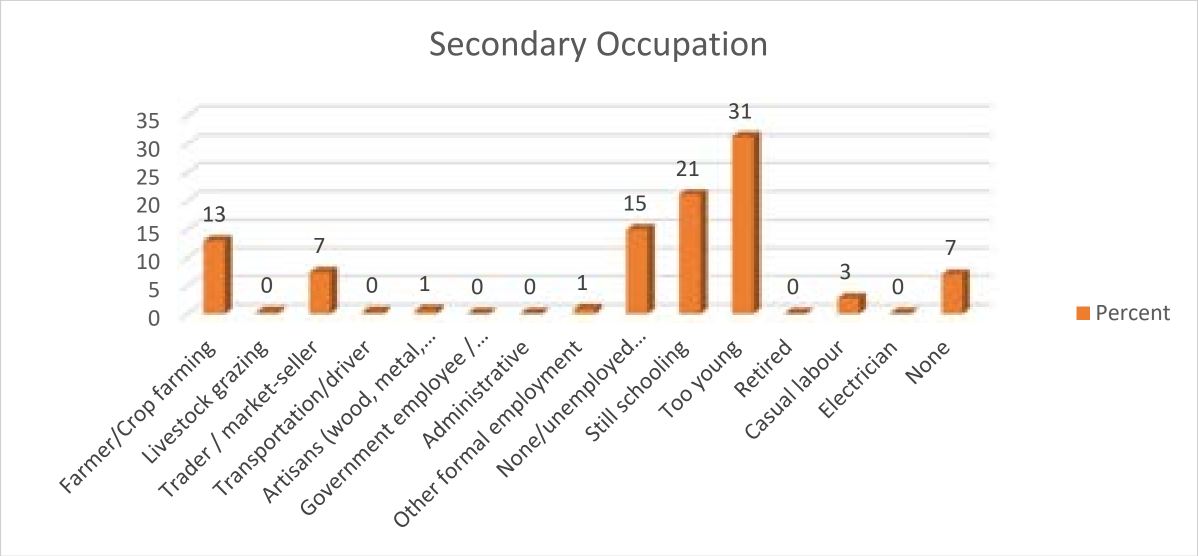


Chart 2: Secondary Occupation

- Maize, cowpeas, pigeon peas, groundnuts, finger millet, okra, watermelon, and pumpkins are some of the crops that were observed at the project area (Chart 3). Cow peas, groundnuts and cotton are mainly grown as cash crops.

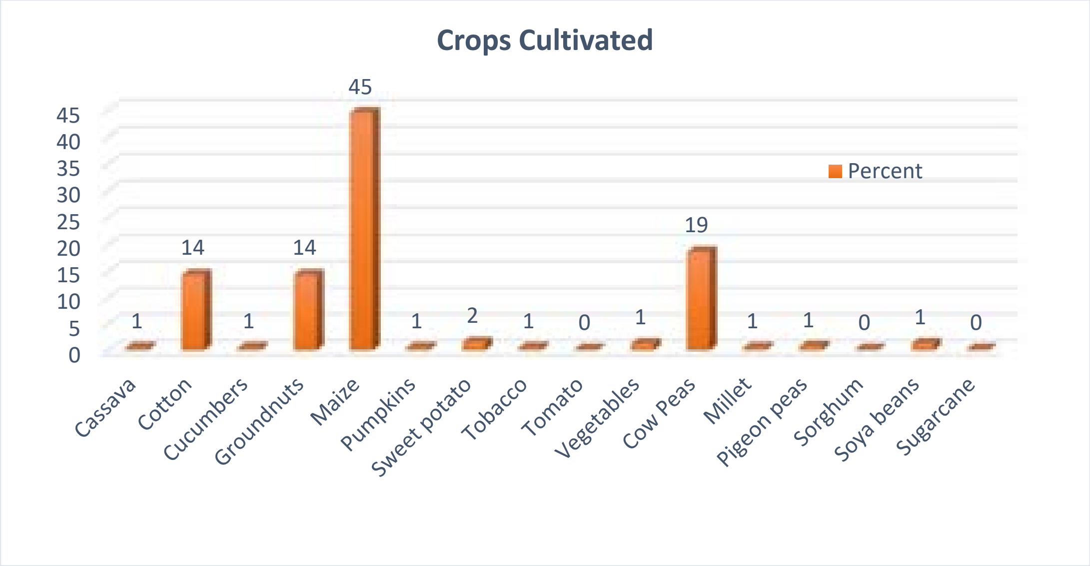


Chart 3: Crops Cultivated

- Cattle, goats, poultry and pigs are livestock that were observed in the project area. Livestock production is mostly affected by diseases such as new castle. The area has a community land that is used for livestock grazing.

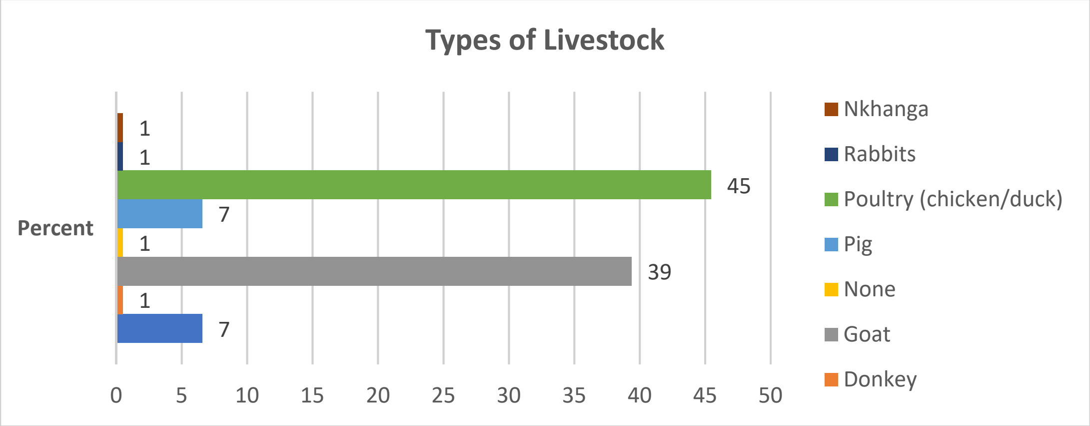


Chart 4: Types of Livestock

4.3. Housing and livelihood

- There is a variety of housing structures in the community. Burnt as well as unburnt bricks, bamboos and soil are some of the materials utilized for the construction of walls. The main floor types for the structures in the community are mud and cement. Roofing materials for the majority of the structures are grass and iron sheets. Charts 5, 6 and 7 illustrate the main building materials used in the community.

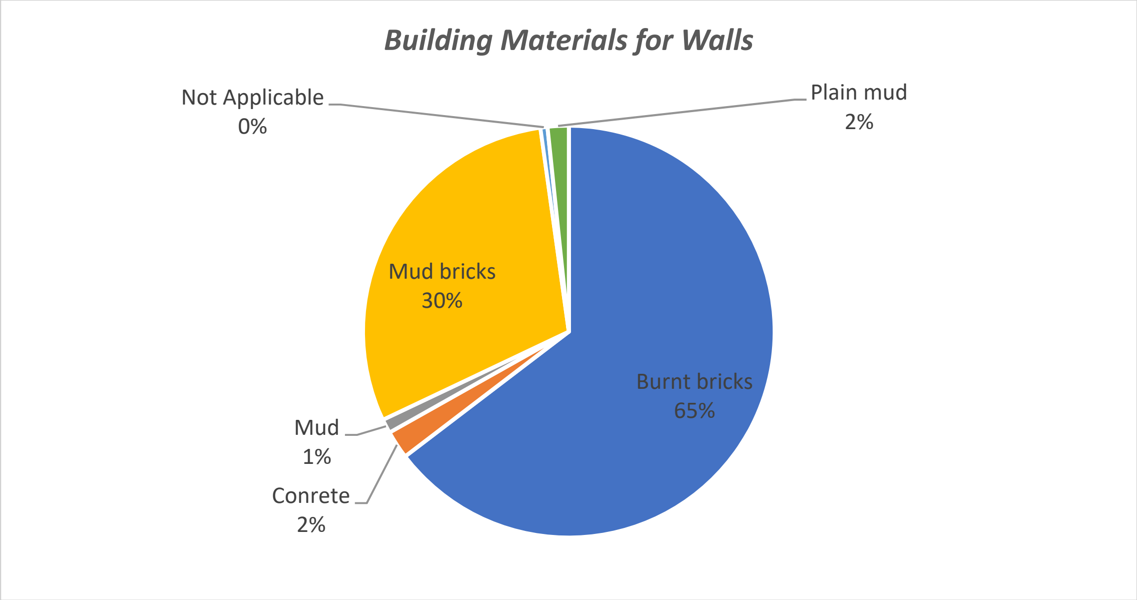


Chart 5: Building Materials for Walls

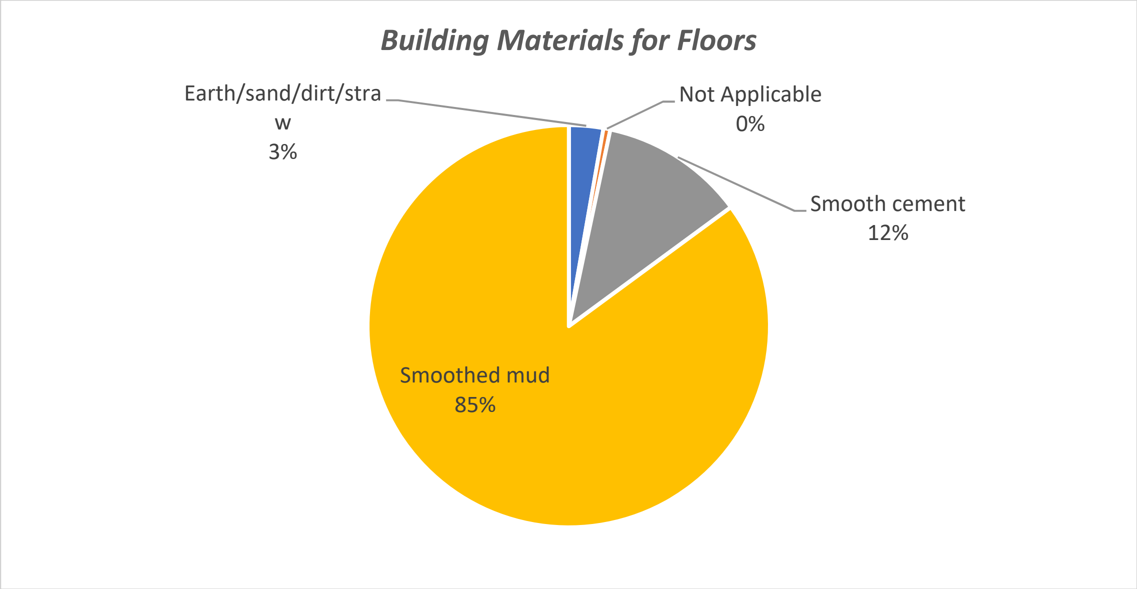


Chart 6: Building Materials for Floors

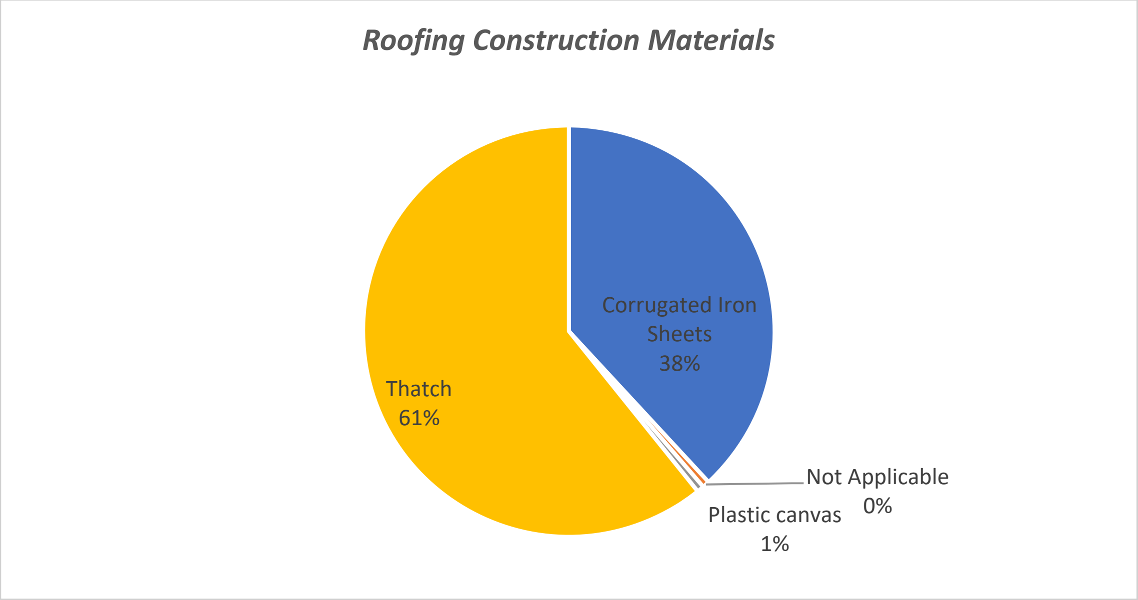


Chart 7: Roofing Construction Materials

4.4. Water and health

- It was also observed that there are few boreholes in the project area and as such the waiting times are long; This is the overwhelming reason most respondents reported water supply as an issue. On average the waiting time is about 30 minutes, but it goes up to 2 hours during the dry season, as the water levels drop, contributing to water shortages. Boreholes are the main source of water supply, regardless of the season (wet and dry).

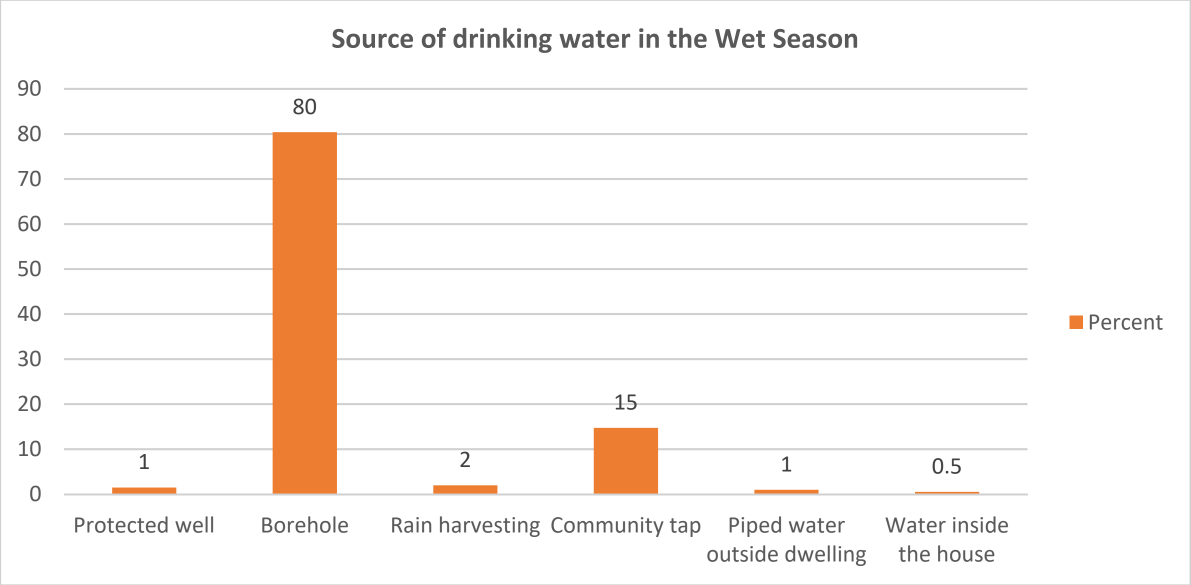


Chart 8: Source of drinking water in the Wet Season.

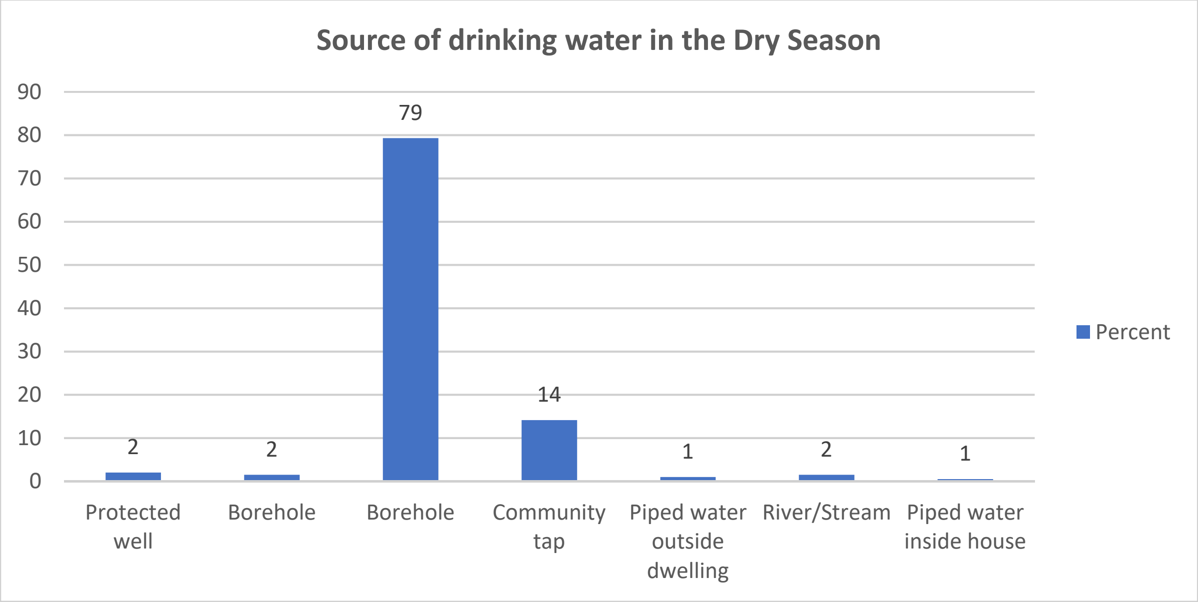


Chart 9: Source of drinking water in the Dry Season

Chart 10: Water Supply Challenges

5. CHALLENGES

- Some people were not very conversant with the project area as such it was difficult to identify them as PAPs or Non PAPs.
- Some of the project affected people stay away from the village which forced the personnel conducting the surveys to travel long distances in effort to locate them.
- Everyone within the community expected to be interviewed even those that were not sure if they were PAPs or not. In addition, some wanted more than one person to be interviewed within the same household.

6. CONCLUSION

In conclusion, the exercise would be considered a success as data of interest was retrieved from the households without any significant hurdles thanks to the cooperation and engagement of the parties involved. The community members are in favour of the project, and expressed how they were excited with the local and national gains from an infrastructure improvement project like this, especially since it is in the energy generation sector which is currently inadequate to meet demands in Malawi. Respondents also expressed that they were looking forward to being compensated for land lost/disturbed in order to purchase replacement land.

7. Appendix

Teams that conducted the household surveys

Name	Qualifications
Prisca Malenga	Degree Environmental science (Field Supervisor)
Alinafe Manjawira	Degree Agricultural Education (Research Assistant)
Chilimbikitso Kawinga	Degree Agricultural Economics (Data Manager)
Mphatso Zimba	Degree Social Studies (Research Assistant)
Arthur Baluwa	Degree in biometrics-pending (Research assistant)
Chifundo Kasowa	Diploma in ICT (Research assistant)

APPENDIX E BIODIVERSTIY BASELINE REPORT (WWEC)

April 2019

Table of Contents

1. INTRODUCTION

1.1 Background

More than 98 percent of Malawi's electricity is provided from hydropower. Electricity Supply Corporation of Malawi (ESCOM) is the national utility company charged with the responsibility for transmission and distribution of electricity to consumers throughout the country. It is also responsible for maintenance of the sector assets and planning for system expansion to meet growing demand for electricity in the country.

Currently, the Malawi's installed electricity generation capacity, which is produced by Energy Generation Company (Malawi) Limited (EGENCO) is approximately 287 megawatts (MW), of which only about 267 MW is available. In contrast, the estimated demand is approximately 325 MW. With a projected peak demand of 757 MW by 2020, hence electricity generation capacity needs to increase at an average annual growth rate of 10 percent (ICF International, 2010).

To address the current power supply challenges, the Republic of Malawi ("Malawi") is inviting power independent producers, to invest in the power sector, as one way of increasing power generation to meet the projected demand. In this regard, JCM Solar Corporation Limited, a subsidiary of JCM Power, proposes to construct a 20 to 40 MW Solar Power Plant on a 90.605 hectare (ha). piece of land located approximately 0.5 km from the Golomoti ESCOM Substation and less than 1 km from Golomoti Trading Centre in Dedza District, within Traditional Authority (TA) Kachindamoto. The proposed project will help improve accessibility and availability of electricity in the country, to contribute to meeting the high demand currently at over 325 MW.

1.2 Aims of This Report

The aims of this report are to:

- *assess and collect biodiversity baseline data for the Project Site.* This was aimed at assessing and identifying species of flora, mammals, birds, reptiles, amphibians and habitats; and/or vegetation cover types of the project site, against which the likely project impacts can be evaluated and future changes compared;

- *assess and collect baseline data for the Priority Ecosystem Services of the Project Site.* This included assessment of priority ecosystem services, regulating ecosystem services, supporting ecosystem services and cultural ecosystem services that maintain healthy functioning of the ecosystems and/or habitats of the Project Site and support livelihoods for local communities living around the Project Site and beyond;

- *assess potential impacts of the proposed project.* This included assessment and identification of the likely impacts of the proposed project on biodiversity and ecosystem services; in terms of their geographical extent, duration, severity, probability of occurrence and overall significance; and

- *determine mitigation measures for the potential impacts.* This entailed proposing practical measures (for mitigating the adverse impacts; and enhancing positive impacts where appropriate, of the proposed project on biodiversity and ecosystem services) to avoid and/or minimize loss of the biodiversity species and priority ecosystem services found on the Project Site and surrounding areas.

2. RELEVANT LEGISLATIVE AND REGULATORY FRAMEWORK

2.1 International Framework

2.1.1 Agenda 21 of 1992

Malawi is signatory to agenda 21, which came into force in 1992,which provides a policy framework and action plan for sustainable development at global, national and regional levels. Local agenda 21 entails participation and co-operation of local authorities to develop their own Local Agenda 21 plans and strategies according to the region's available specific priorities and resources. The Department of Environmental Affairs (EAD) developed the National Biodiversity Strategy and Action Plan, which provides a national framework, for sustainable development (EAD, 2006). The framework includes significant changes to land tenure, including granting full statutory recognition to customary land as free simple customary estate, registered and available for disposition under market conditions.

2.1.2 Convention on International Trade in Endangered Species of Wild Fauna and Flora, 1982

Malawi has been a signatory to the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), which was enacted in 1982. The aim of the convention is to ensure that international trade in specimens of wild animals and plants does not threaten their survival. The convention also prohibits or restricts the commercial hunting of a number of animals such as the Nile Crocodile, Leopard, Elephant and Lion. Malawi has 127 species of fauna, some of which are listed under CITES, in either Appendices I, II or III). Some relevant species of fauna in the project area are all owl species, and Rock and Nile monitors. However, none of these species were recorded from the Project area.

2.1.3 Conservation of Migratory Species of Wild Animals, 1983

Malawi has been a signatory to the Convention of Migratory Species of Wild Animals (also known as the CMS or Bonn Convention), which came into force in 1983. This is an intergovernmental treaty, concluded under the aegis of the United Nations Environment Programme that aims to conserve terrestrial, marine and avian migratory species throughout their range. Relevant mammals are Schreiber's Long-fringed bat and Straw coloured Fruit Bat; and relevant birds which include the Red-footed Falcon, Amur Falcon, Lesser Kestrel, Rufous-bellied Heron, Stork species, African Sacred Ibis, African Spoonbill, Common Quail, Corncrake, Black-winged Pratincole, all migratory wanders (sandpipers, plovers, etc), European Bee-eater and European Roller. Malawi is also a signatory to the Agreement on the Convention of African-Eurasian Migratory Waterbirds, which is a multilateral agreement for the conservation of migratory birds that are ecologically dependent on wetlands in Africa and Eurasia.

2.1.4 Convention on Biological Diversity, 1992

The Convention on Biological Diversity came into force in 1992. The main aim of this convention is to conserve biodiversity and use its products in ways that are both sustainable and equitable. An underlying principle of this convention is that states have sovereign rights to exploit their own resources. However, activities within a country should not cause damage to their environments and those of other states. Article 8 states that *"Each Contracting party shall, as far as possible and as appropriate:*

> *(a) regulate or manage biological resources important for conservation of biological diversity, whether within or outside protected areas, with a view to ensuring their conservation and sustainable use; and*
>
> *(b) rehabilitate and restore degraded ecosystems and promote the recovery of threatened species, inter alia, through the development and implementation of plans or other management strategies.*

2.1.5 The Ramsar Convention on Wetlands, 1991

The Ramsar Convention on Wetlands came into force in 1991. Malawi has Lake Chilwa is presently designated as a Wetland site of International Importance in Malawi. However, contracting parties to the convention accept general obligations relating to the conservation and wise use of all wetlands throughout their territory. Broad aims of the convention are to stem the loss of wetlands, to ensure their conservation and wise use; and to promote special protection of listed wetlands.

2.1.6 International and Regional Conventions Ratified by the Government of Malawi

Malawi has either ratified or is a signatory to a number of international and regional conventions and treaties, which aim to protect the environment by contrilling pollution and protecting wildlife and natural resources. Table 1-1 lists the international conventions and treaties relevant to the proposed project, which Malawi has ratified and/or accepted:

Table 1-1. Relevant international conventions and treaties Malawi ratified and/or accepted

Stockholm Convention on Persistent Organic pollutants	2001
Kyoto Protocol to the United Nations Framework Convention on Climate Change (Ratified)	1997
Convention on Biological Diversity (Ratified)	1992
Convention on International Trade in Endangered Species of Wild Fauna and Flora «CITES» (Ratified)	1973
Convention relating to Wetlands of International Importance Especially as Waterfowl Habitat «RAMSAR Convention» (Ratified)	1971
African Convention on Conservation of Nature and Natural Resources (Ratified)	1968
Convention on Conservation of Wildlife Migratory Species (CMS) (Ratified)	2003
African Convention on the Conservation of Nature and Natural Resources (Accepted)	1973
Lusaka Agreement on Co-operative Enforcement Operations Directed at Illegal Trade in Wild Fauna and Flora (Ratified)	1994

2.2 National Framework

2.2.1 The Constitution of the Republic of Malawi, 1995

The Constitution of the Republic of Malawi provides a foundation for environmental management in Malawi. Section 13 (d) provides the principles of environmental management as to manage the environment responsibly in order to:

- prevent degradation of the environment;
- provide a healthy living and working environment for the people of Malawi;
- accord full recognition to the rights of future generations, by means of environmental protection and sustainable development of natural resources; and
- conserve and enhance the biodiversity of Malawi.

This implies that all activities undertaken in Malawi, including the construction of the solar power plant and the short transmission line for this project, must conform to these principles of environmental management as set out in the Constitution of the Republic of Malawi, to promote environmental sustainability and conservation of biological resources for the benefit of the present and future generations.

2.2.2 National Environmental Policy, 2004

The overall policy goal of the National Environmental Policy is to promote sustainable social and economic development, through sound management of the environment and natural resources. The specific policy goals include to:

(a) secure for all persons now and in the future, an environment suitable for the health and well-being of the people;
(b) promote sustainable utilization and management of the country's natural resources and encourage, where appropriate, long term self-sufficiency in food, fuelwood and other energy requirements; and
(c) promote ecosystems management approach to ensure sustainable environment and natural resources management.

Construction of the solar power plant and the transmission line must therefore, integrate the principles of this environmental policy into the project's activities; so that the project is implemented in an environmentally responsible manner, with the participation of all stakeholders. Trade-offs between economic development and environmental degradation can be minimized through this Environmental and Social Impact Assessment (ESIA) and environmental management and monitoring plans.

2.2.3 National Forestry Policy, 2016

This policy aims at promoting sustainable contribution of national forests, woodlands and trees towards the improvement of the quality of life in the country, by conserving the resources for the benefit of the nation and to the satisfaction of diverse and changing needs of Malawi population, particularly rural households. The policy further prohibits destruction of a list of protected species, which are gradually becoming rare; and prevents changes in land-uses, which promote deforestation, constrain farm forestry or endanger the protection of forests with cultural, biodiversity or water catchment conservation values. It also discourages excisions in gazetted forests, except for purposes of developing environmentally friendly public utilities. It advocates environmental impact assessment where actions are likely to have significant adverse impacts on important forests and forest resources; and where such actions are subject to the decision of a compete authority.

Construction of the solar power plant and the transmission line shall conform to the principles of the National Forestry Policy, to ensure that forest resources that are found in the adjacent areas are protected; and that for every one tree to be cut down from the project site, five trees of the same species are planted in the vicinity of the project site. The project developer shall also ensure that wildlife species are safeguarded against poaching during construction and operation of the project.

2.2.4 National Parks and Wildlife Policy, 2000

The National Parks and Wildlife Policy advocates sustainable conservation and management of wildlife resources; and the sharing of benefits arising from use of the resources for both present and future generations. One of the policy objectives is to ensure adequate protection of ecosystems and their biological diversity, through promotion and adoption of appropriate practices that adhere to the principles of sustainable development.

The aim of the National Parks and Wildlife Policy is to ensure proper conservation and management of wildlife resources, to provide for sustainable utilization and equitable access to the resources; and the sharing of benefits arising from the use of the resources for both present and future generations. One of the policy objectives is to ensure adequate protection of ecosystems and their biological diversity, through promotion and adoption of appropriate land management practices that adhere to the principles of sustainable use.

The policy recognizes the Poverty Alleviation Program and any efforts that target eradication of poverty so as to remove poverty driven pressures on protected areas and wildlife reserves (Chapter 2, sub section (ix)). It empowers communities to manage wildlife resources on communal land, to support the management of national parks, wildlife and forest reserves and to be involved at all stages of project planning and implementation (Sub section 3.2).

The proposed project may affect habitats for some wildlife such as terrestrial birds, reptiles and amphibians that occur on the project site. Implementation of the proposed project should, therefore, adhere to the National Parks and Wildlife Policy to ensure that the project implementation protects wildlife resources that are found in the proposed project site.

2.2.5 The Malawi Growth and Development Strategy III (MGDS III), 2017-2022

The strategy recognises that the environment plays a very significant role in influencing social and economic development at both household and national levels. The success of many important sectors of the economy relies on environment and natural resources to enhance their productivity. Degradation of the environment and natural resources continues to be a major threat to the social and economic development of Malawi. This degradation includes deforestation, decreasing soil fertility and increasing erosion, water depletion, loss of biodiversity, increasing pollution and increased vulnerability to climate change. It is therefore, imperative that the environment and natural resources are sustainably managed by:

- promoting integrated afforestation for wood fuel, fruit production, windbreak and shade, timber and poles at household and community level to address wood fuel shortage and curb encroachment into reserves
- promoting environmental education, awareness and information sharing among stakeholders;
- increasing participation of the public in environmental management programs;
- enhancing community based natural resource management;
- conserving and sustainably use of water resources such as lakes, rivers and wetlands;
- enhancing biological diversity;
- promoting research, planning, monitoring and evaluation of Environmental and Natural Resources Management (ENRM) programs;
- enforcing Environmental and Social Impact Assessment (ESIA) and other related environmental laws;
- enhancing trans-boundary initiatives in environmental and natural resources programmes; and
- strengthening compliance on pollution control and waste management.

Construction of the proposed solar power plant, as well as the transmission line will have negative impact with regards to the aims of the MGDS III. Therefore, implementation of the proposed project should ensure that the environment and biodiversity of the project site and the surrounding environs are effectively protected for the sustainability of the project and the environment.

2.2.6 National Biodiversity Strategy and Action Plan II (2015-2025)

The goal of the National Biodiversity and Strategy Action Plan II (2015-2025) is to enhance conservation and sustainable use of biodiversity for the environment and human well-being. This goal will be achieved through the following specific strategic objectives aimed to:

a) improve capacity and knowledge on biodiversity issues;
b) mainstream biodiversity management into sectoral and local development plans;
c) reduce direct pressures on biodiversity; d) Improve the status of biodiversity by safeguarding ecosystems, species and genetic diversity; and
d) enhance access and benefits sharing from biodiversity and ecosystem services.

The following principles guide this strategy: a) Conservation of biodiversity is a form of natural resource management whose primary goal is to meet the needs and aspirations of both present and future generations; b) Biodiversity has an intrinsic value and is vital for agricultural, medicinal, scientific, research, tourism and other socioeconomic development; c) Every person in Malawi has the responsibility to fully participate and contribute to conservation and sustainable use of biodiversity; d) As custodians and users of biodiversity, local communities have knowledge, skills and information that can be utilized to promote sustainable management of biodiversity; e) Coordination among various stakeholders at all levels ensures successful conservation and sustainable use of the country’s biodiversity; f) International, regional and national cooperation, including sharing of information and appropriate technology, is crucial for the conservation of biodiversity; g) Conservation of biodiversity is best done following the landscape and/or ecosystems approach; h) The Government is responsible for providing direction and leadership in biodiversity management in Malawi; i) Strategic and effective decision-making on conservation and sustainable use is possible when individuals and policy makers have a better understanding and appreciation of biodiversity.

Therefore, proposed project should adhere to the National Biodiversity Strategy and Action Plan II to ensure that the project activities do not cause negative impacts on biodiversity species and ensure that deliberate efforts are put in place to enhance biodiversity conservation in the project area.

2.3 National Legal Framework Relevant for this Project

2.3.1 Environment Management Act, 1996

The Environment Management Act (EMA) (No. 23 of 1996) aims to promote a clean environment and ensure the protection, management, conservation and sustainable use of natural resources in Malawi. Part IV of this Act outlines the purpose and requirements for national and district environmental action plans. The national targets for 2010 included the following, *inter alia,* to*:*

- increase the number and distribution of rare and threatened species and discourage their commercial use;
- develop programs related to invasive species;
- promote sustainable use of forest and aquatic resources;
- promote community participation, public awareness and capacity building (government and private sector), and
- promote awareness of the importance of biological diversity in economic development and livelihood of the people.

Section 24 of the Act outlines the Environm,ental Impact Assessment (EIA) processes to be followed in Malawi and requires that all project developers in both the public and private sectors comply with the process. The Act, under section 26 (3), further requires that no licensing authority issues any license for a project which an EIA is required, unless the Environmental Affairs Department (EAD) has given consent to proceed due to completion and approval of a satisfactory EIA or due to non-requirement of an EIA.

The Act prescribes the projects or activities that cannot be implemented without an EIA and these activities are outlined in the EIA Guidelines for Malawi (Government of Malawi, 1997). In line with the prescribed activities, the construction of the proposed solar power plant and the associated structures falls under the list of prescribed projects that require an EIA before implementation.

2.3.2 National Forestry Act, 1997

The purpose of the National Forestry Act (No. 4 of 1997) is, *inter alia,* to:

- identify and manage areas of permanent forest cover as protection or production forest in order to maintain environmental sustainability, to prevent resource degradation and to increase social and economic benefits;
- augment, protect and manage trees and forests on customary land in order to meet the basic fuelwood and forest needs of communities and for the conservation of water and soil;
- promote sustainable utilization of timber, fuelwood and other forest produce;
- control trafficking in wood and other forestry produce, including exportation and importation, and
- protect fragile areas such as steep slopes, river banks, water catchment; and conserve and enhance biodiversity.

According to Section 46 (a) of this Act, a license is needed to cut down/ fell, destroy, uproot, collect and remove forest produce from a forest reserve, customary land, public land and protected forest areas. Construction of the solar power plant and the transmission line will have to undertake measures to protect trees within and outside the project site. Therefore, the project shall avoid and/ or limit the cutting down of trees to cases where it is absolutely necessary to do so, in consultation with the relevant authority, the Forestry Department for Dedza district.

2.3.3 National Parks and Wildlife (Amendment) Act, 2016

The National Parks and Wildlife Act (Amendment of 2016) deals primarily with the protection and sustainable management of wildlife. Part VI of this Act requires Wildlife Impact Assessments to ensure protection of endangered and endemic wildlife species. The Amended Act permits any person to request the Minister to have a Wildlife Impact Assessment prepared where they have *“a good and sufficient reason to believe that any proposed or existing government process or activity may have adverse effect on wildlife species or community”*. Therefore, the project shall avoid and/or limit the cutting down of trees, including poaching of wildlife species during the construction and that any worker to commit an offense shall be guilty of the offense and punished in accordance to the relevant Sections in the Act.

2.3.4 Local Government (Amendment) Act, 2017

The Act outlines the decentralization of government control in Malawi. As a result, the natural resource management sector; mostly fisheries, forestry, wildlife and water resource management; has been decentralized to the local level. The Act details the requirements necessary for creation of District Councils in order to assist the government in sustainable management and conservation of natural resources in the country.

In this connection, the project developer should adhere to the Local Government Act of 2017, to ensure that biodiversity of the project site is protected at all times and that monitoring of the implementation of the project activities must be conducted in liaison with Dedza District Council staff.

3. STUDY AREA

3.1 General

The Proposed Golomoti Solar Photovoltaic (PV) Plant will be constructed on a 90.605 ha. of land located approximately 0.5 km from the Golomoti ESCOM Substation and less than 1 km from Golomoti Trading Centre in Dedza District within Traditional Authority (TA) Kachindamoto (Figure 1).

Figure 1: Satellite image of the proposed project site at Golomoti Trading Centre in Dedza District

The project will include construction of a short power transmission line, approximately 0.5 km from the Solar Power Plant Site, to the Golomoti ESCOM Substation; and two short access roads, extending from the highway, to the M5 road on the northeast and another one from the existing Golomoti Substation access road. The proposed project site is in Traditional Authority Kachindamoto and it shares boundaries with the following villages: Pitala, Msamala, Kalumo, Kapesi, Chtseko, Chisaka and Ching'anipa (Malawi Government, 2018).

The Project Site is located along the African Rift Valley floor, at altitudes ranging from 600 to 980 m above the sea level; whereas in the upper escarpments, the altitudes range from 850 m to 2,200 m above the sea level (Malawi Government, 2013). The major river in the district is Linthipe and some streams including Mwachakula (Malawi Government, 2018). The district has tropical continental climate, with a mean annual temperature of 21^{o}C. The highest temperatures, which reach as high as 28^{o}C, are experienced in the month of October; while the lowest temperatures, reaching 8^{o}C, are experienced between May and July.

An initial desktop assessment of the likely environmental issues associated with the proposed Solar Photovoltaic Plant Project was undertaken by JCM Solar Power Corporation Limited (JCM). The assessment identified biodiversity as one of the key issues that would need more detailed investigation. In earlier 2019, JCM Solar Corporation Limited appointed Water Waste and Environment Consultants (WWEC) to undertake a baseline assessment for the proposed development. One of the assessments under this scope of work was Biodiversity Survey of the flora/vegetation, mammal, bird, reptile and amphibian species; and Priority Ecosystem Services Survey of the site. Therefore, this baseline survey report is part of the ESIA study, focusing on the terrestrial biodiversity and priority ecosystem services that may be impacted by the proposed project. The report is based on review of available information and field surveys undertaken by WWEC in March 2019.

Two ecologically sensitive areas are located in the vicinity of the proposed project site:

- **A Graveyard** is located about 200 m to the south east of the proposed solar power plant project site. This is a sacred place used for burying dead people and the Chewa people sometimes use these sacred places for performing in their traditional cult dances popularly known as “the Nyau Dance”. Another sensitive area located close to the proposed project site **is the Kirk Range Forest Reserve**, located 250 m to the south west and north-west of the proposed solar plant project site. This is public land that is used for conservation of different indigenous tree species. Forest reserves in Malawi are used for protecting water catchments and for prevention of soil erosion.

3.2 Exploration License Area

The exploration license area for the Golomoti JCM Solar Power Plant Project covers an area of 91.605 ha. of land (Figure 1-1). This report focuses on this potential footprint area only.

3.3 Terrestrial Ecoregions

Golomoti falls within a large terrestrial ecoregion known as Central Zambezian Miombo Woodland. This is one of Africa’s largest ecoregions, which stretches across Central Africa below the equator and includes most of Central and Northern Malawi. This ecoregion has the highest plant species richness and diversity within the miombo biome and has a higher proportion of evergreen trees compared to other miombo woodland types. Soils are highly weathered, well-drained, highly leached and nutrient-poor; and tend to be acidic with a low proportion of organic matter. In the undisturbed natural forest, the canopy cover is 10 to 20 m tall and is dominated by broad-leaved species of *Brachystegia*, *Julbernardia* and *Isoberlinia*. The understory is lush, comprising grasses, broad-leaved shrubs and geophytes (www.worldwildlife.org/profiles/terrestrial/at/at704_ full.html).

3.4 Vegetation Types

At a finer scale, the Study Area falls within a transition zone between three vegetation types as described by Wild and Fernandes (1967) and as indicated on the Vegetation map of the Flora Zambesiaca Area (Wild and barbosa, 1967):

i. *Brachystegia floribunda – Julbernardia paniculata Semi-Deciduous Northern Plateau Miombo Woodland*
This vegetation type comprises tall woodland on variable soils that are widespread in Zambia and also occurs mostly along the western half of Malawi. The trees *Brachystegia floribunda, B. longifolia, B. boehmii* and *Julbernardia paniculata* are dominant, with locally common evergreen species including *Erythrophloeum africanum* and *Marquesia acuminate*. *Uapaca kirkiana* is usually prominent below the canopy.

ii. *Brachystegia floribunda – Julbernardia globiflora Tardily Deciduous Northen Plateau Miombo Woodland*
This woodland is characteristic of the broken terrain of the central plateau, as opposed to the above vegetation type. This vegetation type is widespread over northern and north-western Zambia and occurs in southern Malawi, as well as along the eastern half of the central plateau. *Julbernardia globiflora* is prominent, while the dominant *Brachystegia* species are *B. floribunda, B. longifolia* and *B. manga*.

iii. *Pterocarpus – Combretum – Pericopsis* Deciduus (Basement Complex) Tree Savannah
This tree savannah woodland is largely confined to patches around the Kafue Flats and near Lusaka in Central Zambia. In Malawi, it occurs mostly between Lilongwe and Dedza on the Central Plateau, with an outlying area north-east of Kasungu. The deciduous trees *Pterocarpus angolensis* and various *Combretum* species are dominant, while other important trees are *Pericopsis angolensis, Terminalia sericea, Burkea africana, Markhamia obtusifolia, Xeroderris stuhlmannii* and *Acacia polyacantha*.

3.5 Aquatic Ecoregions

The Study Area falls within the Lake Malawi Ecoregion, which comprises Lake Malawi and influent rivers and streams. More than 200 rivers flow into Lake Malawi and most of these are annual and many flow in the rainy season (FEOW, 2010).

4. APPROACH AND METHODS

4.1 Approach

The approach to this study was to assess and confirm the status of the habitat of the proposed project area, assess and identify flora, mammal, bird, reptile and amphibian species of the proposed project area; and assess the priority ecosystem services of the project area. The following aspects were considered:

- Assess the Present Ecological State of the proposed project site, using the IFC PS 6 Criteria;
- Presence of endemic and threatened species and habitats;
- Key components of terrestrial ecosystems, including flora, mammals, birds, reptiles and amphibians; and
- Priority ecological services.

4.2 Desktop Studies

Important sources of available information that were used for this study included the following:

- National Guidelines for Environmental Impact Assessment (EIA) (Government of Malawi, 1997);
- Desktop Environmental Scoping Report for Golomoti JCM Solar Power Plant Project (ERM, 2019);
- Socio-economic Profile for Dedza District (2013-2018);
- Satellite image taken in February 2018; and
- Identification guides, including:
    - Terrestrial Vegetation: Baunman (2005), Msekandian & Mlangeni (2002);
    - Birds: Dowsett-Lemaire and Dowsett, (2006), Watson (2003), Stevenson & Fanshawe (2003);
    - Mammals: Monadjen, (2010);
    - Reptiles and Amphibians: Channing (2010), Frost (2010), Spawls *et al.*, (2004);
- Various databases and websites, including:
    - Flora Zambesiaca (http://apps.kew.org/efloras/search.do)
    - The International Union for the Conservation of Nature (IUCN) Red list of Threatened species (http://www.iucnredlist.org);
    - Reptiles (http://tigr.org/reptiles);
    - Amphibians (http://amphibianweb.org);
    - Global Biodiversity Information Facility (GBIF) database (http://data.gbif.org);
    - Avibase (http://www.africanbirdclub.org/countries/checklists/download) and
    - https://www.ifc.org/wps/wcm/connect/bff0a28049a790d6b835faa8c6a8312a/PS6_English_2012.pdf?MOD=AJPERES

4.3 Field Survey

One field survey was undertaken as follows:

Late wet season (29-31 March, 2019) survey. This field survey was aimed at collecting biodiversity baseline data; assessing sensitive habitats; assessing the ecological state of the habitat of the proposed project site and priority ecosystem services that are found on the proposed project site.

4.3.1 Flora

Assessment of flora species was done using transect walks across the proposed project site and in various vegetation communities. All flora species that were seen during the field survey were identified and recorded in a field notebook. Plants that could not be identified onsite were photographed or their specimens were collected for identification at the place of lodging, using the Flora Zambesiaca volumes and various field guides. Particular attention was paid to species of conservation concern (i.e. endemic, protected and endangered species).

4.3.2 Birds

The standardized search method of Watson (2003) was used to survey birds by walking slowly through various vegetation communities, preferably along paths or tracks and recording the species seen or heard within 20-minute segments in each vegetation community. Six transects of approximately 200 m apart were established on the proposed project site. The bird species were surveyed twice in the morning, twice in midday and twice in the evening. This was done in order to capture all species of birds that reveal themselves at different times of a day. Playback calls were used to encourage cryptic species to reveal themselves. This was done to supplement visual observation data.

4.3.3 Mammals

Mammal species were recorded incidentally while surveying birds. Indirect evidence such as spoor or dung was used to confirm presence of mammal species in the proposed project area, in conjunction with limited visual or audio confirmation. Similarly, mammal species were surveyed twice in the morning, twice in midday and twice in the evening in all the six transects that were established on the proposed project site.

4.3.4 Reptiles and Amphibians

Reptiles and amphibians were surveyed during the day by visual scanning of likely habitat, investigating potential refuges such as under logs, between rocks, beneath the old bark of dead trees, leaf litter, etc.

4.3.5 Present Ecological State

Assessment of the Present Ecological State of the proposed project site was done using physical observation, professional judgement and based on subjective assessment of expected and observed abundance and diversity of flora and fauna species, including insects. The results were classified into one of the six categories, ranging from *Unimpaired* (Category A) to *Very Severely Impaired or Modified* (Category F) of the ecosystem. The assessment and classification of the present ecological state of the proposed habitat was adopted using Guidelines of IFS PS6 (Table 1-1).

Table 1-1. IFC Guidelines used to assess the Present Ecological State of the Habitat of the Proposed Project Site

Category	Description
A	*Unmodified* • natural diversity of taxa, and; • numerous sensitive taxa, and • abundance as expected under natural conditions; • no taxa dominating each other, and; • no alien invasive species
B	*Slightly Modified* • As above, but fewer sensitive taxa and slightly lower taxa, and; • No alien invasive species
C	*Moderately Modified* • Moderate diversity of taxa relative to diversity expected under natural conditions, and; • moderate numbers of sensitive taxa, or; • moderate reduction in abundance of some or all taxa relative to that expected under natural conditions, and; • alien invasive species may be present.
	Considerably Modified • low diversity of taxa relative to diversity expected under natural conditions, and;

D	- mostly tolerant taxa, and; - considerable reduction in abundance of some or all taxa relative to the expected under natural conditions, and; - more than one taxa dominating other taxa for extended periods, and; - alien invasive species may be common.
E	*Severely Modified* - very low diversity of taxa relative to diversity expected under natural conditions, and; - only tolerant taxa present, or; - severe reduction in abundance of some or all taxa relative to that expected under natural conditions, and; - only one taxon dominating other taxa for extended periods, and; - alien invasive species may be abundant.
F	*Very Severely Modified* - as above under Category E, but with Very Severe reduction in taxa diversity and abundance.

4.3.6 Ecosystem Services (ES)

Ecosystem Services were assessed and identified using adopted method developed by World Research Institute (WRI) (https://www.wri.org/sites/default/files/weaving_ecosystem_services_into_impact_assessment.pdf) coupled with data and information gathered during consultations held with local communities such as subsistence farmers, livestock herders and some local villagers.

5. BASELINE DESCRIPTION

5.1 Habitat of the Proposed Project Site

The proposed project site is generally flat land and is predominantly used for subsistence agriculture (Figure 2). Crops cultivated on the project site and surrounding areas include *Zea mays (*Maize), *Arachis hypogaea* (Groundnut), *Gossypium herbaceum* (Cotton), *Sorghum bicolour* (Sorghum), *Eleusine coracana* (Finger millet), *Cucubirta maxima (*Pumpkin), *Vigna unguiculata* (Cowpea), *Cajanus cajana* (Pegion pea) and *Hibiscus cannabinus* (Okra) among others. Trees on the site include natural, planted and fruit trees such as mangoes, which are harvested. Within the project site, residents also rear livestock such as *Bos taurus* (Cattle), *Capra aegarus hircus* (Goats) and *Ovis aries* (Sheep). One third of the project site is made up of seasonal wetland where livestock such as cattle, goats and sheep are fed on nutrient rich grasses such as *Urochloa mossambicensis* (Fig. 3).

Fig. 2: Pictorial Habitat Map of the Proposed Project Site

Figure 3: Part of the Seasonal Wetland of the Proposed Project Site Used for Livestock Grazing

5.2 Baseline Flora of Dedza District

Dedza District has three types of vegetation communities, namely; Miombo (*Brachystegia*) Woodland, Savannah Woodland and Mopane Woodland. The district has also perennial wet grasslands and open canopy woodlands of hills and scarps. The Miombo woodland comprises dry and semi-deciduous trees in the genera *Brachystegia* and *Julbernardia*. The common tree species that are found in these woodlands are *Brachystegia boehmii* (Mombo)*, B. Longifolia* (Tsamba)*, B. Floribunda* (Tsamba), *Burkea africana* (Mkalati)*, Pterocarpus angolensis* (Mlombwa)*, Adansonia digitata* (Malambe)*, Sclerocarya birrea* (Mfula), *Bauhinia thonningii* (Chitimbe), *Tereminalia sericea* (Naphini) *Dalbergia mexanoxylon* (Phingo), *Pericopsis angolensis* (Muwanga), *Faihderbia albida* (Msangu), *Colophospermum mopane* (Tsanya), *Stecurlia quinqueloba* (Kweranyani) and *Syzygium cordatum* (Katope) among others (Government of Malawi, 2013-2018).

5.3 Habitat Types of the Proposed Project Site

Three habitat types were recognised within the Study Site. These habitat types were Secondary Mixed Deciduous Woodland, Seasonal Wetland and Cultivated Mosaic Woodland. Mapping of this habitat types or vegetation communities is shown in Figure 1-2 and Figure 1-3, and photographs are included in Appendix A.

5.3.1 Cultivated Mosaic Woodland

Most of the Project site has been cultivated with dryland crops (Figure 4) such as *Zea mays* (Corn Maize), *Sorghum bicolor* (Sorghum), *Arachis hypogaea* (Groundnuts), *Gossypium arboreum* (Cotton), *Cucumis anguiria* (Maroon Cucumber), *Citrullus lanatus* (Water Melon), *Mandifera indica* (Mango), *Ipomoea batatas* (Sweet potato), *Cucumis melo* (Cucumber), *Vigna unguiculata* (Cowpea), *Cajanus cajana* (Pigeon peas) and *Cucumis* *maximum* (Common Pumpkin). The area under cultivation has also some scattered indigenous trees and shrubs, including weed plants that are common in disturbed woodlands. Species include *Adansonia digitata* (Baobaba tree), *Sclerocarya birrea* (Marula tree), *Ocimum americanum* (American basil), *Faidherbia albida* (White acacia), *Piliostigma thonningii* (Monkey bread tree), *Combretum zeyheri* (Large fruited bushwillow), *Sterculia africana* (African star-chestnut tree), *Vangueria infausta* (Velvet wild medlar tree), *Ximenia caffra* (Sourplum tree), *Ximenia americana* (Yellow plum), *Ficus thonningii* (Chinese banyan), *Bauhinia petersiana* (Kalahari White Bauhinia), *Mangifera indica* (Mango tree), *Commelina benghalensis* (Tropical spiderwort), *Ageratum conyzoides* (Billygoat-weed), *Pennisetum unisetum* (Duncan grass), *Hibiscus cannabinus* (Okra), *Trichodesma zeylanicum* (cattle bush), and *Chrysopogon zizanioides* (Vetivar grass).

The presence of cultivated crops and weed plants such as *Ocimum americana, Mangifera indica*, *Ageratum conyzoides, Commelina benhalensis, Hibiscus cannabinus, Trichodesma zeylanicum* and *Chrysopogon zizanioides* on the propose project site suggest that the area has been totally transformed from its natural state with the remaining trees being present likely to remain as these provide benefits to the communities that utilise the area. This type of habitat is therefore, classified as *Considerably Modified Habitat*.

Figure 4: Cultivated Mosaic Woodland of the Project Site

(a) Species Composition

A total of fifty-nine (59) terrestrial flora or plant species were recorded from this habitat type of the project site as listed in Table 1-3.

Table 1-3: Flora Species Identified on the Cultivated Mosaic Woodland of the Project Site

Species Name	Local Name	Comment
Faidherbia albida	(Msangu) or Ana tree	Common tree typical of riparian habitat. Seed pods are eaten by livestock and the tree fix nitrogen in the soil.
Adansonia digitata	Baobab tree	Tree, typical of dry woodland
Zea mays	Maize	Cultivated annual grass used for food
Citrullus lanatus	Water melon	Cultivated annual climber used for food
Gossypium arborea	Cotton	Introduced annual herb, cultivated on farmland
Cucumis anguiria	Maroon Cucumber	Cultivated annual climber used for food
Cucumis melo	Cucumber	Cultivated annual climber used for food
Vigna unguiculata	Cowpea	Annual herb, cultivated for food
Cajanus cajana	Pigeon pea	Perennial shrub, cultivated for food
Cucumis maximum	Pumpkin	Annual climber, cultivated for food
Pennisetum unisetum	Udzu or Mission grass	Common grass, typically occurring in disturbed land and is invasive in some cases.
Commelina baanghelensis	Tropical spiderwort	Common weed, typically occurring in disturbed land and is invasive in some cases.
Acacia tortilis	Umbrella thorn Acacia	Common tree of dryland. Plant is used as feed for livestock
Senna obstusifolia	Sickle Senna	Alien tree, typically introduced by communities on farmlands.
Vernonia glabra	Cornflower	An annual herb, typical of secondary woodland
Trichodesma zeylanicum	Camel bush	Annual herb, typical of secondary woodland
Sclerocarya birrea	Marula tree	Common tree, typical of dry Savannah woodland
Melinis repens	Natal grass	Perennial grass, typical of dry land and used for thatching houses
Vernonia poskeana	Sandveld vernonia	Annual herb, typical of secondary woodland
Vernonia glabra	Conflower	Annual herb, typical of secondary woodland
Stereospermum kunthianum	Zana	Small tree occurring in open woodland
Ocimum americana	American basil	Small annual herb, typical of open cultivated land.
Corchorus olitorius	Bush Okra	Small annual herb, typical of open cultivated land.
Ceratotheca sesamoides	Sesame	Wild weed and locally grows in cultivated land
Merremia pinnata	Kosrae	Common annual climber
Siphonochilus aethiopicus	Wild ginger	Annual herb, typical of cultivated land
Combretum zeyheri	Large-fruited bushwillow	Tree, typical of open dry woodland
Leucas amartinicensis	Whitewort	Annual herb, typical of cultivated land
Pannicum maximum	Guinea grass	Grass, typical of cultivated and open woodland
Cucumis sativus	Cucumber	Cultivated fruit

Species Name	Local Name	Comment
Hibiscus subdariffa	Roselle	Annual woody-based Okra, used for making tonic drink
Vangueria infausta	African medlar	Tree, typical of open secondary or primary forest
Strychnos innocua	Monkey orange	Shrub, typical of cultivated land and natural secondary forest
Ximenia americana	Yellow plum	Tree, typical of cultivated land or natural secondary forest
Sorghum bicolour	Sorghum	Perennial grass usually cultivated
Eleusine coracana	Finger Millet	Annual grass usually cultivated for food.
Codyla africana	Wild Mango	Tree, typical of primary or secondary woodland
Andropogon shirensis	Beard Grass	Annual grass , typical of cultivated land
Senna spectabilis	Whitebark senna	Tree, introduced in cultivated land by humans
Hyparrhenia filipendula	Fine-hood Grass	Grass, typical of disturbed land used for thatching.
Digitaria milanjiana	Crabgrass	Grass, typical of disturbed land.
Bidens steppia	Beggarticks	Annual herb, typical of open cultivated land
Heteropogon contortus	Black spear grass	Perennial grass, typical of disturbed land.
Markhamia obtusifolia	Golden bell-bean	Tree, typical of closed and secondary woodland.
Biophytum kassneri	Reinwardit	Annual herb, typical of open cultivated land
Vitex mombasae	Chaste tree	Small tree, typical of open woodland and its fruits are edible
Hibiscus esculentus	Lady's fingers Okra	Annual herb, cultivated plant and is edible as relish
Bidens pilosa	Black jack	Introduced weed annual herb, present as a result of soil disturbances
Impatiens gomphophylla	Balfour	Annual herb, typical of moist condition and cultivated land.
Bauhinia thonningii	Camelfoot tree	Common tree, typical of dry conditions.
Sterculia quinqueloba	Large-leaved star chestnut	Tree, typical of open woodland.
Sida acuta	Wireween	Weed annual plant, present as a result of soil disturbances.
Cissus buchannii	Mwanmphepo	Annual herb, typical of dry conditions.
Tridax procumbens	Tridax daisy	Annual weed, present due to soil disturbances.
Crinum macowanii	Spider lily	Annual herb, typical of moist conditions.
Chrysopogon zizanioides	Vetivar grass	Introduced grass, typical of moist conditions.
Ficus thonningii	Common wild fig	Tree, typical of open dry woodland
Lagenaria sicenaria	Long melon	Cultivated climber used for food
Chloris vigata	Rhodes grass	Annual grass, typical of open and disturbed habitats
Abelmoschus esculentus	Okra	Annual herb, typical of disturbed land

b) Tree Density

The tree density in this habitat was estimated to be about 13 individual trees per ha. and over 4 individual trees of these belong to the genus *Faihderbia* and *Adansonia*.

c) Threatened, Endemic and Protected Species

None of species recorded from the cultivated degraded mosaic habitat were either threatened or endemic to the study area. However, *Adansonia digitata* (Baobab tree) was the only tree, which was recorded from this habitat of the Project site and is protected by the Forestry Laws and Regulations due to its over-exploitation.

d) Present Ecological State of the Habitat

The Present Ecological State of this habitat is *Considerably Modified* even though some natural trees still exist in this type of a habitat. Species composition had been severely transformed as a result of repetitive cultivation of the land for subsistence agriculture and hence, the potential to support biodiversity is moderate.

e) Invasive Alien Species

No invasive alien species was recorded from this habitat of the project site.

5.3.2 Secondary Mixed Deciduous Woodland of the Project Site

a) Species Composition

This was another vegetation community or type found on the of Study site at Golomoti (Figure 5). A total of 39 species were recorded from this vegetation type or community, which represents 30% of the total plant species of the Study site.

The most well represented families were Poaceae and Fabaceae subfamily Mimosoideae. Most trees were deciduous. Grasses were prominent and the herbaceous layer was noticeably diverse.

Figure 5: Secondary Mixed Deciduous Woodland of the Project Site

A total of thirty-nine (39) terrestrial flora or plant species was recorded from this habitat type of the project site as listed in Table 1-4.

Table 1-4: Flora Species Identified from Secondary Mixed Deciduous Woodland of the Project Site

Species Name	Local Name	Comment
Pterocarpus rotundifolius	(Round-leaved bloodwood	Common tree typical of dry habitat
Dalbergia nitidula	Purple wood tree	Common tree typical of dry habitat
Markhamia obtusifolia	Golden bell-bean	Tree, typical of closed and secondary woodland.
Combretum zeyheri	Large-fruited bushwillow	Tree, typical of open dry woodland
Sterculia quinqueloba	Large-leaved star chestnut	Tree, typical of open woodland
Sclerocarya birrea	Marula tree	Tree, typical of open dry woodland
Brachystegia spiciformis	Brachstegia	Tree, typical of closed canopy and open natural woodland
Acacia polyacantha	White thorn	Tree, typical of open dry woodland
Vitex payos	Chinese Chaste tree	Tree, typical of open woodland

Species Name	Local Name	Comment
Pennisetum unisetum	Udzu or Mission grass	Common grass, typically occurring in disturbed land and is invasive in some cases.
Solanum panduriforme	Bitter apple	Perennial herb, typical of open dry woodland and disturbed areas
Acacia tortilis	Umbrella thorn Acacia	Common tree of dryland. Plant is used as feed for livestock
Azanza garckeana	Slime apple	Tree, typical of open dry and secondary woodland
Vernonia glabra	Cornflower	An annual herb, typical of secondary woodland
Combretum adenogonium	Four-leaved bushwillow	Tree, typical of open dry and secondary woodland
Faihderbia albida	(Msangu) or Ana tree	Common tree typical of riparian habitat. Seed pods are eaten by livestock and the tree fix nitrogen in the soil.
Melinis repens	Natal grass	Perennial grass, typical of dry wodland and used for thatching houses
Piliostigma thonningii	Monkey bread tree	Tree, typical of dry woodland
Vernonia glabra	Conflower	Annual herb, typical of secondary woodland
Adansonia digitata	Baobab tree	Tree, typical of dry woodland
Sterculia quinqueloba	Large-leaved star-chestnut	Tree, typical of dry woodland
Eucalyptus camaldulensis	Bluegum	Introduced tree, typical of disturbed natural woodland
Annona senegalensis	African custard-apple	Shrub, typical of open dry woodland
Bauhinia petersiana	Kalahari White Bauhinia	Tree, typical of open dry woodland
Hyparrhenia rufa	Giant thatching grass	Annual grass, typical of open woodland
Markhamia obtusifolia	Golden bean tree	Tree, typical of open dry woodland
Senna siamea	Siamese cassia	Introduced tree
Pannicum maximum	Guinea grass	Grass, typical of cultivated and open woodland
Steganotaenia araliacea	Carrot tree	Shrub, typical of open woodland
Strychnos innocua	Monkey orange	Shrub, typical of dry open woodland
Vangueria infausta	African medlar	Tree, typical of open secondary or primary forest
Strychnos innocua	Monkey orange	Shrub, typical of cultivated land and natural secondary forest
Ximenia americana	Yellow plum	Tree, typical of cultivated land or natural secondary forest
Commiphora sansibarica	Corkwood tree	Tree, typical of dry open woodland
Trichodesma zeylanicum	Cattle bush	Annual herb, typical of open woodland
Crinum macuanum	Amaryllis	Perennial herb, typical of open and closed woodland
Lonchocarpus bussei	Small apple-leaf tree	Tree, typical of open dry woodland
Lonchocarpus violacea	Apple-leaf	Tree, typical of open dry woodland

Species Name	Local Name	Comment
Dichrostachys cinerea	Kalahari Christmas tree	Tree, typical of open dry mixed woodland

b) *Tree Density*

The tree density in this habitat was estimated to be about 35 individual trees per ha. and over 12 individual trees of these belong to the genus *Markhamia* and *Adansonia*.

c) *Threatened, Endemic and Protected Species*

None of species recorded from the cultivated degraded mosaic habitat were either threatened or endemic to the study area. However, *Adansonia digitata* (Baobab tree) was the only tree, which was recorded from this habitat of the Project site and is protected by the Forestry Laws and Regulations due to its over-exploitation.

d) *Present Ecological State of the Habitat*

The Present Ecological State of this habitat is *Moderately Modified* and that is why some natural trees still existed on this type of a habitat. Species composition had slightly been transformed due to felling of trees for fuelwood. However, this habitat has the great potential to support biodiversity of the Project Site.

f) *Invasive Alien Species*

No invasive alien species was recorded from this habitat of the project site.

5.3.3 Seasonal Wetland

a) *Species Composition*

This was the third vegetation community or type that occurs on the proposed Project Site at Golomoti (Figure 6). A total of 13 species were recorded from this vegetation type or community, which represents 16.5% of the total plant species of the Study site.

The most well represented families were Poaceae, Cyperaceae and Tiliaceae. Most trees were deciduous shrubs. Grasses were prominent and the herbaceous layer was noticeably diverse.

Figure 5: Seasonal Wetland of the Project Site

A total of twenty-one (21) terrestrial flora or plant species were recorded from this habitat type of the project site as listed in Table 1-5.

Table 1-5: Flora Species Identified from Seasonal Wetland of the Project Site

Species Name	Local Name	Comment
Urochloa mosambicensis	Bushveld signal grass	Grass, typical of dry seasonal wetland
Acacia polyacantha	White thorn	Tree, typical of open dry woodland
Pennisetum unisetum	Udzu or Mission grass	Common grass, typically occurring in disturbed land and is invasive in some cases.

Species Name	Local Name	Comment
Clematis simensis	Clematis	Annual herb, typical of mist conditions
Scleria bulbifera	Nutrushes	Sedge, typical of seasonal wetland
Vernonia glabra	Cornflower	An annual herb, typical of secondary open woodland
Combretum adenogonium	Four-leaved bushwillow	Tree, typical of open dry and secondary woodland
Scleria racemosa	Sword grass	Sedge, typical of seasonal wetland
Melinis repens	Natal grass	Perennial grass, typical of dry woodland and used for thatching houses
Hyparrhenia rufa	Giant thatching grass	Annual grass, typical of open moist woodland
Markhamia obtusifolia	Golden bean tree	Tree, typical of open dry moist woodland
Senna siamea	Siamese cassia	Introduced tree
Pannicum maximum	Guinea grass	Grass, typical of cultivated and open woodland
Cynodon dactylon	Dog's tooth grass	Grass, typical of moist conditions
Chloris gayana	Rhodes grass	Grass, typical of moist conditions
Cissus grisea	Wild grape	Climber, typical of open woodland
Cissus rubiginosa	Adamant creeper	Climber, typical of moist open woodland
Embelia schimperi	Amargna	Climber, typical of moist open woodland
Grewia asiatica	Phalsa	Shrub, typical of open woodland
Grewia villosa	Mallow raisin	Shrub, typical of open woodland
Grewia retusifolia	Emu-berry	Shrub, typical of open woodland

b) *Tree Density*

The tree density in this habitat was estimated to be about 17 individual trees per ha. and over 5 individual trees of these belong to the genus *Grewia*.

c) *Threatened, Endemic and Protected Species*

None of species recorded from the cultivated degraded mosaic habitat were either threatened or endemic to the study area.

d) *Present Ecological State of the Habitat*

The Present Ecological State of this habitat is *Moderately Modified* and that is why some natural trees still exist on this type of a habitat. Species composition had slightly been transformed due to livestock grazing. However, this habitat has the great potential to support biodiversity of the Project Site.

g) *Invasive Alien Species*

No invasive alien species was recorded from this habitat of the project site.

5.4. Mammals of Malawi

About 190 species of mammals (Ansell & Dowsett, 1988; Chitaukali, 2005) have been recorded for Malawi. Of these, 8 species representing 4.1% are threatened (Hilton-Taylor (IUCN) 2000). According to the IUCN 2000 report, Malawi has 8 threaten mammal species. One Critically Endangered, 2 Endangered and 5 Vulnerable. In descending order, these species are *Diceros bicornis* (Black rhino), *Loxodonto africana* (African Elephant), *Lycaon pitus* (Wild Dog), *Rhynchocyon cirnea* (Checkered Sengi), *Acinonyx jubatus* (Lion), *Panthera leo* (Lion), *Paraxerus palliates* (Red Bush Squirrel) and *Lutra amculicollis* (Spotted-Necked Otter). No endemic mammal species have been recorded in Malawi (Chitaukali, 2005).

5.4.1 Mammal Species of the Study area

(a) Species Composition

During the fieldwork, no single mammal was recorded from the project site. However, it was reported by local communities living around the Project Site that were interviewed that the following mammal species, presented in Table 1-6 below occur on the Project Site.

Table 1-6: Summary of mammal species reported to occur on the Project Site

Name	Status	Habitat encountered/Reported
Acomys spinosissimus (Rodent)	VC	Secondary Mixed Deciduous Woodland, Cultivated land
Lophuromys flavopunctatus (Mouse)	VC	Secondary Mixed Deciduous Woodland, Cultivated land
Mus triton (Mouse)	VC	Secondary Mixed Deciduous Woodland, Cultivated land
Mus musculus (Mouse)	C	Secondary Mixed Deciduous Woodland, Cultivated land
Crocuta crocuta (Spotted Hyena)	C	Secondary Mixed Deciduous Woodland, Cultivated land
Lepu saxatilis (Scrub Hare)	C	Secondary Mixed Deciduous Woodland, Cultivated land
Hystrix africaeaustralis (Cape porcupine)	C	Secondary Mixed Deciduous Woodland, Cultivated land
Sylvicapra grimmia	R	Secondary Mixed Deciduous Woodland

Legend: VC = Very common, C = Common, R = Rare

(b) Abundance

No trapping took place in this study, so no quantitative statement of mammal abundance can be made. The most abundant mammals on the Study site were those associated with cultivation of crops (e.g. mouse and rats) and a few species associated with Secondary Mixed Deciduous Woodland (e.g. Scrub hare).

(C) Present Ecological State

The low representation of typical woodland mammals and lack of resident large mammals attributed to hunting and loss of habitats indicate that the Present Ecological State of the woodland was *Considerably Modified* due to deforestation for charcoal production, firewood collection and continued subsistence farming.

(d) Threatened and Endemic Species

There were no either threatened or endemic species of mammals recorded from and/or reported to occur on the Project Site. Similarly, no threatened or endemic mammal species from the Study site were recorded in documents that were reviewed during this study. Nonetheless, because of lack of primary and thick secondary vegetation communities in the proposed project area, the site is considered to be of *LOW* conservation importance for both large and small mammals.

(e) Species of CITES List

No species of mammals that are on CITES list either of Appendix I, II or III were recorded from the Project Site during the field work (CITES, 2017).

(g) Alien Mammal Species

Three alien mammal species namely; *Bos taurus* (cattle), *Capra aegagrus hircus* (goat) and *Ovis aries* (sheep) were recorded from the Project Site during the survey.

5.5 Birds of Malawi

Malawi has approximately 650 species of birds. Of these, 107 are non-breeding migrants or vagrants, leaving more than 450 species which breed in the country. There are 7 species listed as threatened for Malawi and 12 species of conservation concern (BirdLife International, 2004). There are 4 endemic subspecies that have been recorded in country (Kaliba, 2005).

5.5.1 Bird Species of the Study area

(a) Species Composition

A total of thirteen (13) bird species of was recorded from the Study area during the field survey. Of these, 59 species were identified during the field survey while 7 were reported to occur in the Study area by local communities. The ten most abundant bird species that were identified and/or reported by local communities are presented in Table 1-7.

Table 1-7: Summary of bird species recorded from and reported to occur on the Proposed Project Site

Name of Species	Status	Habitat encountered/Reported
Phyllastrephus flavostriatus (Yellow-streaked Bulbul)	C	Secondary mixed deciduous woodland, Cultivated land

Phyllastrephus placidus (Placid Bulbul)	C	Secondary mixed deciduous woodland, Cultivated land
Nectarinia olivacea (Olive Sunbird)	VC	Secondary mixed deciduous woodland
Nectarinia talatala (White-bellied Sunbird)	VC	Secondary mixed deciduous woodland
Uraeginthus angolensis (Blue Waxbill)	C	Secondary mixed deciduous woodland
Serinus gularis (Streaky-headed Canary)	VC	Secondary mixed deciduous woodland
Anthreptes collaris (Collared Sunbird)	C	Secondary mixed deciduous woodland
Streptopelia capicola (Cape Turtle Dove)	C	Secondary mixed deciduous woodland
Threskiornis aethiepicus (Scared Ibis)	R	Seasonal wetland
Numida meleagris (Helmeted Guinea fowl)	R	Secondary mixed deciduous woodland, Cultivated land, Seasonal wetland
Quelea quelea (Red headed Quelea)	VC	Secondary mixed deciduous woodland, Cultivated land, Seasonal wetland
Francolinus afer (Red-Necked Francolin)	R	Secondary mixed deciduous woodland, Cultivated land, Seasonal wetland
Bubo lacteus (Giant eagle Owl)	C	Secondary mixed deciduous woodland

Legend: VC = Very Common, C = Common, R = Rare

(b) Abundance

The most abundant species according to the standardized count data were Yellow-breasted Bulbul, Placid Bulbul, Olive Sunbird, and White-bellied Sunbird among other (Table 1-7). More intensive sampling around cultivated lands would have resulted in other seed-eating species being indicated as abundant, e.g. Pin-tailed Whydah.

(C) Present Ecological State

The strong dominance of generalist woodland species and paucity of closed-canopy Zambezian woodland endemics indicates a *Moderately to Considerably Modified* woodland bird community (Category C and D), and a *Moderately Modified* grassland bird community (category C) on seasonal wetland.

(d) Threatened and Endemic Species

No threatened bird species was recorded within the proposed Project Site (Table 1-7) according to the National and IUCN Red list.

(e) Species of CITES List

No species of birds recorded from the proposed Project Site are on CITES list either of Appendix I, II or III (CITES, 2017).

(g) Alien Species

No alien bird species was spotted and/or recorded from the Study area during the survey. In addition, no alien bird species had been reported to occur in the Study area by other researchers.

5.6 Reptiles of Malawi

There are about 145 species of reptiles in Malawi. There are 3 endangered species of reptiles in Malawi.

5.5.1 Reptile Species of the Study area

(a) Species Composition

No species of reptiles were recorded from the proposed Project Site during the survey. However, it was reported by local communities during the interviews conducted that the following species shown in Table 1-8 occur on the Project Site. In total five (5) species of reptiles were reported by local communities to occur on the Project Site.

Table 1-8: Summary of Reptile species reported to occur on the proposed Project Site

Name of Species	Status	Habitat encountered/Reported
Python natalensis (Lesser African Python)	R	Secondary mixed deciduous woodland, Cultivated land
Dendroaspins polylepis (Black mamba)	R	Secondary mixed deciduous woodland, Cultivated land
Ophiophagus hannah (King cobra)	R	Secondary mixed deciduous woodland
Bitis arietans (Puff Adder)	R	Secondary mixed deciduous woodland
Ahaetulla nasuta (Vine snake)	C	Secondary mixed deciduous woodland, Cultivated land
Chamaeleo chamaeleon (Common chameleon)	C	Secondary mixed deciduous woodland, Cultivated land

Legend: VC = Very Common, C = Common, R = Rare

(b) Abundance

The most abundant species according to the results of the interviews were *Ahaetulla nasuta* and *Chamaeleo chamaeleon* (Table 1-8).

(C) Present Ecological State

Low species diversity of reptiles indicates a *Considerably Modified* woodland (Category D), and hence cannot support more species of reptiles.

(d) Threatened and Endemic Species

No threatened reptile species was recorded within the proposed Project Site (Table 1-8) according to the National and IUCN Red list.

(e) Species of CITES List

Two species of reptile (*Python natalensis* and *Bitis arietans* which are on CITES list either of Appendix II (CITES, 2017) were reported to occur on the proposed Project Site are

(g) Alien Species

No alien reptile species was spotted and/or recorded from the Study area during the survey. In addition, no alien reptile species had been reported to occur in the Study area by other researchers.

5.6 Amphibians of Malawi

There are about 83 species of reptiles in Malawi. Some of these species are threatened while others are endemic to Malawi.

5.6.1 Amphibian Species of the Study area

(a) Species Composition

A total of 4 species of amphibians was recorded from the proposed Project Site during the survey. These species are shown in Table 1-9 below.

Table 1-9: Summary of Amphibian species reported to occur on the proposed Project Site

Name of Species	Status	Habitat encountered/Reported
Hyperolius pictus (Reiche's Squeaker)	R	Secondary mixed deciduous woodland, Cultivated land
Sclerophrys garmani (Garman's toad)	R	Secondary mixed deciduous woodland, Cultivated land
Sclerophyrs gitturalis (Guttural toad)	R	Secondary mixed deciduous woodland
Afrixalus delicatus (Delicate Spiny Reed Frog)	R	Secondary mixed deciduous woodland, Seasonal Wetland and Cultivated land

Legend: VC = Very Common, C = Common, R = Rare

(b) Abundance

The most abundant species that was encountered several times in both Secondary Mixed Woodland and Cultivated land was *Sclerophyrs gitturalis* (Table 1-9). Other species were very rare in the project site.

(C) Present Ecological State

Low species diversity of amphibian indicates a *Considerably Modified* habitat (Category D), and hence cannot support more species of amphibians.

(d) Threatened and Endemic Species

No threatened amphibian species was recorded within the proposed Project Site (Table 1-8) according to the National and IUCN Red list.

(e) Species of CITES List

No species of amphibian recorded from the Project Site was on CITES list either of Appendix II (CITES, 2017).

(g) Alien Species

No alien species was spotted and/or recorded from the Study area during the survey. In addition, no alien reptile species had been reported to occur in the Study area by other researchers.

5.7 Ecosystem Services of the Project Site

Ecosystem Services are the benefits that people derive from the ecosystem of the Project site. Besides provisioning services or goods like food, wood and other raw materials, plants, animals, fungi and micro-organisms provide essential regulating services such as pollinating crops, prevention of soil erosion and water purification, and a vast array of cultural services, like creation and a sense of place (Millennium Ecosystem Assessment, 2016).

During the field survey, various ecosystem services belonging to different categories were physically observed and also reported by local communities during the public consultations. Table 1-10 presents some of the ecosystem services that were present or occurring on the proposed project site.

Table 1-10: Ecosystem Services Offered and/or Found at the Proposed Project Site at Golomoti

ECOSYSTEM SERVICE	EXPLANATION
PROVISIONING ECOSYSTEM SERVICES	
Food crops	There are a number of cultivated food crops such as maize, groundnuts, cucumber, water melon, sorghum, finger millet, okra, cow peas, pigeon peas

	and others that are grown on the project site each year. These food crops are harvested by subsistence farmers for consumption and income.
Edible wild and exotic fruit trees	The project site is also a home to some wild and exotic fruit trees such as *Vitex payos*, cucumber, mangoes, *Annona senegalensis* (Mpoza), *Azanza garckeana* (Matowo), *Adansonia digitata* (Malambe) and *Ximenia caffra* which are harvested by local communities living around the Project site for food and income.
Livestock grazing land	The seasonal valleyhead wetland is used for livestock (cattle and goats) grazing. It was reported by communities that the project site support over 80 livestock that feed on grasses found on this seasonal wetland.
Bush meat	Wild animals that are hunted from the project site for bush meat include mice, common hare and birds. These animals are sources of proteins to local communities living around the project site.
Fuelwood	Some trees especially the exotic species are harvested for fuelwood for cooking.
Thatch grass	The project site has some thatch that communities harvest for thatching their houses.
Natural medicine	Some species of flora found on the project site are harvested by local communities for traditional medicine used to cure various illnesses.
Feeding and nesting ground for Sacred ibis and livestock	The project site has a seasonal wetland on the east, which is used as feeding and nesting ground for Sacred ibis and livestock.
REGULATING ECOSYSTEMS	
Regulation of water flows	The wetland grasses and sedges found on the eastern side of the project area are important in regulating floods.
Soil erosion control	The project site has grasses and which are important in prevention of loss of soil.
Regulation of soil quality	Tree species such as *Faidherbia albida* are kept by farmers a source of nitrogen in the soil. It was estimated that the project site has over 50 mature individual species of *Faidherbia albida*, which must be restored when cleared during the project implementation
Pollination of crops	The project site a good number of insects such as butterflies and bees which pollinate agricultural crops on the project site.
CULTURAL ECOSYSTEM SERRVICES	
Ethical values	The project site has some trees such as *Faidherbia albida* whch ethically influence peoples' desire to protect them as they fix nitrogen in the soil.
SUPPORTING ECOSYSTEM SERVICE	
Biodiversity maintenance	The project site has the potential to support biodiversity such as trees, small mammals, amphibians, reptiles, insects and birds.
Primary Production	The project site maintains formation of biological materials through photosynthesis and nutrient assimilation

5.7.1 Prioritization of Ecosystem Services

Ecosystem Services (ES) that were assessed on the project site were prioritized using the logical framework adapted from WRI are presented in Table 1-11.

Table 1-11: Prioritization of Ecosystem Services of the Project Site

Description of ES	Likely Impact	Importance to Beneficiaries	Replaceability	Prioritisation Result
Brief description of important attributes	Yes/No: Explanation of why ES will/will not be impacted	Yes/No: Explanation of why ES is/is not important	Yes/No: Explanation of availability/non-availability elsewhere	Priority/Non priority ES to the people/ecosystem
PROVISIONING ECOSYSTEM SERVICE				
Crops cultivated at the project site are source of food and income	Yes, the project will have impact on peoples' livelihoods due to turning of agricultural into industrial land	The crops cultivated such as *Zea mays, sorghum bicolor, Sorghum dochna, Arachis hypogaea, Gossypium arboretum,* etc are sources of food and income to farmers	Yes, some crops of similar varieties are found elsewhere and can be cultivated elsewhere if another piece of land is bought for displaced farmers	Non-priority ES
Wild and exotic fruit trees	Yes, the project will have impact on peoples' livelihoods due to turning of agricultural into industrial land	Wild plant fruits such as *Ximenia Americana, Vitex mombasae* found at the project site are source of food to communities around	Yes, the wild plant fruits can planted elsewhere and are also commonly found in other farmlands and bush areas nearby	Non-Priority ES
Livestock grazing land	No, the project will not have negative impact on livestock	There is another area such as Msamala hill on the western side where livestock can be grazed	Another potential grazing area is available where farmers can take their livestock to for grazing	Non-priority ES
Bush meat	Yes, the project will somehow have impact on peoples' lives as the project site is source of bush meat.	The birds, mice and grasshoppers found at the project site are also found in other areas around this project site	Yes, the birds, mice and grasshoppers can migrate to adjacent areas where they can seek refuge during the construction	Non-priority ES
Fuelwood	No, the project will not contribute to the scarcity of fuelwood in the area	Yes, the fuelwood of the project is important to the communities,	There are plenty of trees in adjacent areas of the project site and more trees	Non-priority ES

Description of ES	Likely Impact	Importance to Beneficiaries	Replaceability	Prioritisation Result
Brief description of important attributes	Yes/No: Explanation of why ES will/will not be impacted	Yes/No: Explanation of why ES is/is not important	Yes/No: Explanation of availability/non-availability elsewhere	Priority/Non priority ES to the people/ecosystem
		especially old women and young girls from surrounding villages.	for fuelwood can be planted at households.	
Thatch grass	Yes, clearing of grass such as *Hyparrhenia rufa, Panicum maximum, Melinis repens* to pay way for the construction of the project will have impact on people	Grass is used for thatching houses and livestock houses but is also sold for income by villagers	Yes, the thatch grass is also found on other customary lands found in the project area and on Kirki Range Mountain and Msamala hill which can be alternative sources of this ES	Non-priority ES
Natural medicine	Yes, the project will have impact on people due to loss of some medicinal plants	Medicinal plants are used to treat various illnesses at local level	Yes, the medicinal plant species found on the project site are also found in other agricultural and woodlands found around the project area	Non-priority ES
Seasonal wetland is feeding and nesting ground for Scared ibis and livestock	Yes, the project will have impact on the migratory bird and livestock due to loss of wetland	The seasonal wetland is important because it provides feeding and nesting ground for Sacred ibis and livestock	Yes, the seasonal wetlands are also found in other places within the Project site and along the Lake Malawi	Non-priority ES
REGULATING ECOSYTEM SERVICE				
Regulation of water flows	Yes, the project will have impact on regulation of water flows especially during rainy season due to clearing of the seasonal wetland	The seasonal wetland grasses such *Urochloa mosambicensis,* etc. regulate flow of water so that the water is not flooding which can be detrimental to lives and livestock	No, it is not possible to replace it.	Priority ES

Description of ES	Likely Impact	Importance to Beneficiaries	Replaceability	Prioritisation Result
Brief description of important attributes	Yes/No: Explanation of why ES will/will not be impacted	Yes/No: Explanation of why ES is/is not important	Yes/No: Explanation of availability/non-availability elsewhere	Priority/Non priority ES to the people/ecosystem
Soil erosion control	Yes, clearing of grasses on the project site will have impact on soil erosion	Clearing of grasses from the project site will not be of any benefit to farmers as fertile soil will get lost	Yes, it is possible to replace the loss of grasses through planting	Non-priority ES
Regulating of soil quality	Yes, cutting down of plants on the project site will have impact on quality of soil	Clearing of plants from the project site will affect the quality of soil on the project site and beyond	Yes, it is possible to replace plants to be cut down by planting them in adjacent areas	Non-priority ES
Pollination of crops	Yes, clearing of the project site will have impact on pollinating insects such as butterflies, bees	Pollinating insects are important for production and productivity of crops	Yes, it is possible to replace plants which are homes to insects to be lost during the construction by planting	Non-priority ES
CULTURAL ECOSYSTEM SERVICES				
Ethical values	Yes, the project will have impact on ethical values of communities	Clearing of plants such as *Faidherbia albida* and other trees that farmers protect because of their social value will have impact on ethical values of the people	Yes, it is possible to replace them and a lot of similar species are found on cultivated farmlands in the district	Non-priority ES

6. ASSESSMENT OF ENVIRONMENTAL IMPACTS ON BIODIVERSITY

6.1 Impact Assessment Methods

An “environmental matrix” (Table 1-13) and professional judgement were used to identify the potential environmental impacts of the proposed project on biodiversity. Potential sources of impacts from the project activities during planning and design, construction and operation were identified with reference to the biological components to be impacted. The impacts presented in subsequent sections were determined based on the following information:

- Technical aspects of the project: This enabled the identification of potential sources of impacts, based on the analysis of the technical characteristics of the infrastructures to be built, as well as the construction activities, methods and schedule.
- Environmental and socio-economic baseline data (environmental and social components): This information facilitated understanding of the biophysical, social and economic contexts in which the project will be implemented and identification of issues that should be considered. The environmental and social components; and
- Issues and concerns raised by relevant stakeholders and project affected persons (PAPs): These issues from stakeholder consultations assisted in identification of the main concerns and potential impacts related to the project.

Table 1-13: Example of Identification Method of Environmental Impacts Matrix on Biodiversity Species

Proposed Project Activities	Biological Components				
	Terrestrial flora	Terrestrial fauna	Terrestrial ecosystem	Aquatic ecosystem	Habitats
Land demarcating/pegging	x				x
Land clearing					
Right of Way (ROW) to substation pegging	x	x	x	x	x
Clearing of a Right of Way (ROW)	x	x	x	x	x
Erection of power lines	x	x			x
Construction of access roads	x	x	x	x	x
Construction of Campsites and Workshops	x		x	x	x
Waste management	x	x	x	x	x
Influx of job seekers	x	x	x	x	x
Maintenance of Right of Way (ROW)	x	x			x
Decommissioning phase					
Demolition and dismantling of structures (e.g. campsites & workshops)	x	x	x	x	x
Disposal of materials	x	x	x	x	x
Site restoration	x	x	x	x	x

6.1.1 Project Potential Impacts Identified

The following are the potential impacts of the proposed project on biodiversity of the project site:

- Loss or destruction of habitats for fauna and flora;
- Loss of flora species;
- Loss of fauna (small mammals, birds, reptiles and amphibians);
- Loss of threatened and endemic flora and fauna; and

- Loss or reduction of Ecosystem Services (ES) of the Project Site.

6.2 Impacts Rating and Evaluation

Potential environmental impacts of the proposed project on flora and fauna species, ecosystem services and habitats were evaluated using the Government of Malawi EIA Guidelines for Energy Generation and Transmission Projects as follows:

M = Magnitude or Scale: 1 = site only; 3 = within 3-5 km; 5 = regional;
D = Duration: 1 = short-term; 2 = medium-term; 4 = long-term; 5 = very long-term;
P = Probability: 1 = not likely to occur; 3 = likely to occur; 5 = very likely to occur.
S = Significance: 1 = low; 2 = moderate; 3 = high; 4 = very high; 5 = unknown.

6.3 Significance Rating of the Identified Potential Impacts on Biodiversity and ES

The potential environmental and social impacts were assessed and the significance ratings before the mitigation measures are applied are as presented in Table 1.14.

Table 1.14: Impact significance rating before and after the mitigation measures are applied

ID	Potential Environmental impacts o Biodiversity and Ecosystem Services	Severity	Reversibility	Duration	Areal Extent	Environmental Context	Probability	Total	Significance without mitigation/ enhancement	Significance with mitigation/ enhancement
1.	POTENTIAL IMPACTS									
1.1.	Construction Phase									
1.1.1.	Planting of indigenous side adaptive tree seedlings in vicinity of project site	5	3	4	2	5	4	23	Moderate	Very High
2.	NEGATIVE IMPACTS									
	Construction Phase									
2.1	Loss or destruction of habitats for fauna and flora	5	3	2	2	5	5	22	Very High	Very Low
2.2	Loss of threatened and endemic flora and fauna	1	1	1	1	1	1	6	Very Low	Low
2.3	Loss of flora species	5	3	2	2	4	3	19	Very High	Very low
2.4	Loss of fauna (mammals, birds, reptiles and amphibians)	4	2	2	2	4	2	16	High	Low
2.5	Loss or reduction of Ecosystem Services from the Project Site	5	2	5	5	5	5	27	Very High	Moderate

6.4 Mitigation/Enhancement Measures for the Identified Impacts

Positive Impacts

(a) **Planting site specific and adaptive indigenous trees to offset the cleared ones:** For every one tree to be cut down during the construction of the project, five trees of same indigenous species must be planted in the vicinity and/or in places earmarked for village forests. It is estimated that on average, over 600 both large and small trees will be cut down from the project site. It is thus, expected that over 3,000 indigenous trees of various species, principally *Faidherbia albida* and *Adansonia digitata* will be planted in the vicinity of the project site to offset the net loss.

Enhancement measures:

- Plant fast growing indigenous tree species which are site specific and adaptive (e.g. *Adansonia digitata, Faidherbia albida,* etc;
- Avoid and/or minimize encroachment of areas not earmarked for the project;
- Manage planted tree seedlings until they reach reasonable size that they can sustain themselves; and
- Train Village Natural Resources Management Committees in tree seedlings raising and management.

Potential Negative Impacts

(a) **Loss or destruction of habitats for fauna and flora:** Clearing of vegetation for construction of the solar power plant, access and service roads is likely to result in destruction of habitats for fauna and flora. Excavation and compaction of soils may result in loss of habitats for species of small mammals, reptiles and amphibians. This may eventually compromise the survival of soil-based micro and macro-biodiversity that occur on the proposed project site.

Mitigation measures:

- Ensure that vegetation is selectively cleared from the project site and excavations are undertaken as per designs to avoid unwarranted clearing of vegetation;
- Rehabilitate affected land by tilling the soils to facilitate natural regeneration of vegetation from saplings and soil seed banks;
- Plant indigenous site specific and adaptive tree seedlings and grass immediately after the construction works to ensure restoration of lost flora; and
- Ensure that seasonal wetland grasses that are found on the eastern part of the project site are not completely cleared away.

(b) **Loss of flora and fauna species from the project site:** Clearing of vegetation from the project site to pave way for the construction of the solar power plant, access and service roads is likely to result in loss or reduction of flora and fauna species that occur on the project site. This may eventually result in loss of natural scenery and livelihoods for the local communities.

Mitigation measures:

- Ensure that vegetation is selectively cleared from the project site and excavations are undertaken as per designs to avoid unwarranted clearing of vegetation;
- Rehabilitate affected land by tilling the soils to facilitate natural regeneration of vegetation from saplings and soil seed banks;
- Plant indigenous site specific and adaptive tree seedlings and grass immediately after the construction works to ensure restoration of lost flora; and
- Ensure that seasonal wetland grasses that are found on the eastern part of the project site are not completely cleared away.

(c) **Loss or reduction of Ecosystem Services (ES) from the project site:** Clearing of vegetation from the project site for the construction of the solar power plant, access and service roads is likely to result in loss or reduction of biodiversity ecosystem services that occur at the project site. This may eventually result in loss of livelihoods and habitats for fauna, birds and flash floods which can cause loss of life and peoples' property.

Mitigation measures:

- Ensure that vegetation is selectively cleared from the project site and excavations are undertaken as per designs to avoid unwarranted clearance of vegetation;
- Rehabilitate affected land by tilling the soils to facilitate natural regeneration of vegetation from saplings and soil seed banks;
- Plant indigenous site adaptive tree seedlings and grass immediately after construction works to ensure restoration of lost flora;
- Ensure that seasonal wetland grasses that are found on the western part of the project site are not completely cleared away;
- Prohibit workers from disturbing the seasonal wetland through complete clearing of vegetation and constructing campsites and maintenance vehicle works on this habitat.

7. CONCLUSION

The biodiversity baseline study conducted has established that the project site has a number of both indigenous and cultivated plant species, small mammals, birds, reptiles and amphibians, including other species such as butterflies and grasshoppers. There are also a number of Ecosystem Services (ES) that the proposed project site provides to both biodiversity species and local communities living around the project site.

It has been determined that the biodiversity species and ES of the project area will be negatively impacted by the project activities. Some of the impacts include loss of habitats for biodiversity species, loss of flora and fauna species through clearing and excavation of the project area, and loss of ecosystem services that support life and the integrity of the habitats.

In this regards, a number of practical mitigation and/or enhancement measures have been developed to guide the Client and the Contractor so that the aforesaid impacts are avoided and/or minimized to acceptable threshold levels. This will ensure environmental sustainability.

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Introduction

Environmental Resources Management (ERM) has been retained by Power Engineers, Inc. (Power Engineers) to conduct an Environmental and Social Impact Assessment (ESIA) for the proposed 20 to 40 megawatt (MW) solar power plant with the option of an energy storage system in the Republic of Malawi (the Project). The Project is being developed by Golomoti JCM Solar Corporation Limited (JCM), a subsidiary of JCM Power.

ERM is conducting the ESIA as part of a larger Feasibility Study being conducted by Power Engineers. Power Engineers is conducting the Feasibility Study under a grant from the United States Trade and Development Agency (USTDA). The USTDA requires that all work under the grant is conducted by residents of the United States and the host country, in this case Malawi. Residents of other countries cannot work on the Feasibility Study or ESIA.

The ESIA will be submitted to the Environmental Affairs Department (EAD) and must therefore comply with Malawi's laws and regulations. Since the ESIA is being funded by the USTDA, however, it must also align with international lender standards, specifically, the International Finance Corporation (IFC) Performance Standards on Environmental and Social Sustainability (2012).

PROJECT AREA

The solar plant will be constructed on a 91.605 hectares (ha) site (Solar Plant Site) located between Latitudes 14° 20'S and 14° 30'S; Longitude 34° 30' E and 34° 40' E and approximately 0.5 km from the Golomoti Substation and less than 1 km from Golomoti Trading Centre in Ntcheu District (Figure 1), within the Masasa Traditional Authority. The Project will also include the construction of a short (approximately 0.5 km) transmission line from the Solar Plant Site to the Golomoti Substation, as well as a short access road or roads extending from the highway to the northeast (M5) and/or from the existing Golomoti Substation access road. For the purposes of this SOW, the Project Area includes the Solar Plant Site, the transmission line corridor, and the two potential access roads.

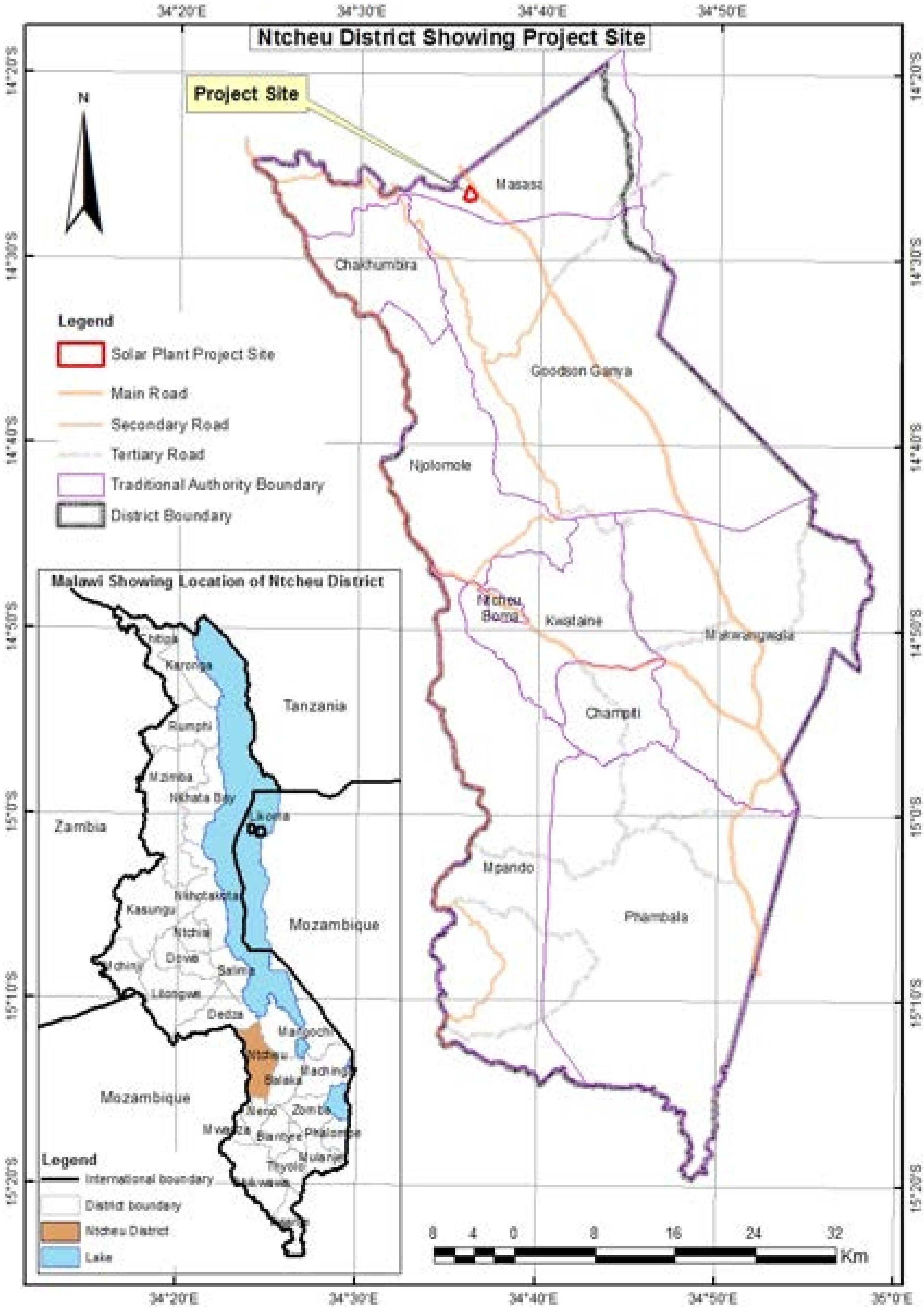

Figure1: Location of the Project Area

Main Objective

To conduct Biodiversity Survey within the Solar Plant Site and its surrounding

Specific Objectives

- To describe habitats and/or vegetation cover types in the Project Area.
- To create habitat map, using the satellite imagery of the Project Area to be provided by ERM as a base map, supported by photographs of plant species and animal species observed in the Project Area and the immediately surrounding vicinity.
- To confirm and identify habitat types and trees previously identified by satellite imagery. Of special interest is confirmation of the presence and distribution of Baobab trees (*Adansonia digitata*).

Methodology

A series of site walkovers was conducted to confirm the vegetation types and tree species of special interest in the project area using a handheld GPS. Field observations were made and have been used to verify and update the base map accordingly.

The base map involved integration in GIS of thematic layers acquired from the department of Surveys including land use data. The Satellite Imagery coupled with field observations were used to update the content from the thematic maps where the latter was considered out of date. For example, the latest land use map for the project Area does not show the Baobab trees grave yard and the Substation which can only be seen on Satellite data and through field observations.

Data Processing

The final maps are a product of desktop work (base maps) integrated with field observations. The GPS points were overlaid on the base maps and the recorded attribute information was useful for verification and updating of the final maps. The maps for the project area are presented and described below:

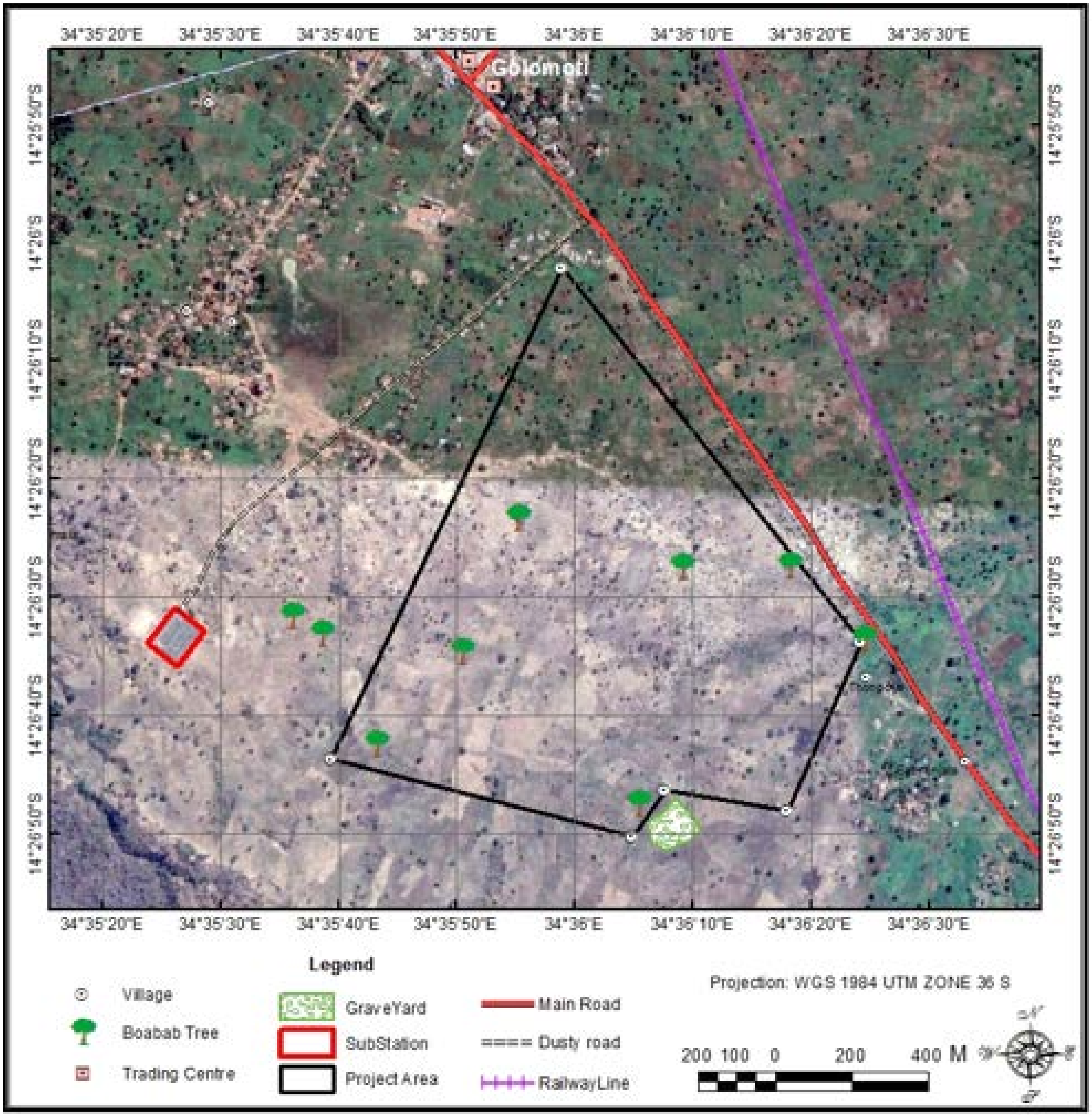

Figure 2: Base Map of the Project Area

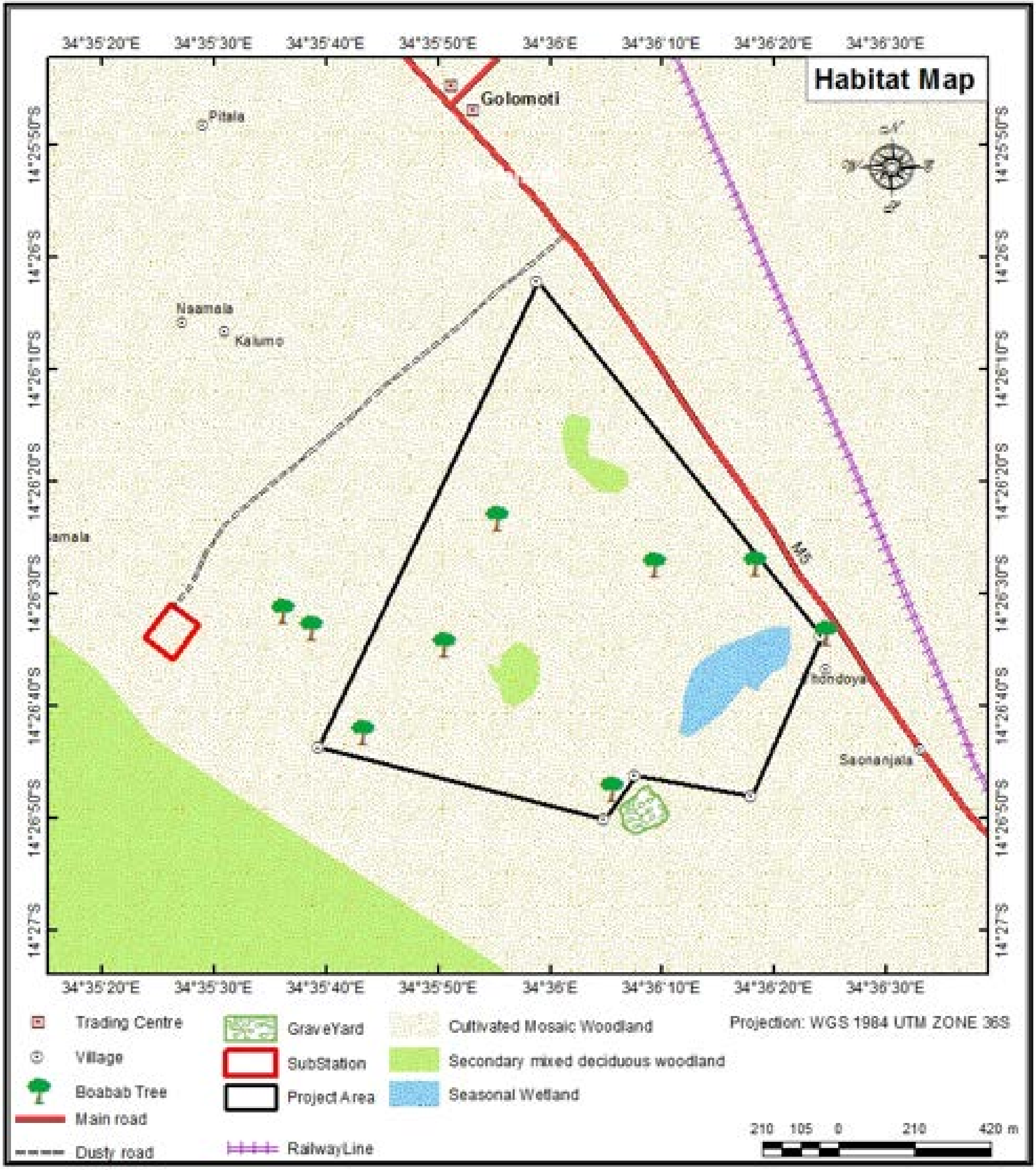

Figure 3: Habitat Map of the Project Site

Results

From a series of the field walkovers in the project site and its vicinity, it can now be confirmed that the area generally has an agriculture land with Maize and Cotton as the major crops currently being cultivated. Fewer areas along the M5 road are characterized by the regeneration of savanna woodland in a cultivated land. Of special interest is the presence of some Baobab trees in the project area. It has also been observed that the habitats north-western and south-eastern parts of the project area are mainly homestead and cultivation.

It has been observed that the project Site lies in the area of traditional Authority Masasa in Ntcheu district and not in Dedza as described under the area by the client

APPENDIX F CULTURAL HERITAGE BASELINE REPORT (WWEC)

April 2019

GOLOMOTI BASELINE CULTURAL HERITAGE IMPACT ASSESSMENT REPORT

April, 2019

EXECUTIVE SUMMARY

An identified site in Golomoti has the potential for setting up a Solar Power Plant project; comprising of solar panels and supporting structures, the associated transmission line and two potential access roads. The project, which is proposed for development at Golomoti, by JCM Solar Corporation Limited (JCM), a subsidiary of JCM Power has the potential to impact on the cultural heritage of the site, covering 91.605 hectare (ha).

As a requirement by the Malawi Government and International Best Practices, the project feasibility study has incorporated an Environmental and Social Impact Assessment, where the Cultural Heritage assessment is a component. The preliminary cultural impact assessment commenced to identify archaeological resources (sites and isolated features and artefacts); built heritage (i.e., historic buildings and structures); and the cultural significance of the site to local communities (Living Heritage). The methodology applied Cultural Heritage survey included desk review, ethnographic patterns and a survey on the site and the surrounding areas.

The scope of the work focused on the fulfilment of all the legal requirements that safeguard the cultural resources of Malawi (i.e. the Monuments and Relics Act and the Cultural Policy) and the international standards to which Malawi is a signatory to the World Heritage Convention. This gave a clear outline for the resources to be identified and valued, the potential impacts on the resources by the project activities and the mitigation measures to safeguard the resources. The assessment provided an insight on the significance of the site, tangible and intangible resources to be potentially affected.

Baobab trees in the proposed project area have significance on the living heritage and archaeological heritage. The trees have been used for burial. Other than the past relevance of the baobab trees, nothing was highlighted on the current significance of the proposed site which is predominantly used for agricultural fields.

Current, the occupants of the villages around the proposed project site have no recollection with the earlier inhabitants. Other findings from the survey include; remains of homesteads; iron working site and clusters of pottery. The pottery can be relatively dated within 1200 to 1750 AD. The site also has the potential to illuminate on the Malawi’s prehistory, on the expansion of the Maravi Kingdom. These findings highlight the significance of the site and further research can validate the assumption. The mitigation proposed is a rescue archaeology which would aid in safeguarding the cultural resource for Malawi on the proposed site.

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1. INTRODUCTION

The Environmental and Social Impact Assessment (ESIA) is in view of the proposed 20 to 40 megawatt (MW) solar power plant proposed for development developed at Golomoti by JCM Solar Corporation Limited (JCM), a subsidiary of JCM Power. The solar power plant will contribute to the generation and availability of electrical energy for the Republic of Malawi. Power Engineers is conducting the Feasibility Study under a grant from the United States Trade and Development Agency (USTDA).

The Project components include the solar power plant, the transmission line and two potential access roads, which can have an impact on the cultural heritage of the site covering 91.605 hectare (ha). Water Waste and Environment Consultants have been sub-contracted to conduct the baseline survey, including an assessment of the cultural heritage impact of the project, as part of the prefeasibility study.

This report presents the potential cultural heritage that may occur in the project area and identifies potential impacts that may result from the proposed clearing and construction activities. The report further provides recommendations for a comprehensive cultural heritage impact assessment to be conducted at a later stage as a mitigation measure in safeguarding the cultural resources on the site.

1.1. Description of Site

The site is located at edge of the boundary between Dedza and Ntcheu district with two ethnically distinct groups occupying the cultural ecological landscape. The proposed site is in Dedza (see map in figure 1) which Golomoti and the villages surrounding the site are predominantly of Ngoni ethnic affiliations. The villages across the boundary settled later than those in the villages around the site. From the preliminary analysis of the site, the earlier inhabitants could have been Chewa with affinities to the Mankhamba Kingdom. The site is a cultural landscape with both intangible and tangible heritage. Disturbance from of the soil layers risks loose of archaeological information which is pertinent in the understanding of Chewa expansions as part of the Maravi Empire. The intangible heritage connects the respective villages that occupied the cultural landscape of Golomoti.

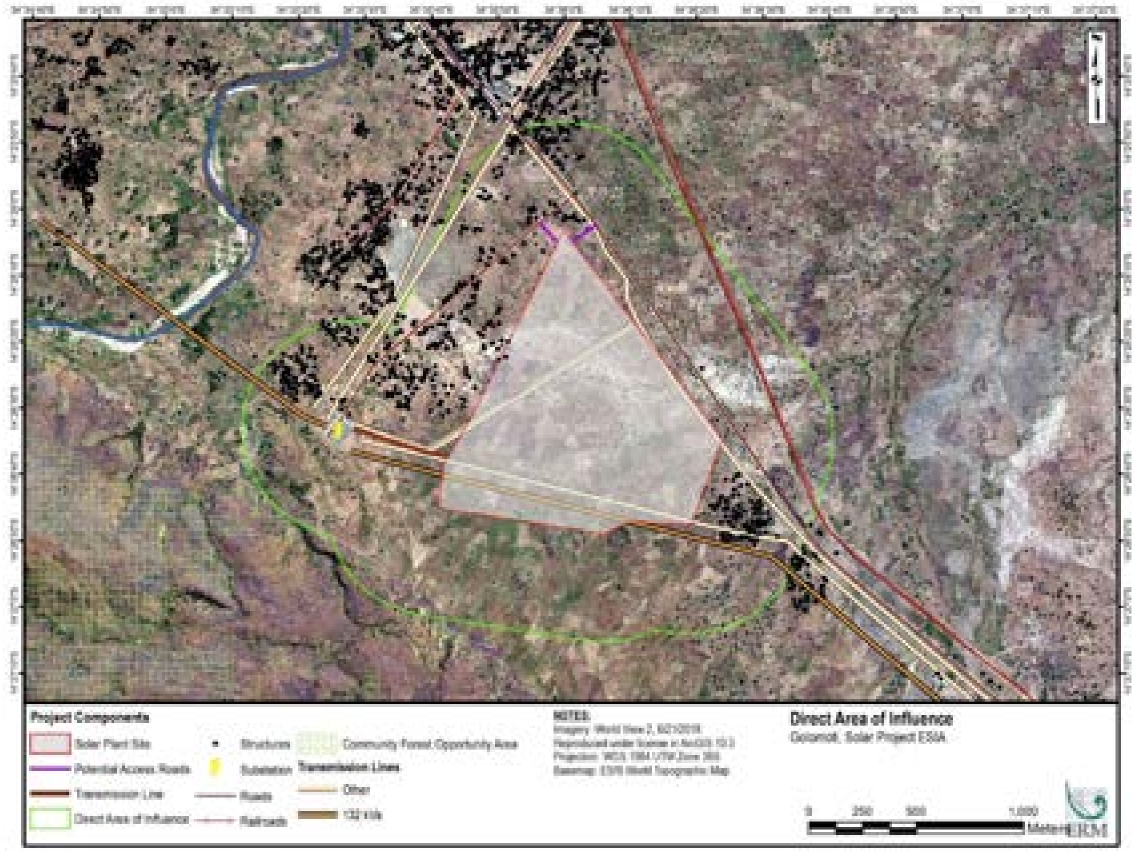

Figure 1: Map of the Golomoti Project Area (Sourced from WWEC ESIA proposal 2019)

1.2. Legal and Regulatory Framework

The survey complied with both the international and local regulations. The Malawi cultural heritage laws and regulations are mainly outlined in two legal documents i.e. Monuments and Relics Act of 1991 and the Cultural Policy (which was approved by the Government of Malawi in 2015). These two instruments clarify the legal mandate and procedures for all activities conducted for this cultural heritage survey. The Cultural policy highlights Malawi's main priority areas and this work is within the scope. Section 5.7.8, Objective 8, from the Cultural Policy requires project proponents "to take into account cultural factors in development projects, policies and programmes for the nation".

The main legal implications of the survey are from the Monuments and Relics Act, which defines culturally significant material as: cultural resources in their tangible forms, comprising both movable and immovable physical cultural heritage. The different types of cultural resource described in the Act are;

- Places, buildings and structures of cultural significance;
- Places and objects to which oral traditions are attached or which are associated with living heritage such as ethnographic art and objects ;
- Historical settlements, townscapes and sites of significance relating to the history of slavery;

- Landscapes and natural features of cultural significance;
- Geological sites of scientific or cultural importance; archaeological and paleontological sites and objects;
- Graves and burial grounds

According to the Monuments Relics Act, the activities to be done as part of an ESIA are stated in Section 29 as follow:

> Section 29.-1 states that a person in charge of any survey, excavation, exploration, construction or new development shall, at the earliest stages of planning for such activities, give notice to the Minister to enable, where necessary, rescue archaeology to be carried out in accordance with the subsection
>
> Section 29- 2 states that rescue of archaeology of a monument or relic shall be carried out by the Chief Antiquities Officer or any qualified person with an excavation permit issued by the Minister and the cost of such work shall, unless the Minister otherwise directs, be borne by the person in charge of any survey, excavation, exploration, construction or other development.

The Terms of Reference for this assignment require adherence to the policy on social and environmental sustainability of the International Finance Corporation (IFC). IFC Performance Standard 7 (Indigenous People) covers the intangible heritage and standard 8 (Cultural Heritage) deals with tangible cultural heritage. In addition, the World Bank OP 4.10 provides guidance on the adherence of the safeguard of cultural heritage.

The 1970 UNESCO Convention on the Protection of the World Cultural and Natural Heritage (World Heritage Convention, WHC) is clearly stated in the Standard 8 of IFC. Malawi is a signatory of the WHC and has to adhere to all its requirements.

2. METHODOLOGY

2.1. Terms of Reference

As part of the Environmental and Social Impact Assessment (ESIA) Baseline Field Investigations, cultural heritage survey of the Project Area has the following as the Terms of Reference:

- Identify archaeological resources (sites and isolated features and artefacts);
- Identify built heritage (i.e. historic buildings and structures); and
- Establish cultural significance of the site to local communities (living heritage)

An antiquities officer was present during the Cultural Heritage survey, to ascertain the relevance of the site, as required by the law.

2.2. Impact Assessment Methodology

In safeguarding the cultural ecological landscape of the proposed site in Golomoti, the aims of the survey included the following:

- Reviewing of existing information on the cultural heritage of the site

- Identifying and describing cultural resources
- Undertaking a field survey to collect baseline data
- Describing the values of the cultural resources
- Identifying impacts on cultural resources, of the proposed developments on the site
- Identifying mitigation measures to safeguard the identified cultural resource, from the proposed project activities.

Three respective methodologies have been applied to investigate the cultural significance of the site.

- Desk Research – literature review of archaeological landscape and ethnographic research done in areas close to the proposed site
- Ethnographic Patterns – this is in reference to both interviews done and observation from around the village and surrounding areas that have associations to the proposed site
- Survey Research – Transect walk around the site to identify possible archaeological materials

2.2.1. Desk Research

Nothing specifically on Golomoti was found in the preliminary desk research. Dedza is nonetheless rich with cultural heritage studies both anthropological and archaeological research. Past archaeological research works in Dedza have identified Later Stone Age (LSA) sites, Iron Age (IA) sites and rich rock paintings. The main documents/ research that were used for the purposes of this work which outline the archaeology of Dedza with closer affinities to Golomoti were few (Cole-King, 1973; Robinson, 1975; Mgomezulu, 1978; Juwayeyi, 2010; Boucher, 2012). A significant archaeological site close to Golomoti is Mtemankhokwe, an extensional location as part of Maravi Empire expansions. The site was excavated and reported by Juwayeyi (2010). The pottery found on the site was predominantly Mawudzu dating from 1200 to 1750. There can be a possible correlation that the sites have close affinities but this can only be verified if further research is done on the site.

2.2.2. Ethnographic Patterns

Cultural significance of the site was assessed from a brief ethnographic research in identifying any past and present memorable activities around the proposed project area. Two local key informants participated in the collection of the oral traditions and the survey. Permission was acquired from the chiefs in the area before conducting the interviews of people in the villages surrounding the site.

The sampling was done by age segmentation and one or more elderly persons were interviewed in relation to the size of the community. The elderly were purposefully sampled as custodians of the oral traditions in the area as the later generation hold little or no recollection of activities done on the site except as agricultural fields. Most of those interviewed nonetheless, did not recall much of other activities attached to the site pre-dating the agricultural fields.

2.2.3. Survey Research

As a process of identifying archaeological resources and built heritage, both surface inspection and subsurface testing were done on the proposed site, covering 91.605 hectare (ha). A systematic surface inspection by four persons[1] involved a foot traverse along the pre-defined linear transects which was spaced at systematic intervals across the survey area. Cultural materials found on the surface were recorded and nothing was collected from the site. Not much sub-surface testing (shovel testing) was done since most of the fields were still covered with crops. Only one unit was recorded but did not yield much on the understanding of the depth of the materials. The Site survey involved a complete surface inspection of the proposed project area.

2.3. Restrictions, Limitations and Gaps

Dedza is among the districts where vast archaeological research has been done with a concentration on the rock paints. LSA, IA and ethnographic research of the district is rich. The vastness of the information also highlighted the possibility that areas that surround Dedza can possibly yield relevant information, especially on the Chewa ethnic group migrations. Nevertheless, from most documents reviewed, less work has been done in and around the Golomoti area. No systematic studies have been done specifically for the Golomoti area, prior to this survey. The Department of Antiquities registry and other relevant documents have well documented information of areas (Mua and Mtemankhokwe) in the vicinity of Golomoti. The work presented on the characterisation of the cultural landscape of Golomoti is with reference to associated activities in the general surrounding areas.

The survey was restricted to areas which were visible, despite presence of the crops in the field. Manoeuvring through the fields was a problem as some of the fields were too densely covered for one to see the ground (see figure 2). Most of the site however, gave a clear view of what cultural resources are present at the site and the possible cultural landscape distribution. A clear view and proper mapping of the cultural resource distribution during months when it is cleared would yield more information.

3. GOLOMOTI CULTURAL LANDSCAPE

Golomoti cultural landscape seems to have associations with three respective ethnic groups of Yao, Ngoni and Chewa ethnic groups. Dedza is predominantly Chewa however, ethnic expansions pushed other Chewa groups from their villages and were occupied by the other ethnic groups. The Ngoni have however assimilated and borrowed most cultural beliefs and practices of the Chewa who were the original inhabitants of the area.

Currently, Golomoti is under the traditional rule of Traditional Authority Kachindamoto, who belongs to the Ngoni ethnic group; signifying the Ngoni conquerors of some of the Chewa tribe inhabited areas. The Kachindamoto reign has faced destabilizing effects from the surrounding areas due to the precariousness of the leadership in the Mtakataka area, which is dominated by 70% of Chewa and Yao villages (Boucher, 2009; Kalilangwe & Kalilangwe, 2002). The estimated

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[1] The consultant, Antiquities officer and two key informants who were briefed on what to look for. The key informants had a closer upper hand information which was handy in the field and during interviews.

time period of Ngoni settlement in the Central Region of Malawi is in the 1850s, which verifies the early inhabitants of the site to have been the Chewa. In view of the history in occupation of the areas around Golomoti, the ethnographic information presented in this report was collected from the Ngoni inhabitants while the archaeological evidence might not be of the current inhabitants but rather the early Chewa inhabitants (Boucher, 2009; Pachai, 1972). Hence, the relevance and significance of the site, with reference to the site habitation history, might be different.

3.1. Ethnographic Patterns

The usage of the site can only be remembered as far back as an early gardening field. The respondents of the interviews, to the relevance of the site, were in relation to the pots and trees that are found in the maize fields. The main oral traditions that stood out from the interviews were about the baobab trees present in the fields and an old school. Most of the younger generations did not recall any significance of the area other than mere maize field gardens. From the oral discussions on the traditions, a cave in the hills, not on the proposed site but overlooking the site, has been mentioned in association to the past usage of the site.

3.1.1. The baobab trees

Baobab trees have relevance in most South Eastern Africa, although the significance can vary between societies[2]. In Malawi, especially in the Lower Shire, rain sacrificial sites at the foot of these trees have been reported (Welling, unpublished doctoral research 2005). Others have used the caving in the tree as a burial site for people suffering from leprosy and for other burial circumstances. However, the relevance of the trees to the villages in the site location is different. The trees are given names with stories that correlate to their significance. The proposed site has three trees, namely:

- Saimba Nluzu (Muluzu)

  Saimba Nluzu literally translates into English as “do not whistle”. Oral traditions have it that the area around the tree was dangerous. There is however no conclusive knowledge of what exactly made the place around the tree dangerous. Other things mentioned include that there was a possibility that the area was inhabited by either spirits, snakes, wild animals, and/or thieves. It is said that, no one was to make noise, or whistle when going past the tree, to avoid being attacked by those mentioned above. Figure 2a, b and c are pictures of the tree, both outside and inside the tree.

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[2] https://www.gounesco.com/malawi-baobab/ highlights the spiritual significance of baobab trees in Malawi

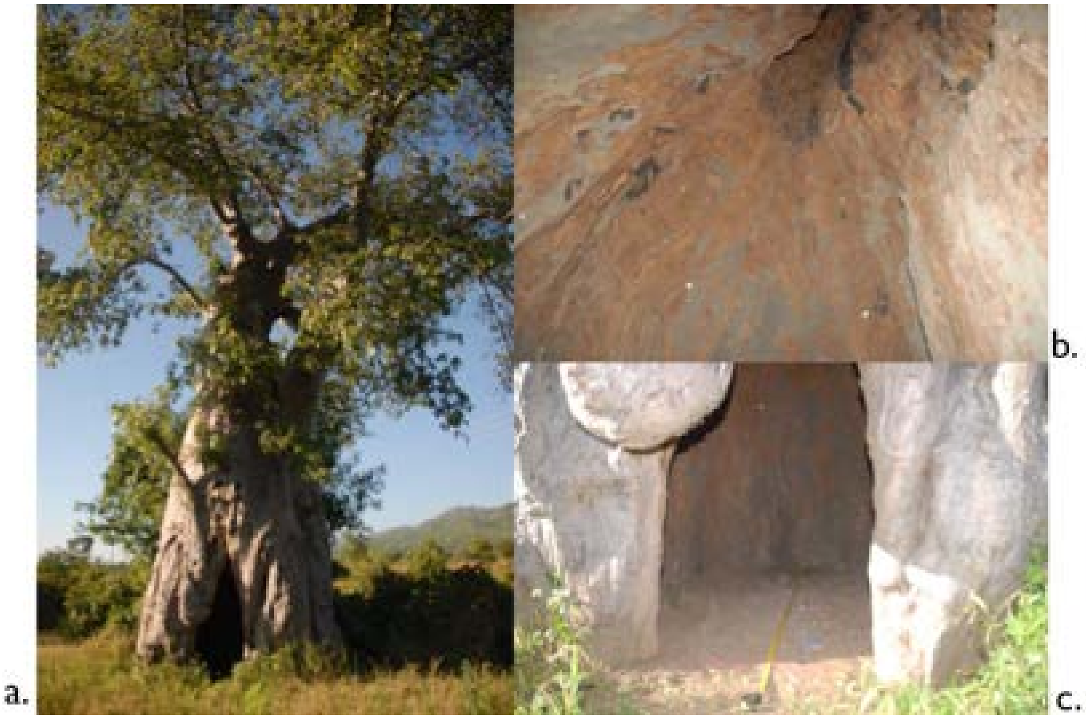

Figure 2: a. Saimba Nluzu baobab tree b. inside the tree looking up c. the cave inside the tree

The tree is now known to have lost the mystical powers it was once revered for due, to the immoral acts done in the tree. Inside the tree is a big cave that can hold more than four people. Visibility around the tree was impossible due to the creeping plants around the tree, which we avoided scrapping off, due to the presence of bees up the tree. From discussions with people from other areas in Malawi, the presence of bees is commonly associated with the presence of spirits. An excavation inside the tree would be of interest, as a respondent highlighted a possible burial or other associated usage inside the tree.

- Mchiza Alendo
  Mchiza (Mchiritsa) Alendo, literally translates into English as "healer of visitors". The tree is within the boundary between Dedza and Ntcheu, where the boundary between the villages is distinct. Different narratives were given about the tree being the healer of visitors; the outstanding narrative was that it was the tree that gave baobab seeds for consumption to the newly inhabited area across the boundary between the two villages. The inhabitants on the Ntcheu side are known to have come later and begged for land from the current villages on the Dedza side. The tree was the resting place where people from the respective villages could meet. The other narrative was that the tree offered baobab seedlings to the boys that went grazing their livestock in the fields. Younger generations knew of the tree but not the etymology of the name of the tree. Figure 3 is a picture of the tree.

Figure 3: Mchiza Alendo tree

- Third Tree

  The tree (younger than the other two trees) was never given a name. The exceptional story was that there might have been a possibility that it was used for the burial of people deceased from leprosy. Across Malawi, those who died from leprosy were not buried in the graveyards but in a cave or in a baobab tree if it had a cave. The current mystical value (according to key informant 2 who spoke with skeptism, speaking with certainty attracts attention to the validity of the story and fear of accusing people in the community of witchcraft and sorcery) might be a grounding of beliefs associated with sorcery in the village. Owls loom around the tree which alludes to the mystical value of the tree. Owls are believed to foretell death, bring bad luck and are associated with witchcraft (Mikkola and Mikkola, 1997). Figure 4 is a picture of the tree.

Figure 4: Third Baobab tree

3.1.2. An Old School Shelter

During the colonial period, there was a shelter which is known to have been used as a school learning facility. Most people recall going to the school during the period it was in operation but the exact date was not verified. Nothing indicated the presence of the shelter which might have been used as the learning shelter on the site, other than the flat and plain ground that the key informants showed WWEC staff.

3.1.3. M’Bisa

M’bisa literally translates into English as “that which hides”. It is a cave overlooking the site from the hills above; according to most of the oral interviews in association with the site. It is known that a village that once existed at the foot of the hill escaped the village to hide in a cave up the hills. Story has it that people were escaping from something in the low lands and ultimately the whole village disappeared inside the cave. The disappearance is surrounded with speculations that either they fell into the cave and died or spirits took them. The mystical value of the hill is in relation to the souls that were lost in the cave. M’bisa (the cave) got its name from hiding the people in the cave and it is believed that the souls still linger around the cave. Figure 5 shows the sight of the hills from the proposed site.

Figure 5: Sight of the hills hosting M'bisa cave

3.2. The Survey

Dedza has yielded archaeological information from all prehistoric time periods. Most research in the area has given information on the LSA and the full outline of all time periods of hunter/gather transitions. The Iron Age information of the area is also rich from the information of early Iron Age periods from third century AD to present. The rich rock art research has generated both archaeological and anthropological studies of the area. Possible finds from the proposed site varied from LSA materials and definite Iron Age materials. The preliminary survey indeed verified the assumption on the vast information that the site holds for the Iron Age materials present at the site. Quartz (stone type) which is a raw material that characterizes most LSA finds in Malawi is highly present in the stratigraphy of the site as noted in the gullies cutting through the site (see figure 6). Not much attention was given on the possible LSA, since the gullies might have reflected disturbed layers of archaeological materials.

Figure 6: Section cutting with pottery fragments

Several pottery fragment clusters were found on the surface, a possible iron smelting/smiting site and remains of more than 10 houses have also been recorded. This evidently supports the assumption of early habitation at the site. The pottery found on the site was mostly undecorated pottery and one decorated pottery had affinities of Kapeni ware. Its estimated time period is from 9th to 15th Century. One pottery sherd cannot be a basis for conclusive evidence of in situ presence of the Kapeni ware. The closest excavated archaeological site is Mtemankhokwe which dates from 1200 to 1750 AD by the presence of Mawudzu ware (Juwayeyi, 2010). All the above-mentioned pottery speaks of an early Chewa settlement, after the second migration but can only be confirmed with an archaeological excavation research.

Most people in the surrounding villages do not recall that there was a village in the fields that referred to the possibility of an overlap in the settlement of the area between the Chewa and the Ngoni. One respondent remembers the area to have been habited. She once dug a whole pot from the ground. This corresponds to the hypothesis that the site might have been vacated abruptly, either because of the Ngoni or Yao raids; thus, an association to the oral traditions of M'bisa cave where people escaped to. The oral tradition might have been a remnant narration of the early inhabitants of the villages below the cave.

3.2.1. Pottery

The site has numerous clusters of pot sherds. Most of the pot sherds that were found were undiagnostic. Nonetheless, among the sherds, a few were noted to be decorated. Mtemankhokwe site yielded a lot of undecorated Mawudzu pottery (see figures 7, 8 and 9). Mawudzu ware is characterised with vessels that are usually simple. The pot vessels are spherical pots with constricted mouths and sometimes shouldered with conical or concave necks. Other pots are large U-shaped pots while most bowls are hemispherical or open and may have flat or pedestal bases, though less usual than rounded ones. Most pots excavated at Mtemankhokwe were undecorated; nonetheless when decorated, Mawudzu ware is characterized by impressed chevrons and scallops; tooth patterns that run around the very slightly shouldered u- part of the pot; incised herringbone; dentate motif in false relief; incised festoons around the slight and pendant arc and stamping, though it is rare. The finish is normally a polychrome burnish which sometimes occurs with an outline of incision. Most of the pot sherds out of the surface finds at Golomoti were undecorated, both as rim sherds and body sherds.

Figure 7: Mawudzu ware reconstructed (pictures taken from the repository)


Figure 8: Decorated Mawudzu ware (excavated by Juwayeyi)


Figure 9: Undecorated Mawudzu ware bowls

Only one sherd from surface finds had definite affinities of Kapeni ware that can be relatively dated to the second migration of the Chewa kingdoms from 9th to 15th Century. Another peculiar was a piece of pottery which was undiagnostic with a possibility of either being a pot handle or an addition placed on a pot as a decoration (see figure 10). Further research and radio carbon dates can help in understanding and estimating the age of the site.

Figure 10: Pieces of pottery, possible a handle or an addition on pottery

3.2.2. Iron Slag

A piece of possible tuners pipe and accumulation of iron slag was found at (see figure 11). The site might have had the potential of iron-working. A water source is close by and the mountain might have been the source of timber. This gives a good geographic understanding of how relative the things might have been distributed around the site. Although there is a possibility of an iron-working station at the site, no iron furnace has been noticed close to the site. Juwayeyi's excavation at Mtemankhokwe found the possibility of iron smelting and locally made iron implements in the vicinity.

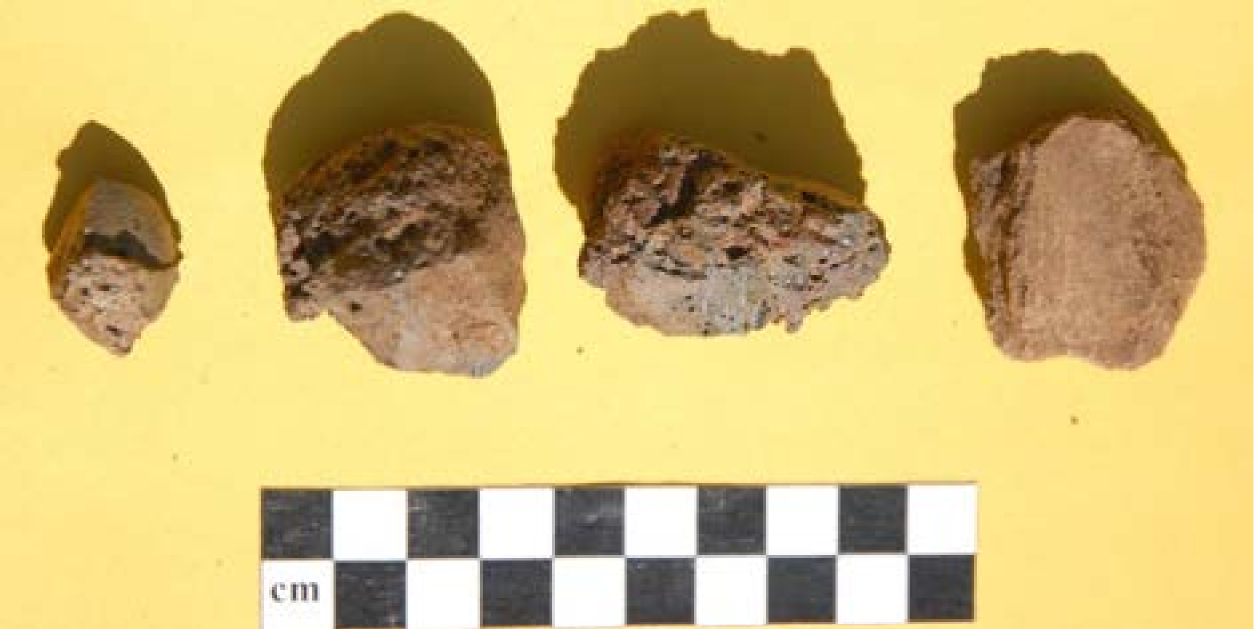

Figure 11: Pieces of iron slag and a piece of a tuyere pipe

3.2.3. Daga

Daga is burnt clay that is left from a fallen house. The survey recorded more than 10 houses that were in close proximity. This verifies a possibility of a village to have been in the area. The older generation in the communities surrounding the fields did not recall people living in the field. They only remembered temporary shelters for people who went to their gardens for farming. Most of the respondents from the interviews, related the presence of the pot sherds to the temporary homesteads of the farming communities around the fields.

The house mounds had pottery scatters around them, which corresponds to an abrupt vacation from the site. It is rare for whole pieces of pottery or a lot of pottery scatter, to be found in cases where a habited site and belongings were left on a peaceful accord. Stories from M'bisa might support assumptions that the communities would have left abruptly, fled into the hills and never returned. Langworthy (1972) states that during the time he was doing his research, most of the Chewa remembered the middle and late nineteenth century wars of the Ngoni, Yao and Chikunda. Radio-carbon dates and a meticulous research can help in verifying the current assumption.

4. PRELIMINARY IMPACT ASSESSMENT

This Preliminary Impact Assessment on the proposed site suggests that Cultural heritage can be affected by deep excavations for construction and road construction.

4.1. Site Integrity

Most of the materials are in situ, despite the top layers of cultivation. The site has a terrain that might have a minimal possibility of washed artefacts to a secondary context. Understanding of the landscape, in relation to most of the clusters, would unveil the distribution and understanding of the site fully. Nonetheless, most materials are in their primary context with minimal disturbance.

4.2. Archaeological resources scientific value

Ten kilometers away from Golomoti is a site that was excavated as reported by Juwayeyi (2010) and the analysis yielded information on the Maravi Empire expansion of the Mtemankhokwe Kingdoms. From the assessment performed, this site might have been an extensional habited area from the Mtemankhokwe kingdom. This site would yield understanding on the second Chewa migrations. The site has neither public significance nor economic/monetary value as an archaeological site, but can be referenced.

4.3. Public significance

Malawi's prehistory remains scanty. Therefore information that can be retrieved from the voyages and coming of missionaries is of primary importance. The information from the site can add interpretive, educational and recreational potential on Malawi's prehistory.

4.4. Ethnic significance

The current inhabitants of the area are not closely aware of the early Chewa settlements. Therefore oral traditions on ethnic significance of the site can better be appreciated if additional information, where available, is collected from the nearest Chewa villages; assuming they have recollections of the early habitations at Golomoti.

4.5. Historic archaeological sites

The site is of high historic value. However, further research in the archives can contribute to the archaeological data for a better perspective of the Golomoti site in the Maravi Empire expansion.

5. RECOMMENDED TERMS OF REFERENCE

The preliminary research of the site has provided an insight for planning a proper Cultural Heritage Impact Assessment (CHIA). The CHIA should answer the following questions:

- Are there oral traditions that can correspond to the early Chewa habitation of the site?
- Is there any Later Stone Age significant site or any other related activities?
- How far extended was the habitation on the site and when was the site inhabited?

These questions can be answered through the following methodology:

- Interviews with (elderly) Chewa residents closest to the site (2 days; 1 person)
- A full cover archaeological survey in the proposed site (1 day; 4 persons)
- Archaeological excavations
  - Inside either of the trees (2 days; 2 persons)
  - Pottery Cluster areas (4 days; 2 persons)
  - At least two hut mounds (3 days; 2 persons)

Full excavation of the site would provide more clear information of the site. The site has potential of providing historical information from the second Chewa migrations and Maravi Empire expansion. Depending on the depth and density of the cultural materials, most of which has been retrieved, no further mitigation measures will be needed once a scientific archaeological research has been done to the site. The excavation should be done between the months of August and September when the fields are clear and the soil is dry.

6. SUMMARY AND CONCLUSION

An area covering 91.605 hectare (ha) has been identified in Golomoti for a potential to set up a Solar Plant and the transmission line corridor, and two potential access roads. A CHIA as a segment of the ESIA has been done to assess the impact on the cultural heritage of the site. The assessment covers the significance of both living heritage and archaeological heritage of the site and proposes possible mitigation measures. This follows from the requirements stated in the legal framework for Malawi and other applicable international standards.

The site has potential to add knowledge on Malawi's history and prehistory. The oral traditions have highlighted the living heritage, especially on the value of the baobab trees in the proposed site. The knowledge is nonetheless fading in the older generations.

The survey on the site has yielded archaeological information from the artefacts and features present on the site. This information, through further archaeological and ethnographic research of the site, can add knowledge on Malawi's history and prehistory, especially towards the understanding of the expansions of the Maravi Kingdom. This is among the priority areas in the cultural policy Section 5.3.1. b. which highlights the need to "conduct research in archaeology, material culture, history, traditional methods of education, vernacular languages, religion, traditional music, traditional dance, traditional medicine, traditional food and traditional games and document the results".

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8. APPENDICES

8.1. GPS Coordinates from Survey

	ELEVATION	36L	UTM	COMMENT
1	561	0672604	8402204	Starting point of survey
2	562	0672529	8402252	Pottery scatter
3	564	0672181	8402380	Perimeter way point
4	566	0672137	8402402	Pottery scatter
5	572	0671891	8402392	Perimeter way point
6	554	0672314	8403306	Perimeter way point
7	549	0673020	8402894	Perimeter way point
8	547	0673018	8402894	Perimeter way point
9	544	0673199	8402572	Perimeter way point
10	544	0673124	8402572	Perimeter way point
11	550	0673066	8402412	Perimeter way point
12	544	0673020	8402308	Perimeter way point
13	552	0673007	8402268	Perimeter way point
14	558	0672954	8402272	Perimeter way point
15	553	0672700	8402314	Perimeter way point
16	553	0672696	8402324	Perimeter way point
17	553	0673017	8402908	Saimba Nluzu (Baobab tree)
18	559	0672579	8403004	Mchiza Alendo (Baobab tree)
19	559	0672513	8403034	Old School Shelter ground
20	561	0672713	8402650	Baobab tree (Possible burial?)
21	560	0672895	8402348	Pottery (Possible Kapeni ware)
22	556	0672893	8402340	Fragment of a Tuyere Pipe (?) and Iron Slag
23	562	0672882	8402274	Cross Section Cutting
24	561	0672602	8402800	Daga
25	554	0672638	8402810	Daga
26	556	0672642	8402758	Pottery & Daga
27	556	0672615	8402662	Pottery & Daga
28	558	0672616	8402662	Pottery & Daga
29	557	0672550	8402594	Pottery & Daga
30	559	0672536	8402554	Pottery & Daga
31	560	0672504	8402536	Pottery & Daga
32	556	0672576	8402472	Pottery & Daga
33	554	0672488	8402474	Pottery & Daga
34	557	0672433	8402506	Pottery scatter
35	560	0672433	8402528	Daga
36	561	0672431	8402530	Pottery scatter
37	560	0672333	8402474	Pottery & Daga
38	561	0672303	8402502	Daga
39	564	0672217	8402502	Pottery & Daga

40	562	0672217	8402500	Daga
41	561	0672179	8402558	Daga
42	558	0672111	8402588	Daga
43	567	0672134	8402906	Daga

8.2. List of Respondents

Key Informants	Hermesi Jimu
	Wyson Witines
Chitseko Village	Mayamiko Yasoni
	Toneta Sementi
Msamala Village	Montifoti Kamtima
	Matilda Philipino
	Hamilton Chitimbe
Nsamala Village	Meleyi Wiladi
Ching'anipa Village	Danger Nelson
Chatsika Village	Farazia Maliko
Kapesi Village	Agness Adiyelo
Kalumo Village	Ketilia Mzembe
Pitala Village	Beleniya Amosi

APPENDIX G LIST OF STAKEHOLDER ENGAGEMENT ACTIVITIES

July 2019

Stakeholder Engagement Activities

Date	Stakeholder(s)	Main Concerns or Comments Raised	ESIA Reference
December 5, 2019	Project Committee Members from the local community; Village headmen from six local villages, and the head of the local Village Development Committee	• JCM, ERM and Power Engineers met with various members of the community with local leadership positions to discuss their views on the Project • The Project Committee (16 members) was assigned by the communities to represent them with regard to the Project, especially related to the land acquisition for the Project site. The Project Committee represents 135 landowners. • The group was curious as to whether the community would receive power from the Project. JCM explained to the Project Committee that the power generated from the solar plant will be transmitted to the Golomoti substation to supply Malawi's electricity grid, and will not directly supply electricity to the community. JCM explained to the Project Committee that ESCOM is responsible for power distribution to communities. • The Project Committee expressed concerns regarding the following topics: 1) increased HIV/AIDS transmission, 2) increases in prostitution, 3) disruption of marriages and the social fabric of the community, and 4) potential conflicts with non-local Project staff.	• Section 6.3.1 Generation of Electricity • Section 6.4.12 STI/HIV Transmission • Section 6.4.14 Labour and Working Conditions
December 6, 2019	Environmental Affairs Department (Shamiso Najira, Deputy Director of EIA and Pollution Control; Biswick Mlaviwa, Principal Environmental Officer)	• JCM, ERM and Power Engineers met with the Environmental Affairs Department (EAD) to discuss their views on the Project • EAD representatives highlighted that the following components would be reviewed during an ESIA for a solar project (like Golomoti): 1) land and land use; 2) loss of property and community assets; 3) deforestation / cutting of trees; 4) water use, 5) chemical use; 6) technology used (e.g., heavy	• Section 2.4 Project Components • Sections 6.4.1 Air Quality, 6.4.2 Noise, 6.4.3 Soils, and 6.4.4 Groundwater • Section 5.1.5 Topography • Section 5.1.7 Land Use • Section 5.1.8 Surface Water • Section 5.1.9 Drainage • Section 5.1.10 Groundwater

Date	Stakeholder(s)	Main Concerns or Comments Raised	ESIA Reference
		metals); 7) stakeholder engagement / community acceptance of project; and 8) agreement with other national agencies (e.g., ESCOM, MIRA).	• Section 5.3.9 Land Ownership and Land Use • Section 7 Public Consultation/Stakeholder Engagement • Section 6.4.9 Land Acquisition and Displacement • Section 6.4.16 Unplanned Events, Soil and Groundwater
December 6, 2019	Ministry of Lands (Euphemia Bota, Acting Commissioner of Ministry of Lands)	• JCM, ERM and Power Engineers undertook a meeting with the Ministry of Lands (MoL) to discuss their views on the Project • The Acting Commissioner MoL expressed concerns regarding the compensation process and differences between local compensation requirements and international requirements and the setting of precedents. • JCM shared that they plan to improve the compensation and training process related to financial management training and support for PAPs to purchase replacement land, compared to that which was carried out for the Salima site.	• Section 6.4.9 Land Acquisition and Displacement
December 7, 2019	Teleconference with ESCOM (Charles Kagona, Senior Manager of Engineering and Services, ESCOM)	• ESCOM did not present any questions or concerns related to the proposed Project designs or specifications.	• Section 6.3.1 Generation of Electricity
March 22, 2019	Grievance Redress Committee Orientation (all villages)	• JCM had a meeting with local community members to structure a Grievance Redress Committee; 153 people attended this meeting (80 females and 73 males). • Community members selected individuals to represent the communities in the grievance redress process. • Community members expressed concern regarding the timeliness of the compensation	• Section 7.3.2 Grievance Mechanism • Section 6.4.9 Land Acquisition and Displacement

Date	Stakeholder(s)	Main Concerns or Comments Raised	ESIA Reference
		process, adequate compensation, and negative impacts to agriculture.	
March 22, 2019	Grievance Redress Committee Orientation (selected members)	• JCM provided an initial training to the selected members of the Grievance Redress Committee • A total of 10 representatives, the selected members, attended this meeting (3 females and 7 males). • The group identified the following possible grievances: 1) gender-based violence against young girls and women; 2) increases in sexually transmitted infections and diseases; 3) failure to share compensations equally amongst families; 4) potential for increased financial strife and marital conflict / divorces; 5) changes in noise and air pollution; 6) environmental degradation and biodiversity disturbances; 7) inward migration; 8) changes in school attendance; 9) unfair labor practices; 10) compensation-related disagreements; and 11) boundary and land measurement disagreements / disputes. • JCM provided the members with hardcover notebooks and reviewed the procedure to record and report a grievance.	• Section 6.4.12 STI/HIV Transmission • Section 6.4.9 Land Acquisition and Displacement • Section 6.4.1 Air Quality • Section 6.4.2 Noise • Section 6.4.3 Soils • Section 6.4.4 Groundwater • Sections 6.4.5 – 6.4.7 Biodiversity • Section 6.4.14 Labour and Working Conditions
March 29, 219	District Forestry Office (Mr. Victor Lusaka, District Forestry Officer)	• WWEC, on behalf of ERM, met with t the District Forestry Officer (DFO) to discuss the Forestry office's views on the Project • The DFO emphasized the importance of mitigating and minimizing project-related impacts as much as possible. • The DFO noted an overall trend in deforestation and removal of natural vegetation for agricultural expansion. • The DFO requested re-planting efforts from JCM, along with the Dedza Department of Forestry.	• Section 6.4.5 Loss of Habitats and Fauna Disturbance

Date	Stakeholder(s)	Main Concerns or Comments Raised	ESIA Reference
March 29, 2019	Dedza District Fisheries Department (Ms. Ida Kandiuze, District Fisheries Officer)	• WWEC, on behalf of ERM, met with the District Fisheries Officer (DFO) to discuss the DFO's views on the Project • The DFO emphasized the need for soil management and erosion control, to prevent negative impacts to surrounding water bodies. • The DFO expressed concern regarding any potential oil or chemical leaks that may occur during the construction/operation phases of development. • The DFO requested re-planting efforts.	• Section 6.4.3 Soils • Section 6.4.4 Groundwater • Sections 6.4.5 – 6.4.7 Biodiversity
March 29, 2019	Dedza District Environmental Officer (Mr. George Kawele, Environmental District Officer)	• WWEC, on behalf of ERM, met with the District Environmental Officer (DEO) to discuss the DEO's views on the Project • The DEO emphasized the need for soil management and erosion control, as it is one of the main environmental issues in Dedza District. • The DEO stated that construction materials should be sourced locally, whenever possible. However, he also expressed concern regarding the impacts of additional quarry sites, barrow pits, and mining for resources. • The DEO expressed concern regarding increased air emission, poor waste management, and open-fire burning of waste. The DEO also discussed	• Section 6.4.3 Soils • Section 6.4.1 Air Quality • Section 6.4.16 Unplanned Events, Soil and Groundwater
March 29, 2019	Total Land Care (Ms. Agness Maweya, Project Officer)	• WWEC, on behalf of ERM, met with Total Land Care • The Project Officer noted concerns regarding the negative impacts on wildlife, biodiversity, and the environment within the Project area. She also noted concerns regarding increased erosion and sediment management. • The Project Officer requested re-planting efforts by JCM as an overall mechanism to reduce impacts and combat deforestation.	• Sections 6.4.5 – 6.4.7 Biodiversity • Section 6.4.3 Soils • Section 6.4.4 Groundwater • Section 6.4.16 Unplanned Events, Soil and Groundwater

Date	Stakeholder(s)	Main Concerns or Comments Raised	ESIA Reference
		• The Project Officers noted concerns regarding the disposal of human waste and other potentially harmful and / or toxic waste into water ways.	
March 31, 2019	Water for All (Mr. Dingiswayo Jere, Project Officer)	• WWEC, on behalf of ERM, met with Water for All • The Project Officer noted concerns regarding the negative impacts of habitat loss, deforestation, biodiversity loss, and soil erosion. • The Project Officer requested re-planting efforts by JCM as an overall mechanism to reduce impacts and combat biodiversity loss. The Project Officers also noted concerns regarding the disposal of human waste into water ways.	• Sections 6.4.5 – 6.4.7 Biodiversity • Section 6.4.3 Soils • Section 6.4.4 Groundwater • Section 6.4.16 Unplanned Events, Soil and Groundwater
March 31, 2019	Community members from Kalumo, Thondoya, Chitesko, Nsamala, Kapesi, and Chisaka villages	• A community meeting was held along with JCM and WWEC prior to start of the baseline study activities. • Community members expressed concerns related to a loss of agricultural land, edible fruits/trees, grasses, firewood, timbers, grazing lands, and hunting lands (e.g., birds, hare, and insects). • Community members expressed concern related to environmental degradation, increased soil erosion, loss of suitable agricultural land, and loss of traditional medicinal plants and herbs. • Community members requested re-planting efforts by JCM, following the removal of all tree and/or plant species. Members also suggested that JCM plant *vetivar* grass around the Project site, to assist with erosion control.	• Section 6.4.9 Land Acquisition and Displacement • Section 6.4.7 Disruption of Ecosystem Services • Section 6.4.3 Soils • Sections 6.4.5 – 6.4.7 Biodiversity
May 14, 2019	Ministry of Lands (MoL), District Lands Officer (DLO), and PAPs	• JCM and the MoL coordinated an initial informational meeting with PAPs in advance of the asset survey being conducted by the MoL	• Section 6.4.9 Land Acquisition and Displacement

Date	Stakeholder(s)	Main Concerns or Comments Raised	ESIA Reference
		for the land acquisition; in addition to representatives from JCM and MoL, the DLO, and community members (83 females and 71 males) were in attendance • Community members requested additional communication and confirmation regarding the Asset Survey "cut-off" date (July 30th, 2019) for all key stakeholders in Golomoti. • Community members requested that all documents be translated into Chichewa and posted in all strategic areas. • Community members were informed of the grievance process, how to file a grievance, and where grievance mechanism instructions and additional information could be found.	• Section 7.3.2 Grievance Mechanism • Appendix H Stakeholder Engagement Plan
May 16, 2019	Dedza District Director of Planning & Development (DPD, Mr. Sohaya), Chief Director of Administration (Mr. Chikhawo, representing the District Commissioner for Dedza District Council), the DLO (Mr Nkhoma), TA Kachindamoto, Chiefs Clerk-Jamison Nkhuku, GVH Pitala and his 10 village heads and 10 members for the management committee	• JCM met with these representatives in the Project area to discuss the Project and specifically the draft memorandum of understanding (MOU) • Attendees discussed the MOU and emphasized their expectations for the Project and JCM's commitment towards community development. • JCM agreed to revise the MOU in accordance with the feedback received and share it with the Senior Chief and the District Council.	• Section 7 Public Consultation/Stakeholder Engagement
June 5, 2019	Women's Village Savings and Loans (VSL) Group	• ERM and WWEC met with members from seven villages in the Project area who are members of the VSL to learn about access to credit in the Project area, and generally to discuss their views on the Project • The Women's VSL presented concerns regarding the timeliness of compensation disbursements, access to large sums of money, and access to formal banking institutions/practices.	• Section 6.4.9 Land Acquisition and Displacement • Section 6.4.13 Community Safety and Security • Sections 6.4.5 – 6.4.7 Biodiversity • Section 6.4.3 Soils • Section 6.4.4 Groundwater

Date	Stakeholder(s)	Main Concerns or Comments Raised	ESIA Reference
		• The Women's VSL also presented concerns regarding the health-related impacts of solar, as well as Project-related environmental degradation, deforestation, biodiversity loss, and pollution.	• Section 6.4.16 Unplanned Events, Soil and Groundwater
June 5, 2019	Youth Network Meeting	• ERM and WWEC met with 11 members from the Youth Network to discuss their views on the Project. The meeting included six males and five females. The ages of the members ranged from 14 to 21. • Activities of the Youth Network include: 1) Climate Change education, including biodiversity re-planting, 2) HIV/AIDs education with peers, 3) Volunteer work, and 4) Organized sporting events for youth. • Members of the network expressed concerns related to the Project including the transmission of STIs, STDs, and an influx of non-local project workers. They also expressed concerns regarding the loss of agricultural land, a general lack of educational / livelihood opportunity for youth, and Project-related health and safety standards.	• Section 6.4.12 STI/HIV Transmission • Section 6.4.14 Labour and Working Conditions • Section 6.4.9 Land Acquisition and Displacement • Section 6.4.13 Community Safety and Security
June 6, 2019	Water Council Network	• ERM and WWEC met with the Water Council Network to learn about water management in the Project area and generally to discuss their views on the Project. The Network consists of 10 members in total who are from seven villages in the Project Area. • The Council stated that although they do not experience water shortages, they do experience very long (~2 hour) queue times. • The Council generally feels as though the water quality and cleanliness of the water stations is good.	• Section 6.4.4 Groundwater • Section 5.3.10 Health
June 6, 2019	Mixed (Women and Men) Village Savings and Loans (VSL) Group	• ERM and WWEC met with a mixed gender VSL group to learn about access to credit in	• Section 6.4.14 Labour and Working Conditions

Date	Stakeholder(s)	Main Concerns or Comments Raised	ESIA Reference
		the Project area, and generally to discuss their views on the Project. The meeting was attended by 4 males and 12 female members, none of whom where PAPs. - The Mixed VSL concern related to an influx of non-local workers, the spread of STIs / STDs, and marital strife / divorce. - The Mixed VSL also expressed concerns regarding the mismanagement of money, separation of families due to financial strife and the purchase of new land that is farther away, additional pressure on already struggling health care clinics, and loss of agricultural land.	- Section 6.4.12 STI/HIV Transmission - Section 6.4.11 Vector Borne and Communicable Diseases - Section 6.4.9 Land Acquisition and Displacement
June 6, 2019	Golomoti AIDS Support Organization (GASO)	- ERM and WWEC met with GASO, to learn about health issues in the Project area, and generally to discuss their views on the Project. - GASO currently supports 56 Youth Clubs (1,122 girls and 761 boys). - GASO expressed concerns regarding an influx of non-local workers, increases in STI / STD transmission, and additional pressure on already struggling health care clinics. - GASO would like to collaborate with community VSLs to help strength these groups and provide more access to credit, financial stability, and economic livelihood.	- Section 6.4.14 Labour and Working Conditions - Section 6.4.12 STI/HIV Transmission - Section 6.4.11 Vector Borne and Communicable Diseases
June 6, 2019	Dedza District Department of Agriculture (Mr. Gomani, Assistant District Agricultural Development Officer (ADADO))	- ERM and WWEC met with the District Department of Agriculture to discuss that office's views on the Project. - The ADADO expressed concerns regarding adequate and prompt compensation of agricultural lands and assets. The ADADO also expressed concerns regarding the management of community expectations, adequate livelihood support, and proper mitigation.	- Section 6.4.9 Land Acquisition and Displacement

Date	Stakeholder(s)	Main Concerns or Comments Raised	ESIA Reference
June 6, 2019	Dedza District Department of Lands (Joseph Flugensio, Acting Lands Officer)	• ERM and WWEC met the Acting Lands Officer to learn about that office's views on the Project. • The Officer expressed concerns regarding the loss of traditional agricultural lands to projects such as Golomoti. The Officer stated the importance of financial and livelihood training, as well as budgeting, to assist with long-term savings and community development. • The Officer expressed a preference towards *leasehold lands*, as these lands are typically safer, more secure, and more valuable. However, because taxes must be paid for leasehold land, the majority of small-crop farmers prefer *customary land*.	• Section 6.4.9 Land Acquisition and Displacement
June 7, 2019	Dedza District Planning Department (Emmanuel Sohaya, District Planning Officer)	• ERM met with the DPD to learn about his views on the Project • The DPD expressed concern regarding adequate compensation and long-term livelihood advancement within the communities. • He also expressed concerns regarding the inflation of prices in the trading center, ensuring that non-local and local workers are safely accommodated, and health-related impacts of solar farms (i.e., he highlighted the importance of education, so that myths do not arise within the villages). • The District Planning Officer stated that JCM would be required to re-plant trees in accordance with District and National Law.	• Section 6.4.9 Land Acquisition and Displacement • Section 6.4.14 Labour and Working Conditions • Section 6.4.13 Community Safety and Security • Sections 6.4.5 – 6.4.7 Biodiversity

APPENDIX H STAKEHOLDER ENGAGEMENT PLAN

February 2019

Prepared for:

JCM POWER

U.S. TRADE AND DEVELOPMENT AGENCY

Golomoti Solar Project

Draft Stakeholder Engagement Plan

February 2019

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List of Acronyms

EGENCO	Electricity Generation Company of Malawi
EIA	Environmental Impact Assessment
ESCOM	Electricity Supply Corporation
ESIA	Environmental and Social Impact Assessment
EPs	Equator Principles
FGD	Focus Group Discussion
IFC	International Finance Cooperation
IFI	International Finance Institution
JCM	Golomoti JCM Solar Corporation Limited
LRP	Livelihood Restoration Plan
MW	Megawatts
MERA	Malawi Energy Regulatory Authority
NGO	Non-Governmental Organisation
PS	Performance Standards (IFC)
SEP	Stakeholder Engagement Plan
TA	Traditional Authority

1. INTRODUCTION

1.1. Context and Purpose of the SEP

Golomoti JCM Solar Corporation Limited (JCM), a subsidiary of JCM Power and InfraCo Africa, is planning to develop a 20 megawatt ac (MWac) with possible expansion to 40 MWac solar photovoltaic (PV) plant ('the Project') on an approximately 92 hectare (ha) land plot near the village of Golomoti, in Dedza District, Malawi. JCM signed a Power Purchase Agreement (PPA) with the Government of Malawi and the power from the Project will be fed directly into the national grid via a short (approximately 0.5 km) 132 kilovolt (kV) or 33 kV transmission line to the Golomoti substation.

This Stakeholder Engagement Plan (SEP) provides a framework to guide the consultation process for the Project, ensuring a meaningful two-way process of communication between JCM and stakeholders that may be impacted by the Project, influence Project decisions, or have a specific interest in the Project (e.g., NGOs or academic institutions).

Key objectives of stakeholder engagement include the following:

BOX 1: GUIDING PRINCIPLES OF STAKEHOLDER ENGAGEMENT

Ensuring understanding: Provide an inclusive and transparent process of culturally appropriate engagement and communication to ensure that stakeholders are well informed about the planned Project.

Build relationships: Through supporting open dialogue, engagement will help establish and maintain a productive relationship between JCM and project affected persons and communities, as well as other key stakeholders.

Facilitate inclusive participation: Ensure that all stakeholders participate in decision-making regarding the Project, regardless of gender, age, ethnicity, status and other socio-economic factors, such that they are not adversely impacted and can access Project benefits.

Engage vulnerable groups: Identify and engage vulnerable groups to enable equal access to Project information and a platform for them to voice their concerns so that appropriate mitigation measures are included in Project design.

Manage expectations: It is important to ensure that the planned Project does not create or allow unrealistic expectations to develop amongst stakeholders about potential benefits, such as employment or compensation. The engagement process will serve as a mechanism for understanding and managing expectations by disseminating the accurate information in an accessible way.

Ensure compliance: The process is designed to ensure compliance with both local regulatory requirements and international best practice.

Facilitate free, prior and informed consultation: Ensure engagement is free of external manipulation, coercion or intimidation, undertaken in a timely way so that stakeholders are informed prior to the development or implementation of the Project, and ensure information is presented in an understandable and accessible way with consideration for literacy and language.

The purpose of the SEP is to provide a framework for managing stakeholder relations to minimise social risk, and to enhance relationships between the developer and Project affected communities.

The SEP has the following objectives:

- To provide a practical framework for engagement with stakeholders during the ESIA process, in compliance with national and international standards;
- To provide a methodology for identifying and mapping key stakeholders based on their level of impact, influence and interest in the Project, including vulnerable groups (e.g., female-headed households, elderly, youth, and subsistence farmers);
- To help maintain and enhance the Project's social license to operate by ensuring two-way inclusive communication between JCM and stakeholder groups through engagement that is culturally appropriate with consideration for language and gender;
- To provide an effective and accessible mechanism for reporting and managing grievances; and
- To define the roles and responsibilities of those involved in managing stakeholder engagement as well as provide a basis for reporting and monitoring engagement activities during each stage of the Project.

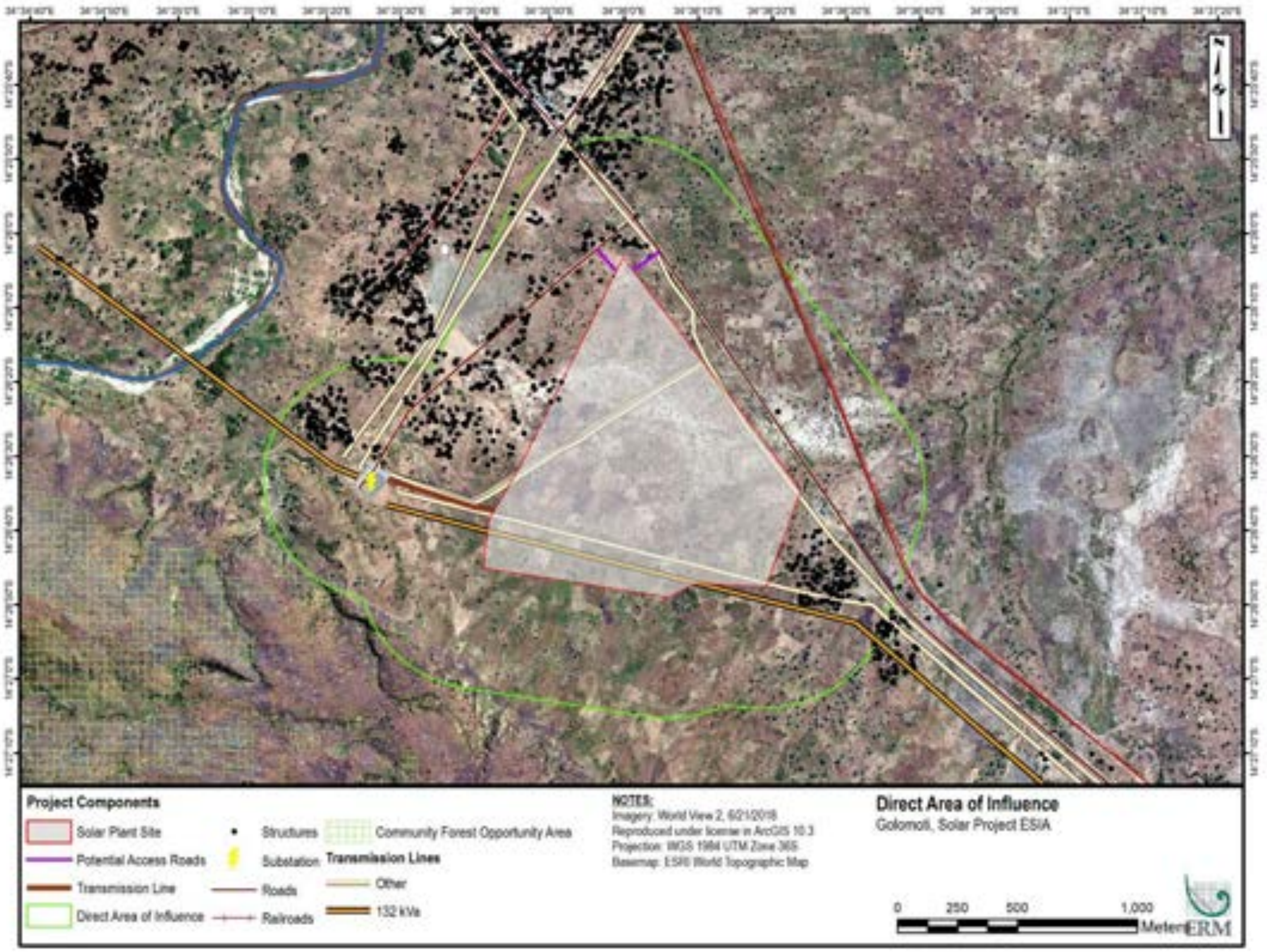
This SEP has been prepared in line with national legislation and international standards including the International Finance Corporation (IFC) Performance Standards (2012). It is a "living" document that will be updated as the Project evolves.

1.2. Project Overview and Site Context

The Project comprises of a 20 MWac with possible expansion to 40 MWac solar photovoltaic (PV) plant on a 92 ha greenfield site in Kachindamoto Traditional Authority (TA), Dedza District. Villages with interest in the land for the Project fall under the Pitala Group Village, and include the following villages: Dzoya, Chinyanipa, Kalumo, Nsamala, Kapesi, Chisaka and Chitseko. The site is 134 km from Lilongwe on the M1 and S127 roads.

The site is currently utilized as agricultural land by local villagers, and there are several existing transmission lines associated with the nearby Golomoti substation. The solar plant will connect via a new, 0.5 km 132 kV or 33 kV transmission line to the substation. Electricity generated will be sold to ESCOM and will be transferred to the national grid. Figure 1 shows the location of the site.

FIGURE 1: SITE LOCATION MAP



At the time this SEP was prepared, the location of the site has been agreed with the TA in the Dedza district. The compensation and acquisition terms for the land rights will be evaluated through an asset survey to be conducted by the Ministry of Lands, Housing and Urban Development.

2. NATIONAL AND INTERNATIONAL STAKEHOLDER ENGAGEMENT REQUIREMENTS

2.1. Introduction

This section provides details of national legislative requirements and international best practice standards, namely the International Finance Corporation (IFC) Performance Standards (2012) and Equator Principles III.

2.2. National Requirements

The main stakeholder engagement requirements for development projects are detailed in the Environmental Management Act, 1996.[1] It states that an environmental impact assessment reports should be developed in accordance with the requirements set out in the Act. The requirements include the following engagement activities:

"The environmental impact assessment report shall be open for public inspection provided that no person shall be entitled to use any information contained therein for personal benefit except for the purposes of civil proceedings brought under this Act or under any written relating to the protection and management of the environment or the conservation or sustainable utilization of natural resources.

Upon receiving the environmental impact assessment report, the Director shall invite written or oral comments from the public thereon, and where necessary may —

- *conduct public hearings at such place or places as the Director deems necessary for purposes of assessing public opinion thereon;*
- *require the developer to redesign the project or to do such other thing as the Director considers desirable taking into account all the relevant environmental concerns highlighted in the environmental impact assessment report, any comments made by the public and the need to achieve the objectives of this Act" …*

Additionally, in relation to land acquisition the following legislation applies, which includes notices to be placed in the *Gazette*:

- *Land Act, 2002*: Land designated for investment purposes shall be published in the *Gazette.*

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[1] The Government of Malawi, Environmental Management Act 1996, Part V, paragraphs 25 and 26. Available at https://www.malawilii.org/mw/legislation/act/1996/6 (Accessed February 2019).

- *Electricity Act, 2004*: Notice needs to be published in the Gazette or in a paper in general circulation. Notices should include the nature of the work and the name and location of the project. Notice will also be provided to the affected person.
- *Land Acquisition Act, 1970*: Notices will be published in the *Gazette* two months prior to acquisition of the land. If the Minister deems that the land is required urgently then the notice period may be less than two months. If the occupier of the land is absent from Malawi during the notice period, then this will be left with a community representative or an agent.
- *The Customary Land Act, 2016*: In the case that the Minister intends to transfer customary land for public interest, this is announced in the *Gazette* and sent to the land committee containing the details of the land to be transferred. Contradictory to the Land Acquisition Act, the Minister shall give 90 days' notice for the transfer. However, it should be noted that the land acquired for the Project was private land and therefore this requirement does not apply.

Other requirements the Project must observe are grounded in the Constitution of Republic of Malawi (1995) which focuses on human rights and participation of various groups in society such as women, children and the disabled that may be vulnerable to Project impacts. As such, vulnerable groups will require specific measures to ensure they are included in stakeholder engagement activities.

2.3. International Requirements

This section outlines international best practice requirements stipulated by the IFC and Equator Principles to align stakeholder engagement activities with International Finance Institution (IFI) requirements.

2.3.1. IFC Performance Standards

The IFC defines the objective of stakeholder engagement as being *"the basis for building strong, constructive, and responsive relationships that are essential for the successful management of a project's environmental and social impacts."*[2] The IFC Performance Standards include specific guidance on conducting stakeholder engagement both during the planning phase and throughout the Project lifecycle. Stakeholder engagement requirements are primarily contained in *Performance Standard 1: Assessment and Management of Environmental and Social Risks and Impacts*, as summarised in

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[2] IFC Performance Standard 1: Environmental and Social Risks and Impacts. Available at http://www.ifc.org/wps/wcm/connect/115482804a0255db96fbffd1a5d13d27/PS_English_2012_Full-Document.pdf?MOD=AJPERES (accessed February 2019)

Box 2.

BOX 2: PERFORMANCE STANDARDS REQUIREMENTS FOR STAKEHOLDER ENGAGEMENT

IFC PS1: Assessment and Management of Environmental and Social Risks and Impacts: Stakeholder engagement is an on-going process that may involve, in varying degrees, the following elements: stakeholder analysis and planning, disclosure and dissemination of information, consultation and participation, grievance mechanism, and on-going reporting to Affected Stakeholders.

Disclosure of relevant project information: Provide affected stakeholders with access to relevant information on: (i) the purpose, nature, and scale of the project; (ii) the duration of proposed project activities; (iii) any risks to and potential impacts on such stakeholders and relevant mitigation measures; (iv) the envisaged stakeholder engagement process; and (v) the grievance mechanism.

Informed Consultation and Participation: Conduct an informed consultation and participation process involving a deep exchange of views and information, and an organized and iterative consultation, leading to the project incorporating into their decision-making process the views of the affected stakeholders on matters that affect them directly, such as the proposed mitigation measures, the sharing of development benefits and opportunities, and implementation issues.

The process should be documented, in particular the measures taken to avoid or minimize risks to and adverse impacts on the affected stakeholders. The stakeholders should be informed about how their concerns have been considered.

External Communications: Implement and maintain a procedure for external communications that includes methods to (i) receive and register external communications from the public; (ii) screen and assess the issues raised and determine how to address them; (iii) provide, track, and document responses, if any; and (iv) adjust the management program, as appropriate. In addition, clients are encouraged to make publicly available periodic reports on their environmental and social sustainability.

Grievance Mechanism for Affected Stakeholders: Establish a grievance mechanism to receive and facilitate resolution of affected stakeholders' concerns and grievances about the client's environmental and social performance.

On-going Reporting to Affected Stakeholders: Provide periodic reports to the affected stakeholders that describe progress with implementation of the project Action Plans on issues that involve on-going risk to or impacts on affected stakeholders and on issues that the consultation process or grievance mechanism have identified as a concern to those stakeholders. After completion of an environmental assessment the consultation and disclosure must continue throughout the life cycle (construction and operation phase) of the project.

Source: IFC Performance Standard 1, January 2012.

Additionally, IFC's *Performance Standard 5: Land Acquisition and Involuntary Resettlement* is especially key to the Project, given the planned land acquisition. PS5 promotes the concept of negotiated settlements to avoid expropriation and the forcible removal of people or land use activities. It also includes requirements regarding community engagement to ensure that affected communities are informed and participate in decision-making processes related to land acquisition.[3]

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[3] IFC Performance Standard 5: Land Acquisition and Involuntary Resettlement Paragraph 10. Available at http://www.ifc.org/wps/wcm/connect/115482804a0255db96fbffd1a5d13d27/PS_English_2012_Full-Document.pdf?MOD=AJPERES (accessed February 2019)

2.3.2. *Equator Principles*

Equator Principles (EPs) III, June 2013 are a risk management framework, adopted by many IFIs, for determining, assessing and managing environmental and social risk in projects. The EPs comprise 10 principles and apply the IFC Performance Standards. The most relevant principles in relation to this SEP are:

- Principle 2: Environmental and Social Assessment;
- Principle 5: Stakeholder engagement;
- Principle 6: Grievance mechanism; and
- Principle 10: Reporting and transparency.

Additional detail regarding the EPs can be found at: http://www.equator-principles.com/index.php/ep3

3. STAKEHOLDER IDENTIFICATION AND MAPPING

3.1. Stakeholders

Stakeholders include individuals or groups that may influence or be affected by the Project, as described in Box 3 below.

BOX 3: IFC DEFINITION OF A STAKEHOLDER

> *"Stakeholders are persons or groups who are directly or indirectly affected by a project, as well as those who may have interests in a project and/or the ability to influence its outcome, either positively or negatively. Stakeholders may include locally affected communities or individuals and their formal and informal representatives, national or local government authorities, politicians, religious leaders, civil society organizations and groups with special interests, the academic community, or other businesses."*[4]

Stakeholders' level of interest is dependent on a number of factors including level of authority, socio-economic context, and cultural factors. As such, a stakeholder identification and mapping process adopted for the Project will be utilized to assist in understanding interest level and ensuring that various stakeholders are engaged with and receive information related to their specific interests in the Project.

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[4] IFC (2007) Stakeholder Engagement: A Good Practice Handbook for Companies Doing Business in Emerging Markets Available at: http://www.ifc.org/wps/wcm/connect/938f1a0048855805beacfe6a6515bb18/IFC_StakeholderEngagement.pdf?MOD=AJPERES (Accessed February 2019)

3.2. Baseline Context

The stakeholder identification process involves assessing the baseline of the Project Area of Interest (AoI) to determine specific groups within it, including vulnerable groups. It also helps to identify the most appropriate engagement approach and communication method for each group.

Aspects of the baseline context particularly relevant to developing an engagement plan include:

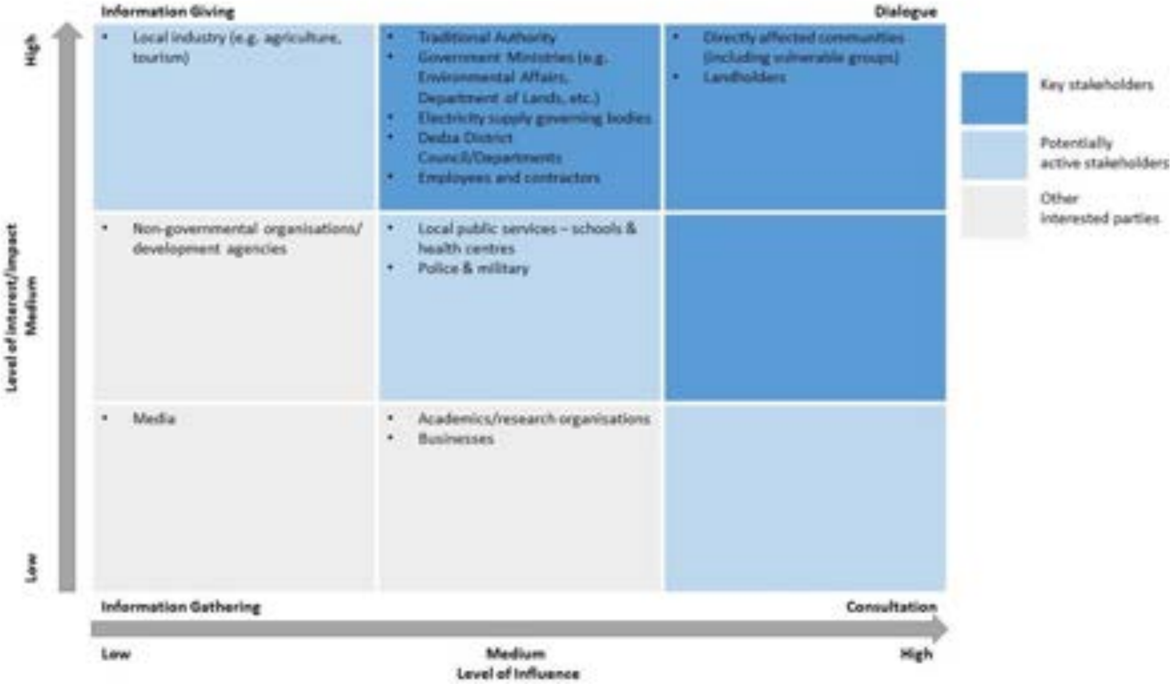
- Population and demographic information;
- Religion, ethnicity and language;
- Vulnerable groups;
- Education and literacy levels; and
- Primary livelihood activities.

At the time of drafting this SEP, baseline surveys were being developed for the Project and will be carried out by local consultants. The context gathered through these surveys will help determine specific stakeholder groups and the engagement approach applicable to each and communication methods, which are presented in Section 4 (Communication Methods).

3.3. Stakeholder Mapping

The aim of stakeholder mapping is to understand the stakeholders' needs and expectations for engagement and consultation in order to tailor engagement to each type of stakeholder. Stakeholders should be categorised and mapped according to their interest, influence and how they are likely to be affected by the Project, as shown in Figure 2.

FIGURE 2: STAKEHOLDER MAP



Stakeholder categories include:

- **Key stakeholders**: Stakeholders who have a high level of interest or will be directly affected by the project, for example neighbouring communities;
- **Potentially active stakeholders:** Stakeholders that will have a high level of interest or influence on the project, particularly in relation to legal requirements and those that may be indirectly impacted; and
- **Other interested parties**: Stakeholders that are likely to voice their opinions and/or concerns but unlikely to experience any impacts from the project.

A list of stakeholders identified to date is provided in Table 1. This list is not exhaustive and will be updated as the Project progresses.

TABLE 1: PROJECT STAKEHOLDERS

Stakeholder category	Stakeholder	Connection to the Project
National Regulatory Bodies - National bodies are of primary importance in terms of establishing policy, granting permits and other approvals for the Project and monitoring enforcing compliance.	Department of Environmental Affairs (DoEA)	The Project has to comply with the Environmental and Social Impact Assessment (ESIA) requirements and to develop environmental management and monitoring plans. The Department is responsible for issuing the Environmental Certificate after an ESIA has been approved
	Electricity Supply Corporation (ESCOM)	ESCOM are responsible for the procurement, transmission and distribution of electricity to consumers. If the affected communities are to benefit from the electricity by way of community investment, ESCOM may have to play a part in the modalities for household connections. Additionally the Project can draw on ESCOM's experience in relation to land acquisition for electricity related projects.
	Ministry of Lands, Housing, and Urban Development/Department of Lands	The ministry, through the Department of Lands, is a key stakeholder in the Project due to the management of land issues in Malawi. The department is the final approving authority for land acquisition related matters. It represents the Ministry of Lands, Housing and Urban Development on all matters to do with compensation and resettlement. As such the department has the authority to issue land leases/ registration certificate to JCM. The Ministry also provides land and housing management services to the general public. It draws its mandate from various statutes and policy instruments such as the Land Act.
	Electricity Generation Company of Malawi (EGENCO)	EGENCO are currently the sole generators of electricity in Malawi. The contribution of the project to the alleviation of energy problems will greatly assist EGENCO.
	Malawi Energy Regulatory Authority (MERA)	MERA is the overall regulatory authority for energy in Malawi.

Stakeholder category	Stakeholder	Connection to the Project
National Government Ministries	Ministry of Gender and Social Welfare (MoGSW)	MoGSW has an interest in the social welfare of the people throughout the country. Therefore, they will be interested in how the Project is managing impacts on vulnerable groups, including women.
	Ministry of Education, Science and Technology (MoEST)	MoEST will be interested in any access related constraints resulting from the Project as well as any skills training and education related community investment that the Project may support.
	Ministry of Local Government and Rural Development (MLGRD)	MLGRD is provides a link between the central and local governments in Malawi and would thus be interested in ensuring district authorities and other local authorities effectivity participate in the development and authorization of the project according to their legal mandates.
	Finance, Economic Planning and Development Department (FEPDD)	Formulates economic fiscal policy and manages financial material resources for the Government for Malawi in order to realize balanced and sustainable economic growth to reduce poverty.
	Natural Resources, Energy and Mining Department (NREMD)	The ministry ensures sustainable development, management and utilisation of energy, minerals and monitoring geo-hazards for socio economic development.
	District Commissioner (DC)	The DC is the overarching local authority for all the development projects in the district. The DC also has the authority to issue the project planning Permit (on behalf of the Department of Physical Planning). Additionally, the DC oversees the compensation process for all projects within the District, including payment of compensation and monitoring related activities. The DC's office works hand in hand with the Community Development Officer on matters related to social aspects including community mobilisation and sensitisation on such projects.
	Ministry of Irrigation and Water Development/ Water Department MoIWD)	The Water Department is responsible for provision of water supply services including piped rural water supply schemes and boreholes. The Department must be engaged in relation to water use by the Project and any water-related CSR projects resulting from the Project. A water abstraction permit will be required from the Water Resources Authority if the Project requires a borehole or abstraction of surface water for construction and/or operational purposes.
	Ministry of Labour (MoL)	The MoL issues the Workplace Registration Certificate as mandated by the Occupational Safety Health and Welfare Act. It is also responsible for monitoring of workers' health and safety during construction and operation.

Stakeholder category	Stakeholder	Connection to the Project
Community level – including: • Kachindamoto • Chinyanipa • Dzoya • Kalumo • Nsamala • Kapesi • Chisaka • Chitseko	Project affected communities including residents in surrounding settlement, land owners and users	Households and communities that will be directly or indirectly affected by the proposed Project activities. This includes people living on the affected land either by direct land take or by social and environmental impacts.
	Chiefs/Traditional authorities Village heads	Local community leaders act as representatives of their local community. Meeting with Traditional Authorities will follow local practices and be held prior to any wider communication in order to respect the political and social structure.
Vulnerable groups	May include: • Women headed households • Children headed households • Elderly, physically or mentally disabled • Youth • Low-income household	Vulnerable groups may be disproportionately affected by the proposed Project by virtue of socio-economic status or physical abilities and are therefore less resilient to change. A vulnerability assessment will be required for the Project to identify specific vulnerabilities in the Project area.
Civil society groups	Community based organisations (CBOs) and cooperatives	Organisations that may be impacted by the Project or that the Project can work with on livelihood development activities.
Non-Governmental Organisation(NGO)/Institutions/Academic	Includes international, national and local NGOs covering biodiversity/conservation, human rights, gender and child related issues	NGO and academic institutions are able to influence the success of projects through advocacy and negative media attention. The Project will identify and engage relevant NGOs and institutions to keep them informed about the Project. They may also act as a partner in implementing livelihood or community investment programmes.
Commerce and Industry	Local businesses / potential suppliers and contractors	Will be interested in procurement opportunities in relation to the Project. They may also create cumulative impacts. As such the Project is required to identify industries in the local area and aim to collaborate with them where appropriate.

4. COMMUNICATION METHODS

4.1. Introduction

During engagement activities, a variety of methods will be employed to engage with specific groups based on their level of authority, social economic context, cultural and other factors such as level of education and literacy.

Although English is the official language in Malawi, Chichewa is the national language spoken by 57% of the population.[5] According to 1998 Population and Housing Census (the latest data regarding language), 91% of the population in the Central Region, which includes Dedza district, uses Chichewa as the language of communication in the household, while Chitumbuka and Chiyao (about 3 percent each) were the other languages that were commonly used for communication in households in the Central Region.[6] The upcoming socioeconomic baseline surveys will verify which languages are used in households likely to be specifically affected by the Project.

At the time of the 2008 Population and Housing Census, 89.97% of males and 81.14% females between the ages of 15 to 24 in Malawi were literate.[7] At the District level, Dedza's literacy rate was just 49% (54% of males and 43% of females), representing the second lowest literacy rate of all the districts in the country.[8] This shows that there are clear gender disparities in educational achievement.

4.2. Communication Methods

Figure 3 provides an overview of the methods that will be used to disseminate information to stakeholders based on the stakeholders group and literacy levels. Additionally, meetings may be held in a variety of formats to ensure that engagement is inclusive and provides a platform for opinions and concerns to be voiced openly.

Meetings are most likely to be in English in Lilongwe and at the government level in Dedza, depending on the level of authority. Meetings in communities and at the local level should primarily be in Chichewa.

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[5] The language spoken in Malawi.-study country.com. Available at http://www.studycountry.com/guide/MW-language.htm (accessed February 2019)

[6] 1998 Population and Housing Census. Available at http://www.nsomalawi.mw/images/stories/data_on_line/demography/census_98/final_report.pdf (accessed February 2019)

[7] Education and Literacy Report. Available at http://www.nsomalawi.mw/images/stories/data_on_line/demography/census_2008/Main%20Report/ThematicReports/Education%20and%20Literacy.pdf (accessed February 2018)

[8] Education and Literacy Report. Available at http://www.nsomalawi.mw/images/stories/data_on_line/demography/census_2008/Main%20Report/ThematicReports/Education%20and%20Literacy.pdf (accessed February 2018)

FIGURE 3: MEETING FORMATS

Focus Group Discussion

- Focused discussion with a group of individuals with similar characteristics such as women, youth disabled groups, landowners etc. to capture targeted information that may not be possible to gather in an open space. These meetings will also create a platform for vulnerable or marginalised groups to freely voice their opinions and concerns to be factored into Project design and implementation of Project elements and programmes.

Key Informant Interview

- One-to-One meeting with a professional or individual with knowledge and expertise about a specific subject area that can provide targeted information in relation to specific aspects of the Project for consideration in Project design and implementation of Project elements or programmes.

Formal Meeting

- Formal meeting to present Project information to a group of individuals with authority or that may be a key stakeholder, such as the government or NGOs, and to gather feedback for consideration in Project design and implementation of Project elements or programmes.

Community Meeting

- Gathering of all members of the community residing in a particular area, such as a settlement or town, to present Project information and gather to feedback for consideration in Project design and implementation of Project elements or programmes.

The type of meeting held is dependent on the topic area and objectives and therefore should be assessed against these definitions.

TABLE 2: COMMUNICATION METHODS

Tool	Purpose	Stakeholder Groups	Use
PowerPoint presentations	Detailed presentation to provide technical information regarding the Project	• National regional and local authorities • NGOs Key Informants/ Professionals	• Used at formal meetings
Basic flipbook/pictorial presentation	Presentation of general information regarding the Project	• Settlements • Vulnerable groups	• Used at settlement meetings and focus group discussions
Videos	To demonstrate what the Project will look like and how it works in reality	• All	• Can be used at all types of meetings
Flyers/leaflets/background information document	Allows stakeholders to take information home and have a line of contact with JCM should they have any questions	• All stakeholder groups	• Distributed at meetings and placed in accessible public locations (e.g. community centre, health centre and schools)
Reports and plans	Technical written reports and management plans that present details on potential impacts on the Project and how JCM are managing the environmental and social aspects of the Project to minimise adverse impacts and maximize benefits	• Government, professional, academics and civil society/public	• Available online, Project office and public places
Newsletters	Contains information regarding Project developments, employee news, community investment etc.	• All	• Available at Project offices and public places
Internet	Provides general detail regarding Project development	• All	• Global or national access to information
Questions and answer guide	List of most frequently asked questions to be used as guidelines to respond to any question from stakeholders	• Internal use by Project staff to align responses to questions. Can also be accessible on the Project website if appropriate	• Available online if appropriate
Media - Television and radio advertising	A short television and radio advertisement on local television or radio channel to disseminate information Project information and details of meetings	• All	• National or local dissemination of information

Tool	Purpose	Stakeholder Groups	Use
Posters	Announce the date/ time and venue of meeting	- All	- In central locations within settlements or in public places
Meeting evaluation	Process to gather information to evaluate the success of meetings and collect further feedback / comments not collected during the meeting	- All	- For literate groups feedback can be provided using a meeting feedback form (see Section **Error! Reference source not found.** (monitoring) after the meeting - For illiterate groups, this can be done verbally or by using creative methods such as pictorial methods

5. STAKEHOLDER ENGAGEMENT STRATEGY

5.1. Introduction

This section sets out the various key stages of engagement that are required throughout the life of the Project.

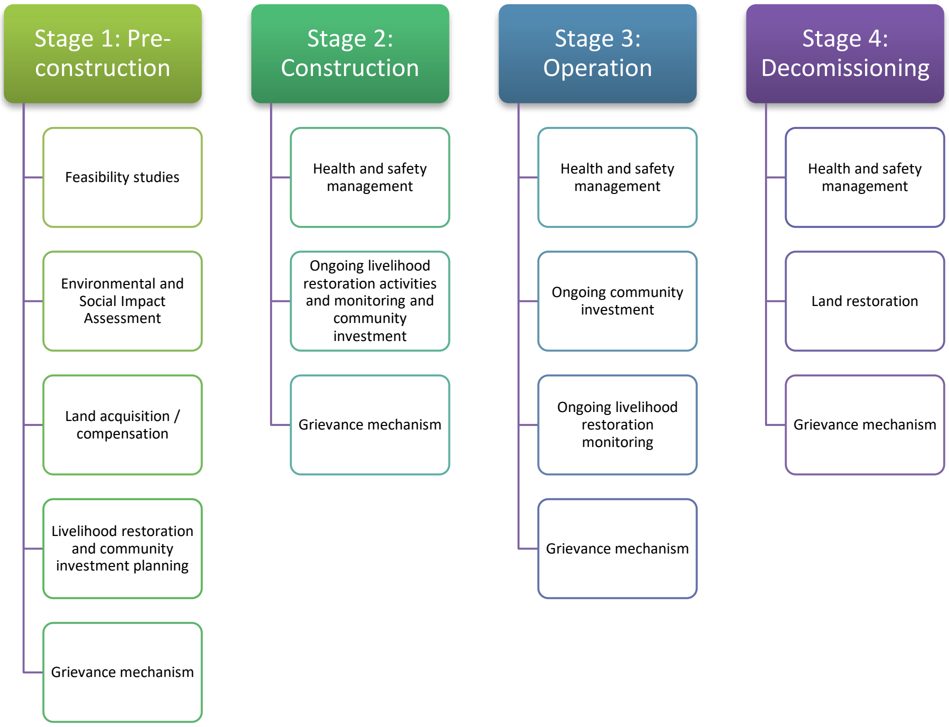
5.1.1. Engagement Background

Stakeholder engagement undertaken in support of the Project so far has primarily been related to initial engagement involving meetings with the Regional and District Lands Officers to gather information on the land acquisition and compensation process in Malawi in relation to the Project. Additionally, meetings have been held with representatives of communities with residents that have use rights to land (i.e., landholders) within the 92 ha solar plant site (including Group Village Headman Pitala, Village Headmen, and the Project Landholder Committee set up by the communities to represent the landholders) as well as community members themselves. Early engagement with the communities and their representatives has focused on forming mutual understanding of the Project plans and the community members concerns and aspirations surrounding the Project, including local employment and community investments.

5.2. Stakeholder Engagement Strategy

Figure 4 below shows four key stages of engagement that are required throughout the life of the Project. Within each of the stages are specific topic areas that need to be covered. It is, however, important to recognise that stakeholder engagement is an ongoing process of communication in order to build relationships and creating benefits for both the Project and affected communities. Therefore, meetings beyond these activities may be required to ensure that stakeholders, in particular affected communities are kept informed about Project developments.

FIGURE 4: STAGES OF ENGAGEMENT



Descriptions of the stages of engagement are provided below.

5.2.1. Stage 1: Pre-construction

The pre-construction stage is key to obtaining a social licence to operate and includes a number of engagement activities. At this stage it is also very important to understand who the stakeholders are and their relationship with the Project.

- **Feasibility studies**: At the early stage of the Project, feasibility studies should include consultations with the Traditional Authority, chiefs/headmen and representatives that are responsible for affected communities to understand the key risks and sensitivities that the Project needs to consider from an impact and cost perspective. At this stage, and to the extent possible, it is also important to understand perceptions regarding land acquisition.
- **Environmental and Social Impact Assessment**: The ESIA is required by the government to obtain a permit for the Project. It is also a key requirement of the IFC. Specific stages for engagement around the ESIA are detailed below and illustrated in Figure 5.2.
- **Land acquisition/compensation**: The Project requires a plot of approximately 92 ha to construct the Project, land that is currently used by surrounding communities for agricultural purposes and will thus trigger economic displacement. JCM will comply with legal requirements in Malawi to compensate those affected by the land take, and

additionally will apply IFC's PS5 including requirements to engage with community members in the planning and decision-making process regarding the land acquisition. This will include relevant information sharing to ensure communities are informed of the process, their rights and responsibilities, and the anticipated timeline. Communities will be engaged in an iterative fashion to prepare them for the land acquisition, and consult them on their views regarding the process, compensation measures and other details so that JCM can incorporate their views in the planning.

- **Livelihood restoration/community investment planning**: As a result of economic displacement, to mitigate negative impacts and deliver development benefits, a gender-focused Livelihood Restoration Plan (LRP) is required. This includes development of livelihoods programming in collaboration with affected communities, chiefs, local government and other key stakeholders. This will ensure that affected persons participate in the decision-making process regarding priorities, needs and feasibility of such programmes. Additionally, communities should be active in deciding what investment activities the Project should engage in as well as take responsibility for ownership and implementation with the support of specialist organisations. Specific stages for engagement around the LRP are detailed below and illustrated in Figure 5.
- **Grievance mechanism:** A grievance mechanism should be established at this stage of the Project to provide an accessible and culturally appropriate platform for stakeholders to express any grievances and receive a response from JCM, as well as provide comments/suggestions regarding the issue of concern. A grievance mechanism is provided in Section 6 of this SEP.

ESIA and LRP Stakeholder Engagement Process

In order to avoid stakeholder fatigue there are three main stages of engagement that form the ESIA and LRP process. These include engaging on the draft scoping report as well as presenting the Project and gathering feedback communities in the direct and indirect AoI. Additionally, a third stage of engagement will be undertaken on drafts of the ESIA and LRP, which will include consultation on the identified impacts and associated mitigation measures that have been proposed Engagement for the ESIA process is presented in Figure 5 below.

FIGURE 5: ESIA AND LRP ENGAGEMENT

- Provide an update on the nature, extent and scale of the project, including information on the land aquisition process
- Introduce the Project to communities in the AoI
- Gather feedback on the impacts identifed to date to incorporate in the ESIA
- Provide details regarding the grievance mechanism
- Publish a notice regarding the project in the *Gazette*

- Focus group discussions with men and women seperately, including with vulnerable groups
- Household and asset surveys to inform the LRP
- Key informant meetings
- Consultation regarding the establishment of a Resettlement Committee

- Provide updates on the Project description and schedule
- Consultation on the eligibility and entitlements matrix for the LRP
- 10 copies of the draft ESIA report will be submitted to the Environmental Affairs Department for their distribution to key relevant government and public institutions for their review and comments.
- Once the feedback has been gathered, the ESIA will be updated and 10 copies of the finalised document will be submitted to the Environmental Affairs Department for approval and issuing the Environmental Certificate.

5.2.2. Stage 2 and 3: Construction and Operation

Construction phase stakeholder engagement will be used to monitor the success of the mitigations that have been established for this stage of work, respond to grievances and identify alternative mitigation measures where required.

During this period meetings with the communities shall be held on a regular basis. Meetings will include Project updates, health and safety sensitisation and obtaining feedback regarding the Project and maintenance of the site office.

As operational impacts will be significantly less than construction (mainly visual due to the presence of the solar farm), affected communities will be reviewed to reduce the number meetings to be held on a regular basis. Meetings will include Project updates, health and safety, and obtaining feedback regarding the Project and the grievance process. As the operational phase progresses and the community adjusts to the change in landscape, it is likely that grievances will significantly reduce.

Table 3 provides an overview of consultation activities and their frequency during Stages 2 and 3 of consultation.

TABLE 3: STAGES 2 AND 3: CONSTRUCTION AND OPERATION ENGAGEMENT ACTIVITIES

Stakeholder Group	Information Requirements	Method of Communication and Frequency	
		Construction	Operation
Government (national, regional, district)	• Project developments • Livelihood restoration/land take issues • Other Project approvals • Community investment	Ongoing as required	Ongoing as required
Traditional Authorities	• Project updates • Represent community grievances • Community investment	Monthly meetings	Monthly for the first 6 months, then quarterly
Directly Affected Communities	• Project updates • Report grievances	Community meetings in areas where construction is taking place at least two weeks prior to work starting and monthly thereafter A community liaison/grievance officer shall be based in key construction locations.	Monthly for the first 6 months, then quarterly Radio updates and flyers shall be disseminated when required
Community Based Organisations	• Project updates • Report grievances	Updates via the local radio Quarterly dissemination of flyers	Radio updates and flyers shall be disseminated when required
Employees/Contractors	• Project updates to keep staff engaged in their working environment • Report issues related to labour and working conditions • Management/monitoring of staff grievances	Weekly team meetings Notices posted around the site Staff newsletters, if applicable	Weekly meetings for all staff working at the site Notices posted around the site Staff newsletters, if applicable
Non-Governmental Organisations	• Project updates • Community investment	Email updates/newsletter as required.\	Email updates/newsletter as required
Local public services	• Project updates • Report issues related to public service grievances	Quarterly meetings, with relevant stakeholders	Email updates/newsletter as required
Media	• Project updates	Email updates/newsletter as required	Email updates/newsletter as required

Stakeholder Group	Information Requirements	Method of Communication and Frequency	
		Construction	Operation
Local businesses	• Project updates • Management of cumulative impacts	Quarterly meetings, with relevant stakeholders Updates via the local radio Quarterly dissemination of flyers	Annual meetings Email updates/newsletter as required
Academics and research institutes	• Project updates	Email updates/newsletter as required	Email updates/newsletter as required

5.2.3. Stage 4: Decommissioning

The impacts of decommissioning are not likely to be significant since the operational impacts will be small. However, engagement still needs to be considered as communities will have evolved over the Project lifespan. As such, prior to decommissioning, the developer will prepare a Site Closure Plan. The Project will consult with stakeholder groups, to ensure that feedback regarding the impacts of decommissioning are considered in the Plan and ensure, among other, that land restoration has been completed.

6. GRIEVANCE MECHANISM

6.1. Overview and Purpose

The purpose of the Project's Grievance Mechanism is to provide stakeholders with a clear process through which to raise issues, concerns or complaints and to have these matters dealt with in a fair and equitable manner. This includes ensuring that all grievances that have been received are acknowledged and logged and that the complainant knows what to expect in terms of the grievance process and timelines for response.

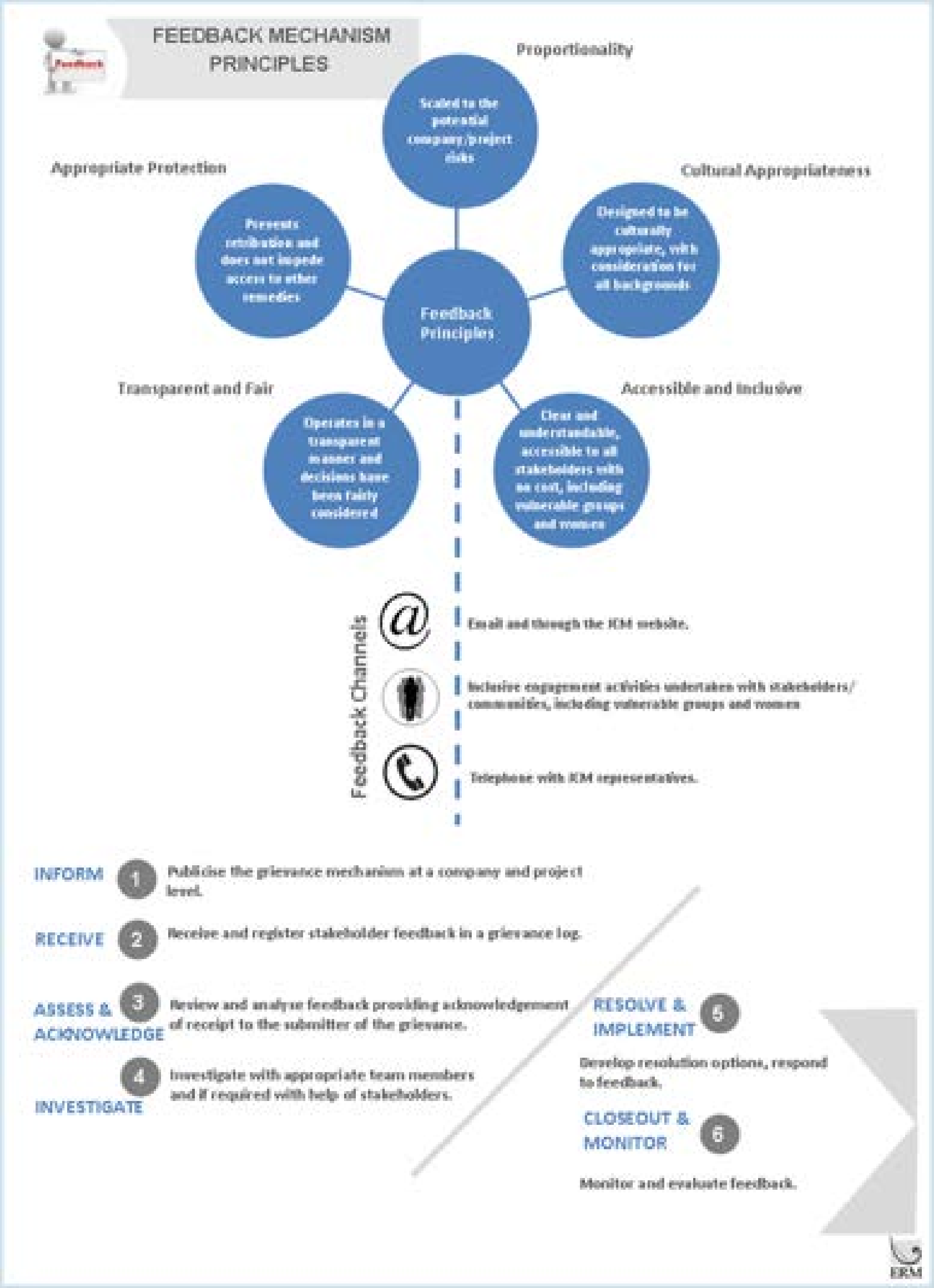
A grievance is an issue, concern, problem, or claim (perceived or actual) that an individual stakeholder or community group has related to JCM and its contractors' activities. Grievances may relate to any aspect of the Project, and could be related to activities that take place on the Project site or are otherwise directly related to the Project. They might be felt and expressed by a variety of parties including individuals, groups, communities, entities, or other parties affected or likely to be affected by the social or environmental impacts of the Project. Types of grievances may vary and may be related to injuries/damage, concerns about routine Project activities, perceived incidents or impacts or requests for more information/clarity on Project activities. Ongoing information dissemination and relationship building can significantly minimise the number of grievances raised, as well as reduce social risk resulting from the time and budget required to resolve issues at a later stage.

The primary objectives of the Project Grievance Mechanism are to:

- Provide a predictable, transparent, and credible process to all parties for resolving grievances, resulting in outcomes that are fair, effective, and lasting;
- Build trust as an integral component of broader community relations activities; and
- Enable systematic identification of emerging issues and trends, facilitating corrective action and pre-emptive engagement.

The key principles of an effective grievance mechanism which have been taken into account in the development of the Project's Grievance Mechanism are illustrated in Figure 6.

FIGURE 6: GRIEVANCE PRINCIPLES



Scaled to the potential company/project risks

Designed to be culturally appropriate, with consideration for all backgrounds

Clear and understandable, accessible to all stakeholders with no cost, including vulnerable groups and women

Operates in a transparent manner and decisions have been fairly considered

Prevents retribution and does not impede access to other remedies

Email and through the JCM website.

Inclusive engagement activities undertaken with stakeholders/ communities, including vulnerable groups and women

Telephone with JCM representatives.

Publicise the grievance mechanism at a company and project level.

Receive and register stakeholder feedback in a grievance log.

Review and analyse feedback providing acknowledgement of receipt to the submitter of the grievance.

Investigate with appropriate team members and if required with help of stakeholders.

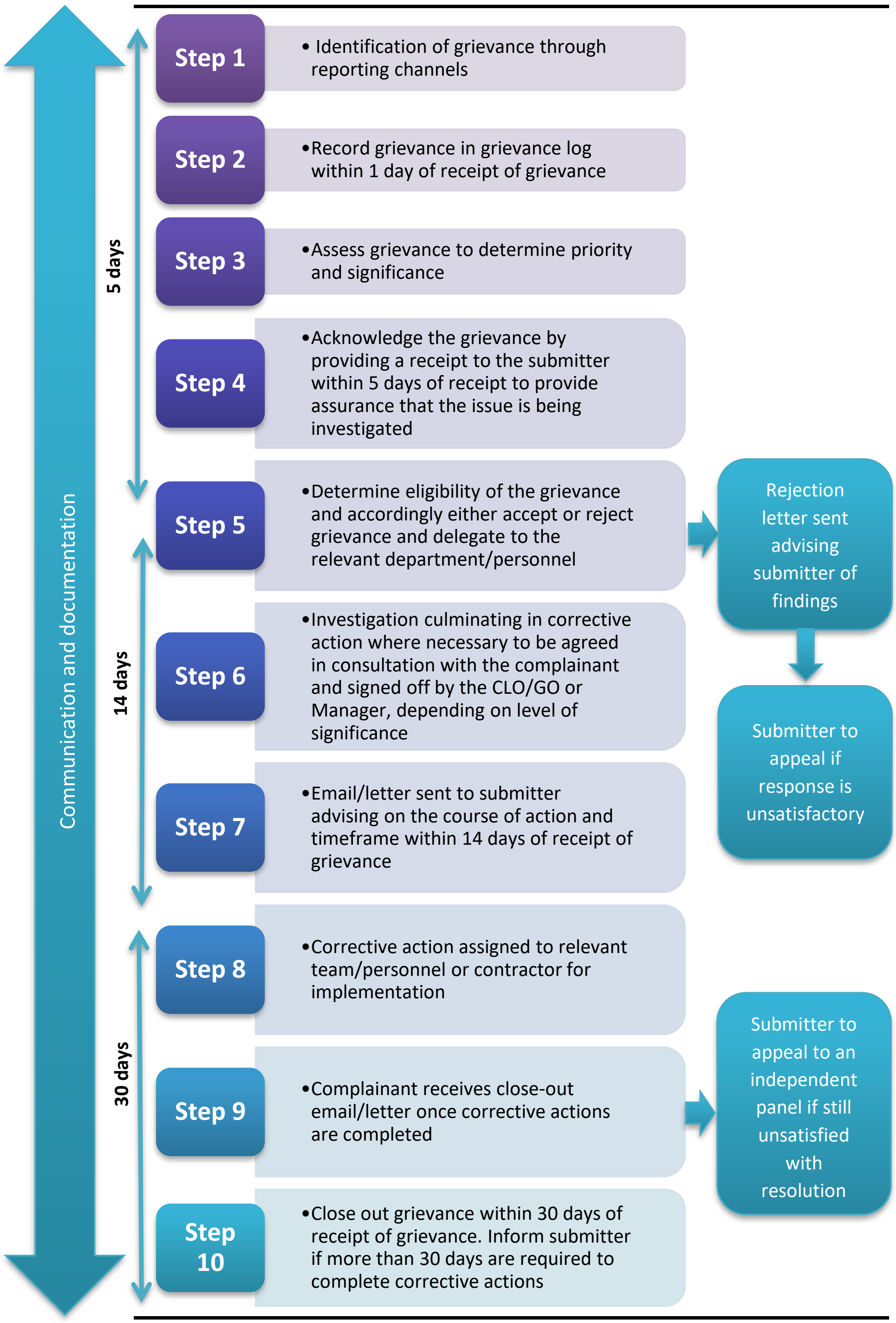
Develop resolution options, respond to feedback.

Monitor and evaluate feedback.

6.2. Grievance Process

A formal grievance procedure based on best international practice will be implemented based on the principles detailed above and the process provided in Figure 7 below. The Grievance Mechanism shall be implemented by a Community Liaison Officer (CLO)/Grievance Officer (GO) or similar who will be based at a site office during key Project phases, primarily construction, to ensure that the local community including vulnerable groups are able to easily raise issues. Presenting a grievance through the Project's Grievance Mechanism does not in any way preclude complainants from pursuing other legal action within their rights; however, JCM hopes that by providing for this mechanism most complaints can be dealt with effectively at the Project level.

FIGURE 7: GRIEVANCE PROCESS



Step 1
- Identification of grievance through reporting channels

Step 2
- Record grievance in grievance log within 1 day of receipt of grievance

Step 3
- Assess grievance to determine priority and significance

Step 4
- Acknowledge the grievance by providing a receipt to the submitter within 5 days of receipt to provide assurance that the issue is being investigated

Step 5
- Determine eligibility of the grievance and accordingly either accept or reject grievance and delegate to the relevant department/personnel

Rejection letter sent advising submitter of findings

Submitter to appeal if response is unsatisfactory

Step 6
- Investigation culminating in corrective action where necessary to be agreed in consultation with the complainant and signed off by the CLO/GO or Manager, depending on level of significance

Step 7
- Email/letter sent to submitter advising on the course of action and timeframe within 14 days of receipt of grievance

Step 8
- Corrective action assigned to relevant team/personnel or contractor for implementation

Step 9
- Complainant receives close-out email/letter once corrective actions are completed

Submitter to appeal to an independent panel if still unsatisfied with resolution

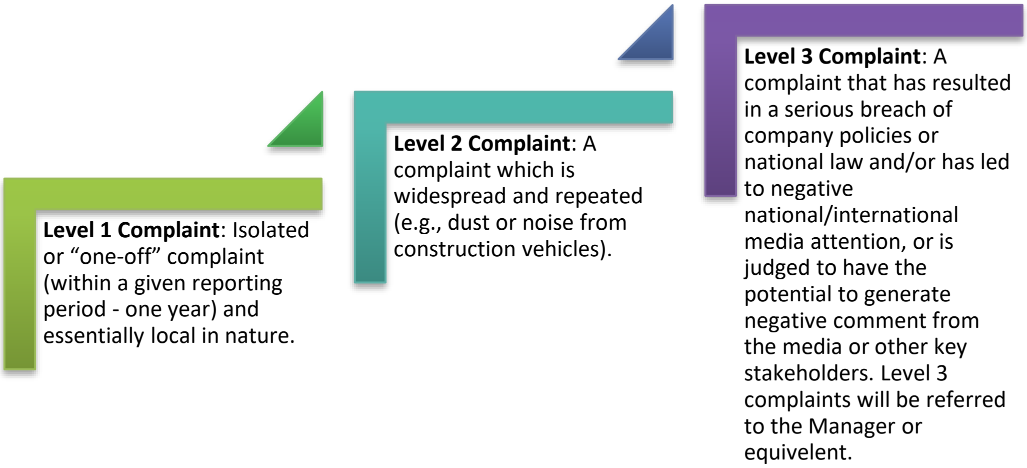
Step 10
- Close out grievance within 30 days of receipt of grievance. Inform submitter if more than 30 days are required to complete corrective actions

The grievance mechanism will be publicly communicated to stakeholders and they will be made aware of the process, their rights to submit grievances, and how the mechanism will function.

Complaints will be submitted to the CLO/GO directly via telephone, letters, site offices, and via email where accessible. In addition to any original documentation submitted by the complainant, all grievances shall be recorded by the CLO/GO using the either the Grievance Record Short Form or Grievance Long Form (templates provided in Annex A) depending on the nature of the grievance.

On receipt of the grievance the CLO/GO will log the complaint in a grievance log (template provided in Annex A). The grievance is then reviewed by the CLO/GO who assesses the significance in order to prioritise the grievance. The significance criteria are presented in Figure 8.

FIGURE 8: SIGNIFICANCE CRITERIA



Level 1 Complaint: Isolated or "one-off" complaint (within a given reporting period - one year) and essentially local in nature.

Level 2 Complaint: A complaint which is widespread and repeated (e.g., dust or noise from construction vehicles).

Level 3 Complaint: A complaint that has resulted in a serious breach of company policies or national law and/or has led to negative national/international media attention, or is judged to have the potential to generate negative comment from the media or other key stakeholders. Level 3 complaints will be referred to the Manager or equivelent.

Level 1 and 2 complaints will be managed by the CLO/GO. Level 3 complaints will be managed in discussion with the in-country manager.

The submitter will receive acknowledgement of receipt of the grievance as soon as possible, and no later than within 7 days of receipt. Such communication will also provide assurance that the grievance is being dealt with as well as a timeframe in which a response could be expected.

The next step after acknowledging receipt will be for the CLO/GO to proceed with an eligibility determination of the grievance as outlined below.

a. Eligible grievances include all those that are directly or indirectly related to the Project and that fall within the remit of the Grievance Mechanism as outlined in Section 6.1 above.

b. Ineligible Complaints may include those that are clearly not related to the Project or its contractors' activities, whose issues do not fall within the remit of the Grievance Mechanism or where other JCM or community procedures would be more appropriate to address the grievance.

The outcome of the eligibility determination should be communicated to the submitter promptly. For ineligible grievances, a full explanation as to the reasons for the rejection must be included in the communication as well as an explanation as to the ability to appeal the decision if the complainant does not agree. For eligible grievances, an estimation as to the timeline for resolution will be included in the communication.

For those grievances eligible to proceed, an investigation will be carried out. The CLO/GO will involve other departments, contractors and senior management (e.g., environment, site management, engineering, etc.) in the process as required in order to fully understand the circumstances that led to the grievance being raised. This will be performed in a timely manner to avoid delaying the resolution of a grievance. The Project will aim to resolve any grievances within 30 days from the date that it was received; however, the timeframe could be extended to 60 days for more complex grievances, if required. The investigation methods will differ depending on the nature of the complaint but may generally involve activities such as interviews with the complainant and other witnesses/relevant parties, documentation review, and/or third party professional assessments (for example, in the case of property damage by a local repairman, or a doctor in the case of injury).

Resolution will require discussion with the complainant to ensure the proposed action is reasonably likely to resolve the complaint. Where possible, grievances will be addressed directly by JCM. The resolution proposal shall be respectful and considered, including rationale for the decision and any data used in reaching it. If wider consultation is necessary, grievances will be forwarded to a third party. This third party should be neutral, well respected, and agreed upon by both JCM and the affected parties. These may include public defenders, legal advisors, local or international NGOs, or technical experts. In cases where further arbitration is necessary, appropriate government involvement will be requested.

Once the relevant parties decided upon the corrective action, it will be approved and signed off by the CLO/GO, or in-country manager or equivalent, if required. The submitter will receive an email/letter within 14 days of submission of the grievance confirming the corrective action to resolve the issue. The relevant parties will then implement the corrective action and aim to close-out the grievance within 30 days of receiving the grievance or in accordance with an expanded timeline if such has been defined. The submitter will be informed if there are any delays.

6.3. Monitoring and Reporting

JCM will regularly monitor the Project Grievance Log to ensure effective management of grievances, implementation of corrective actions and generally with a view to spotting any systemic issues that may arise. This monitoring will be carried out on a routine basis as part of general Project monitoring.

Periodic internal reports will be prepared by the CLO/GO for distribution to the management team. Such reports will help in monitoring the effectiveness of the Grievance Mechanism and will generally include:

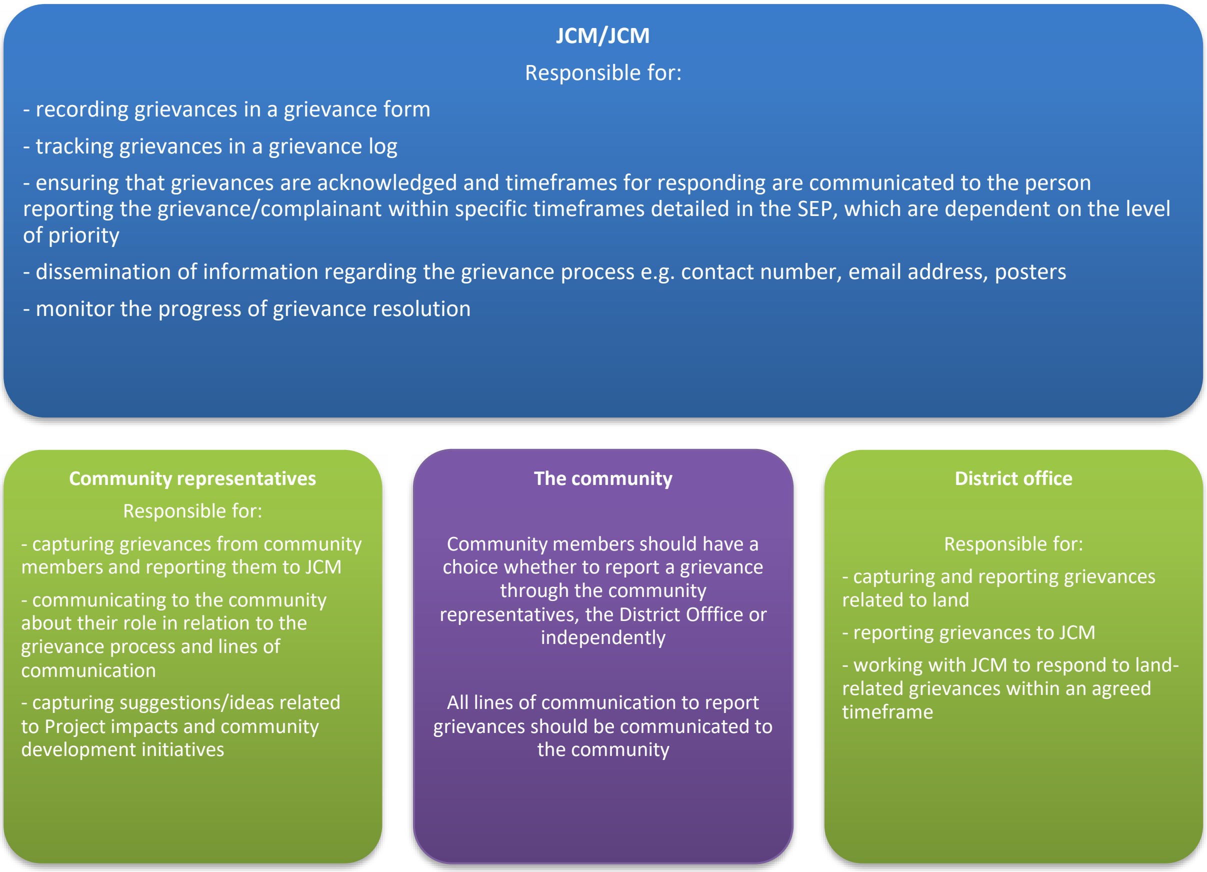
- The number of grievances logged in the proceeding period by level and type.
- The number of stakeholders that have come back after 30 days stating they are not satisfied with the resolution.
- The number of grievances unresolved after 60 days by level and type.
- The number of grievances resolved between JCM and complainant, without accessing legal or third party mediators, by level and type
- The number of grievances of the same or similar issue
- JCMs' responses to the concerns raised by the various stakeholders.
- The measures taken to incorporate these responses into project design and implementation.

The frequency for internal reporting will be defined by the CLO/GO in consultation with JCM Management.

6.4. Grievance Mechanism Roles and Responsibilities

When establishing a grievance process it is important to establish clear roles and responsibilities so that complaints and queries are responded to efficiently, in order to maintain relationships with the community. The figure below outlines responsibilities of key actors relevant for managing grievances.

FIGURE 9: GRIEVANCE ROLES AND RESPONSIBILITIES



JCM/JCM

Responsible for:

- recording grievances in a grievance form
- tracking grievances in a grievance log
- ensuring that grievances are acknowledged and timeframes for responding are communicated to the person reporting the grievance/complainant within specific timeframes detailed in the SEP, which are dependent on the level of priority
- dissemination of information regarding the grievance process e.g. contact number, email address, posters
- monitor the progress of grievance resolution

Community representatives

Responsible for:

- capturing grievances from community members and reporting them to JCM
- communicating to the community about their role in relation to the grievance process and lines of communication
- capturing suggestions/ideas related to Project impacts and community development initiatives

The community

Community members should have a choice whether to report a grievance through the community representatives, the District Offfice or independently

All lines of communication to report grievances should be communicated to the community

District office

Responsible for:

- capturing and reporting grievances related to land
- reporting grievances to JCM
- working with JCM to respond to land-related grievances within an agreed timeframe

This SEP will be updated once the grievance committee is formalised.

7. ROLES AND RESPONSIBILITIES

7.1. Principle of Team Organisation

The community relations team shall follow the key principles outlined below.

- **Overall responsibility and clear reporting lines**: Clear reporting lines and internal lines of communication will be discussed and agreed with the senior managers to ensure that the team has clear roles and responsibilities.
- **Defined responsibilities of third parties regarding communication:** the role of third parties/contractors in communicating to stakeholders will be clearly defined and regularly monitored to ensure that all interactions and engagement are culturally appropriate, do not exclude particular stakeholder groups (such as women, and vulnerable groups), and do not raise false expectations that could lead to perceived promises or commitments without obtaining prior agreement.
- **Hire, train and deploy the right personnel**: all staff interacting with stakeholders will be able to develop good working relationships with groups, from government to settlement level, in order to build maintain and trust and cooperation. Criteria of CLOs (or equivalent) engaging with stakeholders on a daily basis will include:
    - National staff from the local areas, fluent in Chichewa;
    - Staff with good communication and listening skills;
    - Open-mindedness and respect for the views of others;
    - Proactive mind-set and good problem solving skills; and
    - Commitment to the position and an understanding of JCM’s objectives and approach to governance.

Training is important to maintain the skills and capacity of the community relations team. This includes communication skills to manage expectations and deliver key messages, and computer literacy to manage and maintain engagement records and grievance logs.

7.1.1. Community Relation Functions

Details of core social performance functions in order to manage Project risks and communications are detailed in Box 4. However as the site is relatively small, JCM will likely consolidate these roles.

BOX 4: ROLES AND RESPONSIBILITIES

Social Performance Manager (developer or Project level): Primarily responsible for developing and implementing policies and procedures for managing land acquisition, community engagement, community investment etc. Other responsibilities include recruitment of key staff, developing and implementing training programmes, monitoring and review of social performance related activities and approval of budgets.

Community Liaison/Engagement Manager: Responsible for managing the in-country Community Liaison Team, ensuring sufficient resources are made available for designated functions and ensuring that the stakeholder engagement process is effective and is being implemented in line with the approach set out in this SEP.

Community Investment/Fund Officer: Primarily responsible for establishing and implementing community investment projects based on community needs assessments. This includes maintaining stakeholder relationships with partners for delivery of investment projects, monitoring and evaluation of projects, keeping informed with national and regional priorities, to align investment initiatives with the overall country strategy, and managing investment budgets and timelines.

Community Liaison Officers (or equivalent): Primarily the face of the Project responsible for building effective and trusting relationships with stakeholders/communities through regular visits and communication regarding the Project in line with this SEP. Other activities include updating stakeholder lists and logging/tracking of activities and reporting grievances and follow up when required.

Grievance Officers (or equivalent): Responsible for dissemination of information regarding the grievance process to ensure that it is widely understood among Project affected settlements and logging and resolving grievances in a timely manner, in line with the grievance process and best practice principles. This includes undertaking regular visits to settlements or phone calls with community representatives to encourage use of the grievance process and maintaining a grievance log.

8. MONITORING AND EVALUATION

8.1. Monitoring

In order to assess the effectiveness of this SEP and associated engagement activities, JCM will implement a data management and monitoring process as part of the overall monitoring of RAP commitment and performance. The reporting/data management and monitoring process will include stakeholder participation and ensure that areas of improvement and stakeholder feedback are addressed.

8.2. Reporting Mechanisms

All engagement activities throughout the life of the Project will be documented and filed in order to track and refer to records when required and ensure delivery of commitments made to stakeholders. The following stakeholder engagement records and documentation will be used (primarily by JCM).

- **Stakeholder engagement database /log**: Used to store, analyse and report on stakeholder engagement activities. It will be populated with details on information presented, audience questions, responses and commitments made and actions, and meeting evaluation results, when appropriate. The database will also be used to track frequency of meetings.
- **Meeting template**: Used to collect full meeting minutes to be filled into the stakeholder database.

- **Stakeholders list**: A list including key contacts and contact details (telephone number, email addresses etc.) for identified stakeholders. The list will be updated on a continual basis as additional stakeholders are identified.
- **Grievance log**: To record all grievances received in order to address grievances and record whether it has satisfactorily been closed out, to identify patterns, avoid recurrent problems and improve the JCM's overall social performance.
- **Media monitoring**: Includes monitoring of press and radio stories relevant to the Project.

Templates for the above documents are provided in Appendix A.

All documents will be reviewed on a monthly basis in order to ensure that it is up to date and that required meetings are being held

APPENDIX A

Example Stakeholder Engagement Management Templates

MEETING MINUTES TEMPLATE

Meeting Minutes Template			
Section 1. Meeting Details			
Location:			
Settlement:			
Traditional Authority:			
District:			
Region:			
Date:			
Project Representatives:			
No of Females:	**No of Males:**		
Section 2: Meeting Minutes (note relevant questions, responses)			
Section 3: Facilitator Observations			
Insert key observations (level of participation, response to the meeting, general observations):			
Section 4: Follow-on Actions			
Issue Raised	**Who by?**	**Action**	
Section 5: Evaluation of Feedback Process			
How many participants took part in the feedback process?			
Insert the number of yes, no, partially responses to each question in the relevant box			
Was the meeting useful?	**Yes**	**No**	**Partially**

Was the information presented in a clear manner and do you feel that you have a good understanding of the project activities and plans?	**Yes**	**No**	**Partially**
Were you able to ask the questions you wanted?	**Yes**	**No**	**Partially**
Was this meeting organised in a way to facilitate your attendance?	**Yes**	**No**	**Partially**

STAKEHOLDER DATABASE/ACTIVITY LOG (EXCEL SPREADSHEET)

Section 1: Meeting Details	Location	Settlement	District (use picklist)	Traditional Authority (use picklist)	Region (use picklist)	Date of Meeting	Project Representatives (Full name and company)	No of Females	No of Males

Section 2: Meeting Mins	Issue Title (Use picklist)	Participant Question/Comment/Quote	Project Response (If no response required or given, leave blank)	Issue Rating (low/medium/high priority)

Section 3: Facilitator Observations	Insert key observations (level of participation, response to the meeting, general observations):

Section 4: Follow-on Actions	Issue Raised	By Who?	Action

EXAMPLE GRIEVANCE RECORD SHORT FORM TEMPLATE

Project Grievance Form

If you wish to remain anonymous, do not complete items 1.1-1.5, 5 and 7.

1. Statement of Grievance

1.1 Name of Complainant ____________________

1.2 Complainant relationship to JCM ____________________

1.3 Complainant Email ____________________

1.4 Complainant Telephone ____________________

1.5 Complainant Address ____________________

1.6 Date ____________________

1.7 Location ____________________

2. Statement of Grievance

Please write the nature of the facts of the grievance (what, where, who, when, why).

3. Legal, Contract, Policy, or Procedural Violation

Please list which law, contractual clause, policy or procedure was violated (if any)

4. Remedy Sought

Please write what remedy you would propose (if any).

5. Grievance Submission an Acknowledgment of Receipt

Submitted by:

Name Surname

Signature

Received by:

Name Surname	Signature

6. Grievance Close-out

Please write what remedy was implemented in order to address the grievance.

7. Grievance Close-out an Acknowledgment of Remedy

Complainant

Name Surname	Signature

Close out by:

Name Surname	Signature

EXAMPLE GRIEVANCE RECORD LONG FORM TEMPLATE

General Information									
Grievance Reference Number				Date Submitted					
Name of Grievance Officer				Target Date for Resolution					
Mode of Grievance Communication (Mark with “X”)									
Oral		Phone		Written		E-mail			
Complainant Information									
Complainant Name				Complainant Surname					
Complainant Identification Number				Complainant Gender (Mark with “X”)	Male		Female		
Complainant Village / District / TA				Complainant Address					
Complainant Email Address				Complainant Phone Number					
Description of Grievance									
Please provide a detailed description of the grievance. Include details such as date(s), time(s), name(s) of key individuals / organisations, witnesses, frequency of occurrence									
Assessment of Grievance									
JCM Person responsible for assessing the grievance to provide grievance investigation notes here									
Assessors Name		Assessors Surname		Assessors Position		Assessors Signature		Date	

Resolution of Grievance
Based on the assessment of the grievance please provide what are the conclusions / outcomes and actions to be taken
Conclusions / outcomes

Response / resolution details
Actions to be taken

Action	Responsible Person	Target date for Completion	Actions Completed? (Yes / No)

Communication of response / resolution via (Mark with "X")									
Traditional Leader		Mail		Phone		E-mail		Others	

Grievance Close-out				
Has the grievance been satisfactorily resolved? (Mark with "X") If yes, complete the remainder of this page If No, then complete the relevant sections on the following page	Yes		No	
Comments from Assessor				
Comments from the complainant regarding the resolution				

Response / Resolution sign-off									
Assessor Name		Assessor Surname		Assessor Position		Date		Assessor Signature	
Claimant Name		Claimant Surname		Claimant Position		Date		Claimant Signature	
Is the grievance Closed Out? (Mark with "X")	Yes		No						

Grievance Appeal / Escalation to *[insert local authority name]*					
If the claimant is not satisfied with the grievance resolution, he/she can choose to appeal or escalate the grievance to the [insert local authority name]. Please indicate which process the claimant would like to pursue (Mark with an "X")					
Appeal		Escalate to *[insert local authority name]*			
Appeal		Escalate to *[insert local authority name]*			
Appeal referred to (Name & Surname)		*[insert local authority name]*			
Date		Date			
Outcomes of Appeal Process (please attach supporting documentation)		Resolution of *[insert local authority name]* (please attach supporting documentation)			
Is the grievance closed? (Mark with an "X")		Yes		No	
Response / Resolution sign-off					

Assessors / *[insert local authority name]*		Assessors / *[insert local authority name]*		Assessors / *[insert local authority name]*		Date		Assessors / DGRMC Represent	

Representative Name		Representative Surname		Representative Position				ative Signature	
Claimant Name		Claimant Surname		Claimant Position		Date		Claimant Signature	

EXAMPLE GRIEVANCE LOG (EXCEL SPREADSHEET)

GRIEVANCE FORM

Grievance Number	Date	Location	Name of Complai-n-ant	Complainant relationship to JCM	Complainant Email	Complainant Telephone	Complainant Address	Nature of Grievance	Grievance Resolution	Grievance Resolution Date	Griev-ance Closed out?	Griev-ance Close Out Date

APPENDIX I TECHNICAL MEMO: GOLOMOTI PROTECTED TREES

October 7, 2019

Technical Memo: Golomoti Protected Trees

Document Number: JCM-ESG-MG-PT-1.0

Document Version Control

Date	Document Number	Prepared By	Approved By	Notes
2019-10-07	JCM-ESG-MG-PT-1.0	A. Cochran	N/A	Technical Memo: Golomoti Protected Trees

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1 Introduction

JCM intends to build, own, and operate a 27-megawatt (MW) alternating current solar photovoltaic (PV) plant located approximately 0.5 km from the Golomoti Substation and less than 1 km from Golomoti Trading Centre in Dedza District, Malawi (the 'Golomoti Solar PV' or 'the Project'). The Project will be constructed on a 92 hectare (ha) parcel of land and will also include the construction of a short (approximately 0.5 km) transmission line from the Solar Plant Site to the Golomoti Substation, as well as a short (approximately 78.5 m) access road extending from the highway to the northeast (M5) to the Solar Plant Site.

The Project construction will require the clearing, leveling and preparation of the land and as such will necessitate the removal of all vegetation. This will include the removal of trees, some of which are listed as protected under Malawi law. This document presents an account of the protected trees that will need to be removed and the recommended actions in order to sufficiently address their protected status.

2 Protected Trees at Golomoti

The Forestry (Amendment) Rules, 2012, as gazetted in Government Notice No.23 (31 December 2012) lists the protected tree species in Malawi (Annex A). Based on the detailed land and asset surveys undertaken by the Ministry of Lands (MoL) (18 July 2019) five tree species have been identified as occurring within the project boundary. Further details of each of these trees are provided in Table 1 below.

Table 1: List of protected trees at Golomoti Solar PV.

Protected Species Common Name & Latin Name	Protected Species Vernacular Name	Tree Use	Number of Specimens in Project Area			Total Number of Specimens
			S	M	L	
Ghost Tree (*Sterculia* species)	Mgoza	Bark is used to make ropes	0	0	3	3
Natal Mahogany (*Trichilia emetica*)	Msikidzi	Firewood, timber	2	1	0	3
Peacock flower (*Albizia gummifera*)	Mtangatanga	Firewood, timber	6	1	59	66
African sausage (*Kigellia Africana*)	Mvunguti	Medicinal use	4	0	3	7
Baobab (*Adansonia digitata*)	Malambe					2
					TOTAL:	**81**

Of the five species listed in Table 1, the two Baobabs (*Adansonia digitata*) were deemed as irreplaceable and sensitive due to their age, cultural value and keystone role within the ecosystem. Therefore, a separate process was undertaken in order to apply the mitigation hierarchy for these two trees (refer to Golomoti Baobab Analysis, 6 October 2019).

The remaining species (Ghost Tree, Natal Mahogany, Peacock Flower, and African Sausage Tree) were not deemed as irreplaceable as they are relatively fast growing (reaching full maturity within 30-50 years) and do not have any specific cultural value apart from the provisioning ecosystem services they provide (refer to 'Uses' described in Table 1). These species are however sensitive due unsustainable use and thus their protected status in Malawi.

3 Application of the Mitigation Hierarchy

JCM's Environmental and Social Policy (JCM-P-E&S-0.2, 6 November 2018) commits to compliance with the IFC Performance Standards (PS) on environmental and social sustainability (2012). Of relevance with regards to protected trees is IFC PS6: Biodiversity Conservation and Sustainable Management of Living Natural Resources. PS6 states that '*as a matter of priority, the client should seek to avoid impacts on biodiversity and ecosystem services'* and '*Clients are expected to fully exercise the mitigation hierarchy'*(Figure 1).

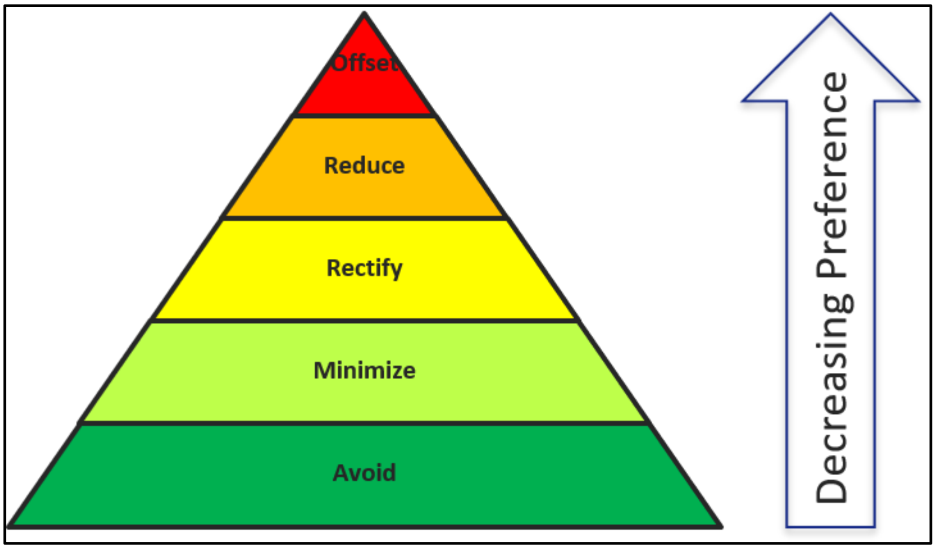

Figure 1: The Mitigation Hierarchy.

JCM undertook a high-level assessment of the feasibility of avoiding the protected trees and found that given the number and distribution of the tree species this would render the Project unfeasible. Therefore, avoidance is not a viable option for the Project to develop further. Additionally, all land intended for the Project development will need to be cleared ruling out the options of minimization, rectification and reduction within the mitigation hierarchy. Thus leaving "Off-set" as the remaining option to mitigate this impact.

JCM engaged with the ESIA biodiversity specialist (Mr. Jamestone Kamwendo) on the topic of offsetting the impact of removing the protected trees. Mr Kamwendo consulted the Assistant Director of the Department of Forestry (telephone conversation, 27 September 2019) who provided the following feedback on the issue:

- The Project does not need to apply for the permit from the Department of Forestry for the Project to clear the stated trees from the project site only;
- However, the Project will need to adhere to the recommendations that as stipulated in the ESIA Report; and
- The Project will need to ensure that for each individual protected tree cut down during the land clearing, the Project must plant five (5) or more individual seedlings of the same species in areas adjacent to the Project.
- This shall be verified during the monitoring visits to be conducted by the departments of Environmental Affairs and Forestry once the project is implemented.

4 Recommendations

It is recommended that the ESIA be updated to include the actions as stipulated by the Assistant Director of the Department of Forestry.

JCM POWER CORPORATION

ESG

ESG CORPORATE OFFICE

2nd Floor The WorkSpace, Unit 6
44 Melrose Boulevard
Melrose Arch
Johannesburg
Gauteng
South Africa

CONTACT:

Alan Cochran (ESG Director)
acochran@jcmpower.ca

Lisa Muller (ESG Coordinator)
lmuller@jcmpower.ca

HEAD OFFICE

21 St. Clair Avenue East
Suite 700
Toronto
Ontario
M4T 1L9
Canada

CONTACT:

Martin Ritchie (Chief Risk Officer)
mritchie@jcmpower.ca

Protected tree species in Malawi: The Malawi Gazette Supplement, dated 3rd December, 2012

Government Notice No. 23

FORESTRY ACT
(CAP.63:01)
FORESTRY (AMENDMENT) RULES, 2012

IN EXERCISE of the powers conferred by section 86 of the Forestry Act, I, GRAIN WILSON MALUNGA, Minister of Natural Resources, Energy and Mining, make the following Rule___

1. These Rules may be cited as the Forestry (Amendment) Rules, 2012.
2. The following list of trees is declared as Protected Trees in Malawi with effect on 3rd December, 2012
3. The 2002 list of trees has amended to include other species, which are under threat due to the declining of its population as a result of unsustainable utilization.

Botanical Name	**Common Name**	**Vernacular Name**
Adansonia digitata	Baobab	Malambe
Adina microcephala	Redwood	Mwenya, Chonya, Mgwenya Mung'ona; Mwina; Mungwina
Afzelia quanzensis	Mahogany Bean	Nkongomwa, Msokosa, Mnangaliondo; Msambamfumu; Mkongwa; Chikunda; Ipapa; Mpapa; Mpapadende
Borassus aethiopum	Palm	Mvumo; Mdikwa; Makoma; Mulala
Bridelia micrantha	Coast Goldleaf	Msopa; Chisopa; Mpasa; Mlewezi; Msongamino; Mwisya
Burkea africana	Ash	Mkalati; Kalinguti;Kawidzi; Nakapanga
Colophospermum mopane	Butterfly Tree/Turpentine	Tsanya; sanya; Ntsano; Mopani; Mpani
Cordyla african	Sunbird Tree Wild Mangp	Mtondo
Hyphaene petersiana	Palm	Mgwalangwa; Mkomakoma; Makoma Mulala
Khaya anthotheca	Mahogany	Mbawa; Muwawa; Bulamwiko
Pterocarpus angolonsis	African Teak	Mlombwa; Mtumbati, Mbira; Nawazi
Terminalia sericea	Yellow Wood	Napini; Nyapini; Mpini Nalinsi, Mkodoni, Mpululu; Njoyi.
Erythrophleum suaveolens	Red Water tree	Mwavi; Mpapa
Sclerocarya birrea	Amarula tree	Mfulu; Mtondowoko
Brachystegai manga	Miombo	Mpapa

Brachystegia microphylla	Miomo	Mombo; Mchinji
Brachystegia bussei	Miombo	Mtwana; Mseza
Tamarindus indica	Tamarind	Bwemba
Combreum imberbe	Leedwood	Msimbiti
Dalbergia melanoxylon	African blackwood	Mphingo
Widdrintonia whytei	Mulanje cedar	Sida
Kigellia africana	African sausage	Mvunguti
Pericopsis angolensis	Heartwood	Muwanga
Entandrophragma excelsum	Round heartwood	Mukarikari
Entandrophragma caudatum	Mountain Mahogany	Nayalai
Trichilia emetica	Natal Mahogany	Msikidzi
Adina microcephala	Redwood	Mwenya
Ocotea usambarensis	Camphorwood	Bokoto
Strombosia scheffleri	Strombosia	Mvivi
Apodytes dimidiata	White pear	Mzaza
Burttdavya nyasica	Burttda	Mbule
Albizia gummifera	Peacock flower	Mtangatanga
Newtonia buchananii	Forest Newtonia	Mkweranyani
Bombax stolzii	Red cotton tree	Mtonjeranga
Swartzia madagascariensis	Snake bean	Chinyenye

Diospyros mespiliformis	African ebony	Msumwa, Mchenje
Sterculia species	Ghost tree	Msetanyani, Njale, Mgoza, Mpepe
Faurea saligna	Willow beachwood	Musese
Zahna africana	Velvet-fruit zahna	Mtalala, Mtutumuko
Polyscias fulva	Parasol gtree	Mpembati, Mwaja, Mwaza
Ficalhoa laurifolia	African wild rubber	Ndopa, Mulnganya
Hagenia anthelmintica	African rosewood	Mkerete, Mnkhwale, Mthethe, Chikongolo
Parkia filicoida	African locust bean	Mkundi, Mgundi
Xymalos monospora	Lemon wood	Mulaka, Mpelekeso, Mpekeso
Fagara species	Wild lime	Pupwe, Mkurungu, Mlunguchulu
Cassia abbreviata	Long-tail cassia	Mkungusa, Mkungudza
Juniperus procera	African juniper	Changalume

APPENDIX J ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT TEAM

The core team members involved in the development of the ESIA Report and their qualifications and roles are listed in the table below.

Name	Organization	Qualifications / Experience	ESIA Role
Emlen Myers	ERM	PhD, Anthropology / >35 years	Partner in Charge / Senior ESIA Expert
Greg Lockard	ERM	PhD, Anthropology / >20 years	Project Manager / Senior ESIA Expert
Reed Huppman	ERM	MSc, Fluvial Geomorphology, Plant Ecology, and Environmental Engineering / >30 years	Biodiversity Specialist / Senior Technical Review
Ashley Morse	ERM	Master in International Affairs / 10 years	Social Specialist
Kara Westerfield	ERM	MS, Natural Resources & Environmental Sustainability / 10 years	Environmental Specialist
Justin Bedard	ERM	MA, Archaeological Studies / 15 years	Cultural Heritage Specialist
Kent Kafatia	WWEC	Registered Engineer / >25 years	In-Country Project Manager for Baseline Studies

The ESIA team contact details are provided below.

Address:	Environmental Resources Management 1776 I Street, NW, Suite 725 Washington, DC 20006 United States of America
Telephone:	+1-202-466-9090
Email:	greg.lockard@erm.com

APPENDIX K CUSTOMARY LAND CONSULTATION WITH CHIEF

January 9, 2020

LANDS DEPARTMENT FORM 1

MALAWI GOVERNEMT

DEPARTMENT OF LANDS AND VALUATION

CUSTOMARY LAND
CONSULTATION WITH CHIEF

Name of Applicant J.CM POWER of .... Village..................... TA..................District

Name of Chief THERESA KACHINDAMO District DEDZA .... Region CENTRAL
(Hereinafter called "the Chief")

Name of Village Headman G.V.H PETER
Property:
Customary land comprising 108.6622 hectares situated or near GOLOMOTI

The Chief and the Village Headman state as follows:

AQUISTION

(1) There is no objection to the proposed acquisition;

(2) No compensation is payable;

or

(3) Compensation amounting to K.............................. as proposed in the attached schedule should be paid;

TREASURY CASHIER
09 JAN 2020
RECEIVED
P.O. BOX 36, DEDZA

LEASE for 99 years/Permit to occupy:

(1) There is no objection to the proposed acquisition;

(2) No compensation is payable;

or

(3) Compensation amounting to K.............................. as proposed in the attached schedule should be paid;

TEMPORARY USE for.......................................months/years:

(1) There is no objection to the proposed acquisition;

(2) No compensation is payable;

or

(3) Compensation amounting to K.............................. as proposed in the attached schedule should be paid;

NOTE: IF THE CHIEF OR THE VILLAGE HEADMAN HAS AN OBJECTION, THE GROUNDS OF THE OBJECTION SHOULD BE SET OUT IN AN ATTACHED MEMORANDUM.

SENIOR CHIEF
KACHINDAMOTO
-07-
NTAKATAKA HEADQUARTERS
DEDZA DISTRICT ASSEMBLY

...., 20..............

Therega Kachindamoto
Chief

...., 20..............

p.E. Ka GVH
Village Headman

The above statement has been read and explained to the Chief and Village headman.

...., 20..........

....
District Commissioner

L. & V.

APPENDIX L NATIONAL LEVEL BASELINE INFORMATION

1 PHYSICAL BASELINE

1.1 Climate and Meteorology

The widely accepted division of the world into major climate categories is referred to as the Köppen-Geiger climate classification system. The majority of Malawi falls into the climate group Aw (Savannah). Climates classified as Aw are equatorial, tropical wet and dry (or savannah) climates, with average temperatures of 18 degrees Celsius or higher and significant precipitation. The driest periods of this climate group see precipitation of less than 60 mm per month.[1]

There are three main seasons in Malawi. A warm and wet season takes place from November to April, during which 95% of the annual precipitation takes place. A cool and dry winter season is from May to August, with mean temperatures between 17 and 27 degrees Celsius. In addition, frost may occur in isolated areas between June and July. A hot and dry season lasts from September to October, with average temperatures between 25 and 37 degrees Celsius.[2]

Figure 1-1 illustrates the average temperature and rainfall for Malawi. Figure 1-2 is a rainfall map of Malawi. Rain in Malawi fluctuates with the movements of the Inter-Tropical Convergence Zone, which varies slightly on an annual basis. Malawi is occasionally affected by tropical cyclones (strong winds and torrential rain), which move inland from the Indian Ocean. Southern Malawi is more easily affected than other areas of the country. The South-West Indian Ocean cyclone season occurs from November to mid-May, but the period in which they are most common is December through mid-April. Average annual precipitation in the Dedza District is 884 mm.[3]

There are 21 agrometeorological stations and 761 rainfall stations in Malawi, however less than half have more than 10 years of climate and meteorological information, so weather forecasting and projections are limited.[4]

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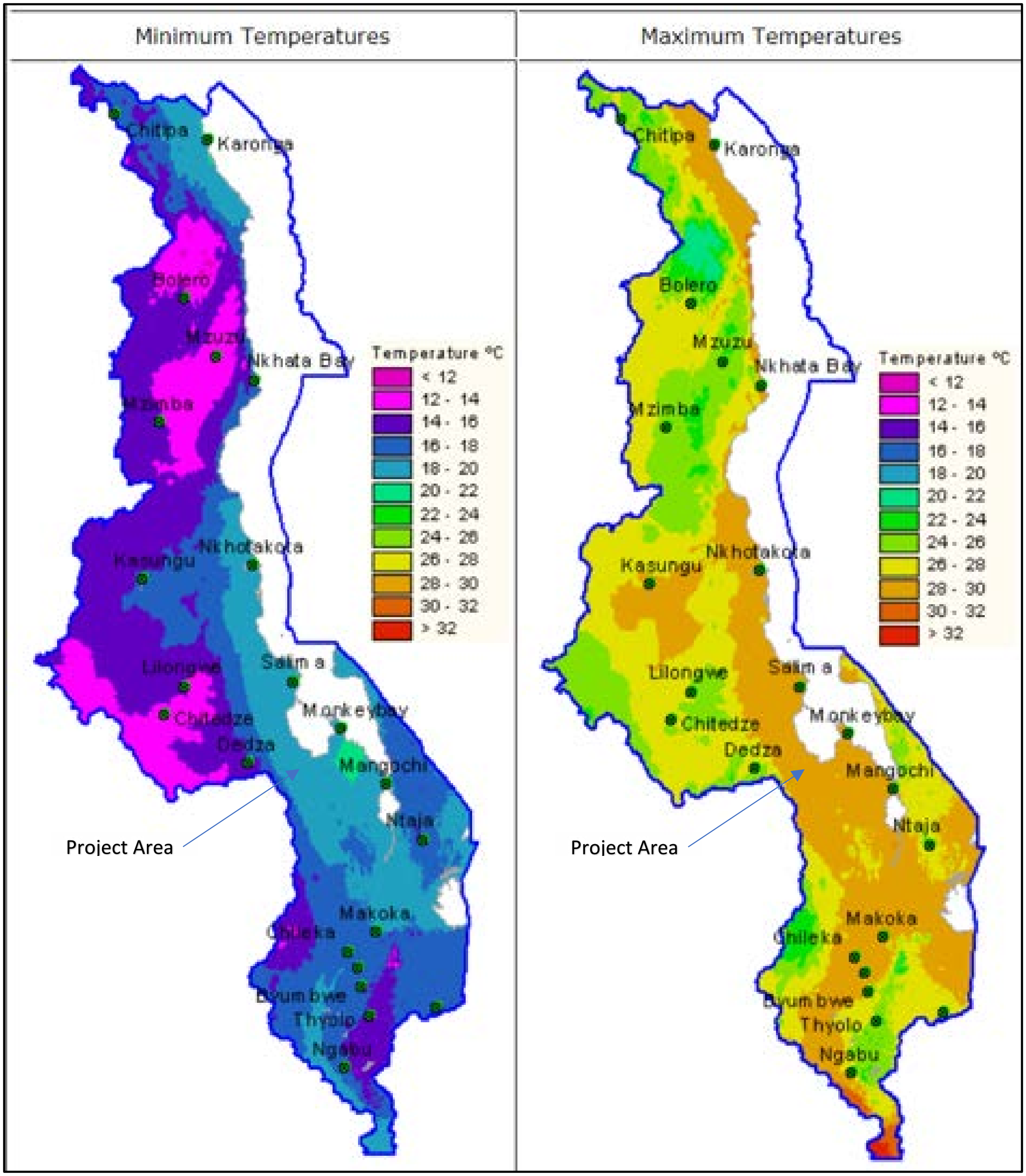
[1] M. Kottek, et al. "World Map of the Köppen-Geiger Climate Classification Updated," 2006. Accessed at: http://koeppen-geiger.vu-wien.ac.at/pdf/Paper_2006.pdf

[2] Department of Climate Change and Meteorology Services (2006), Temperature Maps. Accessed at: https://www.metmalawi.com/climate/temperature.php

[3] Mungai et al., 2016, "Smallholder Farms and the Potential for Sustainable Intensification," Frontiers in Plant Science 7:1720.

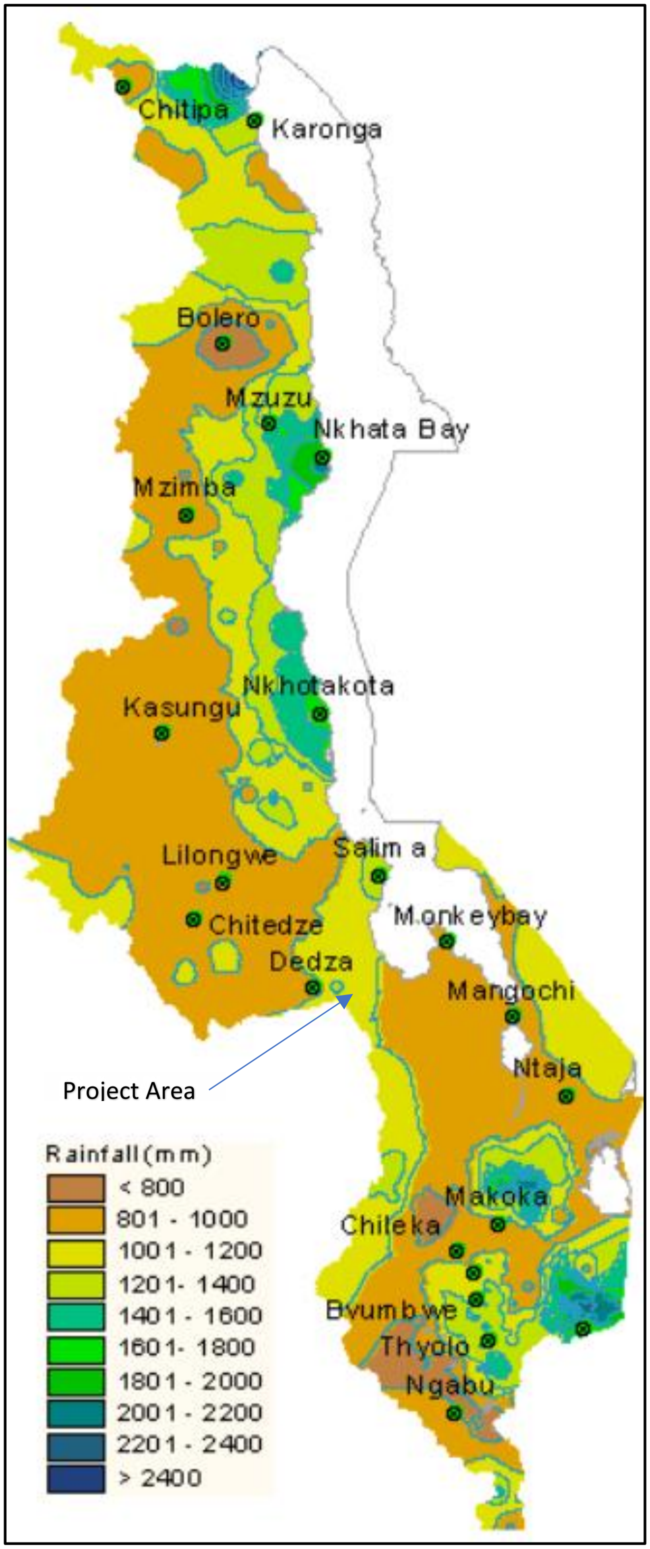
[4] Katharine Vincent, et al. "Analysis of Existing Weather and Climate Information for Malawi," Kaluma Integrated Development Solutions and University of Leeds. April 30, 2014. Accessed at: http://futureclimateafrica.org/Malawi

Figure 1-1: Malawi Annual Temperatures.



Source: Department of Climate Change and Meteorology, 2006.

Figure 1-2: Malawi Annual Rainfall.



Source: Department of Climate Change and Meteorology, 2006.

1.2 Air Quality

In 1990 and 1994, baseline Greenhouse Gas (GHG) inventories were conducted at a national level. The studies concluded that air pollution occurs country-wide in Malawi and is generally composed of a combination of dust, gases, and car exhaust fumes that affect air quality in both rural and urban settings. The use of poorly maintained large diesel vehicles in the transportation sector also contribute significantly to poor air quality (carbon monoxide, carbon dioxide, volatile organic compounds, and secondary pollutants) in urban areas. In addition, smoke and haze (particularly in rural areas) are other pollutants commonly found in Malawi due to bush fires, burning of tires and other waste, biomass burning, and dust.[5]

In rural areas, indoor air quality is generally poor, with rural homes cooking almost exclusively with wood, resulting in exposure to elevated respirable particulate matter (PM_{10} and $PM_{2.5}$). Outdoor air quality in rural areas, however, is generally good, with air quality being diminished primarily as a result of dust from roads and periodic burning of vegetation to clear land. Approximately 1.4% of total mortality, 0.5% of all disability-adjusted life years, and 2% of all pulmonary diseases in Malawi can be attributed to outdoor air pollution. Malawi's lack of monitoring equipment and systems, however, hinder air quality studies and the potential for long-term projections.[6]

As of 2002, two GHG emissions assessments were completed, in 1997 and 2002, in accordance with the requirements of United Nations Framework Convention on Climate Change. The major sources of GHG emissions are energy (e.g., combustion of fossil fuels and fugitive emissions), industrial processes (e.g., mineral processes, solvents), agriculture, forestry and other land use, and wastes (solid waste disposal, incineration/open burning of waste). According to Malawi's National State of Environment Report, Malawi emits approximately 22,708 Gigagrams (Gg) of CO_2 emissions, 95% of which is related to agriculture forestry and other land use.[7] The same sources of GHGs are responsible for sulphur dioxide (SO_2), nitrogen oxide (NO_x), non-methane volatile compounds, and particulate matter. Comprehensive studies regarding particulate matter have not been carried out for Malawi.[8]

1.3 Noise

Malawi has not completed a national baseline assessment regarding noise emissions. Noise emissions in Malawi, however, are generally concentrated near industrial or urban areas and are related to development activities, transportation operations, mining-related activities, and energy-related activities.[9]

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[5] Mapoma, Harold & Xie, Xianjun. (2013). State of Air Quality in Malawi. Journal of Environmental Protection 4:1258-1264.

[6] DG Fullerton, S Semple, F Kalambo, A Suseno, R Malamba, G Henderson, JG Ayres, and SB Gordon, "Biomass fuel use and indoor pollution in homes in Malawi," Occupational and Environmental Medicine, 2009, 66(11):777-783.

[7] Government of Malawi, "National State of Environment Report, 2011," Environmental Affairs Department, Lilongwe, 2011.

[8] Mapoma, Harold & Xie, Xianjun. (2013). State of Air Quality in Malawi. Journal of Environmental Protection 4:1258-1264.

[9] Ministry of Natural Resources, "Malawi State of Environment and Outlook Report," 2010. Accessed at: https://www.undp.org.

1.4 Geology

Crystalline metamorphic and igneous rocks of Precambrian to Lower Palaeozoic age underlie the majority of Malawi's bedrock geology. This is referred to as the Basement Complex. Precambrian-Lower Palaeozoic rocks include gneisses and granuites with granite and syenite intrusive lithologies. The gneiss found throughout the Basement Complex are sedimentary in origin, and are generally rich in graphite and contain sulphide materials, including pyrite and pyrrhotite. Mineral sizes vary from fine to coarse, and are classified as having low primary porosity and permeability.[10]

Depending on the characteristics of surface materials, heavy weathering can cause slope failures, land subsidence, and/or erosion. Most of the surficial materials in Malawi are younger sedimentary and volcanic rocks, which are largely found in small outcrops in the north and south of the country. These surficial materials include the: Permo-Triassic Karoo sedimentary series; Jurassic Karoo Stormberg volcanics; and Cretaceous to Pleistocene sedimentary beds. Intrusive rocks of Jurassic-Cretaceous age occur at several locations in southern Malawi and distinguish the Chilwa Alkaline Province, while unconsolidated Quaternary Alluvium covers the bedrock along the lakeshores and parts of the Shire Valley.[11] A brief description of each of these is provided below.

- **The Karoo Sedimentary Series** underlies the majority of Malawi's Lower Shire alluvium, as well as the Lower Shire Valley. These sedimentary rocks lie on, or against, the underlying Basement Complex. Upper sandstones and marls can be differentiated based on their increasingly red colour.
- **The Karoo Stormberg Volcanics** outcrop on the southwest side of the Lower Shire Valley. This series is comprised of basaltic lava flows (with occasional thin bands of tuff and sandstone) and is most permeable in the more porous layers between successive lava flows.
- **The Cretaceous to Pleistocene Sediments** is comprised of sandstones, unconsolidated sands, sandy marls, clays, and conglomerates. Porosities and permeabilities in this series are classified as relatively high.
- **The Chilwa Alkaline Province** in southern Malawi consists of a number of syenite and granite intrusions and various minor dykes and volcanic vents. This area is also classified as having low primary porosity, low permeability, and poorly developed weathered zones.
- **The Quaternary Alluvium** includes deposits of colluvial, fluviatile, and lacustrine sediments along the shores of Lake Malawi (particularly near Karona, Lake Malombe, Lake Chilwa, and Golomoti). Within this series, there are considerable areal differences in the occurrence of sand and clay over short distances, due to the complex nature of alluvial deposition in outwash fans, river channels, and floodplains. The overall conclusion, however, is that fine-grained sediments are the predominating material in most areas. Along Lake Malawi, the thickness of the alluvial sediments is variable due to the uneven surface of the underlying bedrock. Thickness appears to increase, however, with proximity to the lakeshore.

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[10] B. Halle and J. Burgess, "Country Environmental Profile for Malawi," Draft Report, Commission of the European Communities, August 2006.

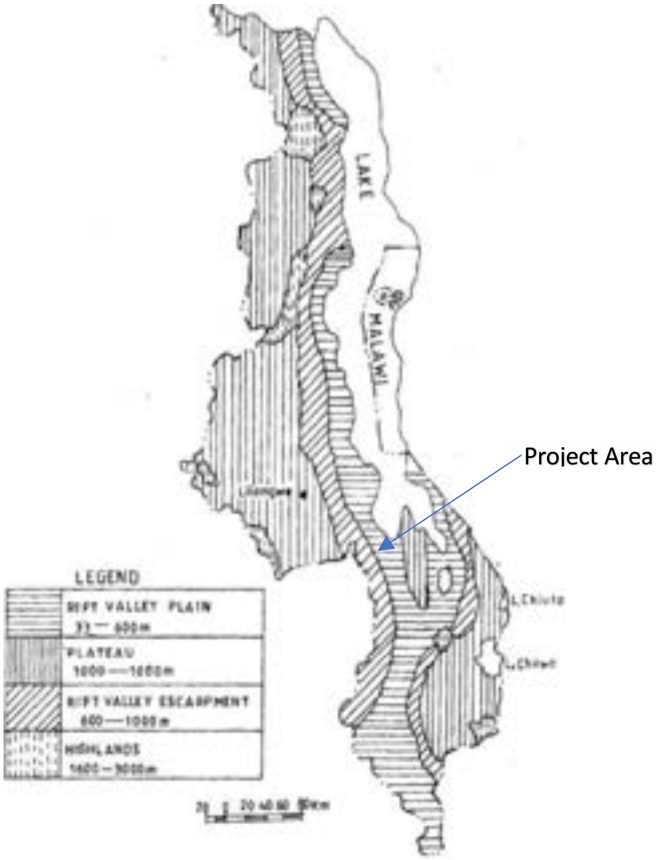
[11] B. Halle and J. Burgess, "Country Environmental Profile for Malawi," Draft Report, Commission of the European Communities, August 2006.

1.5 Topography

Malawi is characterized by a highly diverse physical environment. This wide range of relief largely impacts Malawi's climate and hydrological and edaphic conditions. As shown in Figure 1-3, there are four distinct physiographic zones in Malawi: 1) Highlands; 2) Plateaued Areas; 3) Rift Valley Escarpment; and 4) Rift Valley Floor and Plains.[12] Each of these zones is briefly described below.

- **The Highland Region** is mainly comprised of mountains and hills, the most prominent being the Mulanje, Zomba, and Dedza Mountain ranges.
- **The Plateaued Areas** cover extensive tracks of the Central and Northern regions of the country and are characterized by broad valleys and interfluves.
- **The Rift Valley Escarpment** is one of the southern stepped faults, extending from the East African Rift System. Lake Malawi, Lake Malombe, and the River Shire occupy this zone and the area remains seismically active today.
- **The Rift Valley Floor and Plains** are depositional plains, largely formed by the deposition of materials eroded from the Rift Valley Escarpment. Subdued relief and gentle slopes characterize this area.

Figure 1-3: Major Physiographic Regions of Malawi.



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[12] B. Halle and J. Burgess, "Country Environmental Profile for Malawi," Draft Report, Commission of the European Communities, August 2006, page 17.

Source: Malawi State of Environment and Outlook Report, 2010.

1.6 Soils

Figure 1-4 illustrates the dominant soil groups in Malawi. The Department of Agricultural Research classifies Malawian soil into three major soil types: eutric; chrome; and haplic. Eutric soils are commonly referred to as lithosols and cover an area of approximately 2,243,390 ha. These soils are generally distinguished by shallow, stony soils and are found in all areas of broken relief and/or steep slopes. Chromic luvisols are also referred to as latosols and cover an area of approximately 2,233,153 ha. These red- to yellow-coloured soils are among the best agricultural soils in the country and are typically found within the Lilongwe Plain and parts of Malawi’s southern region. Chromic luvisols are also distinguished by their generally good structure and deep, well-drained qualities. Chromic luvisols also include weathered ferrallitic soils, which have poor natural fertility and are easily depleted. Haplic lixosols include the alluvial soils of the lacustrine and riverine plains, vertisols of the Lower Shire Valley, the Phalombe Plain, and mopanosols in the Liwonde and Balaka areas. Haplic lixosols cover an area of approximately 1,671,495 ha.[13]

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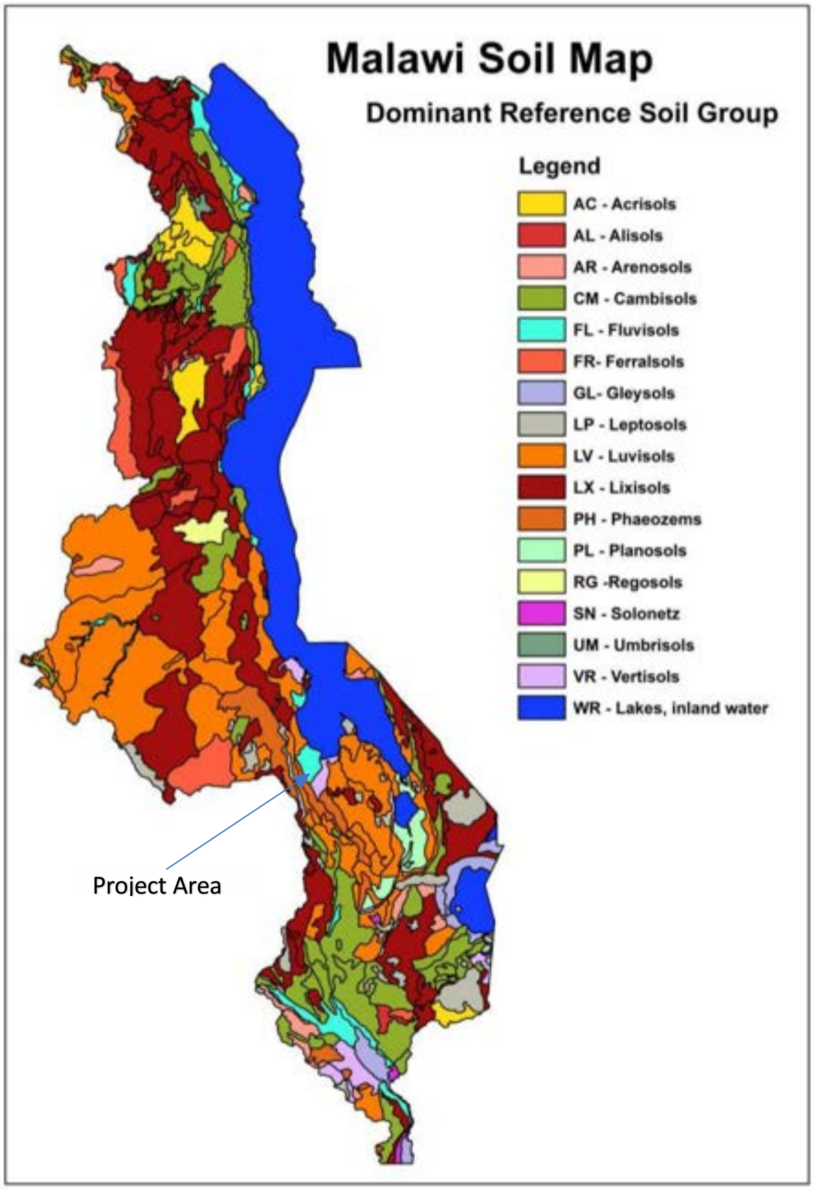
[13] Ministry of Natural Resources, “Malawi State of Environment and Outlook Report,” 2010. Accessed at: https://www.undp.org.

Figure 1-4: Dominant Reference Soil Groups in Malawi.



Source: Soil and Terrain Database, Government of Malawi, 2015.

1.7 Land Use

Table 1-1 identifies the major land availability in Malawi. Land available for agriculture represents the largest area, with 82% of total land available. The remaining percentages of available land includes protected areas and developed areas.

Table 1-1: Land Availability in Malawi.

Land Type	Million Hectares (ha)	Percentage of Total
Total Land Area of Malawi (excluding water)	9.4 Ha	100%
Protected Area (national parks, forest, game reserves)	1.7 Ha	18%
Land Available for Agriculture	7.7 Ha	82%
Estimated Land Under Estates	1.2 Ha	13%
Land Available for Smallholders	6.5 Ha	69%

Source: Ministry of Natural Resources, "Malawi State of Environment and Outlook Report," 2010. Accessed at: https://www.undp.org.

Table 1-2 identifies the current major land use in Malawi. Agricultural land covers the majority of the country (40.5%), followed by forest and woodland (26.8%), water body coverage (20.1%), herbaceous coverage (9%), urban areas (1.4%), shrubs (1.1%), and tree plantations (0.8%). Public forests include forest reserves, national parks, and wildlife reserves.

Table 1-2: Land Use in Malawi.

Land Use	Million Hectares (ha)	Percentage of Total
Total Land Area of Malawi (including water)	11.76 Ha	100%
Agriculture Land	4.78 Ha	40.5%
Forest and Woodland	3.16 Ha	26.8%
Water	2.36 Ha	20.1%
Herbaceous Coverage	1.06 Ha	9.0%
Developed Land (urban areas)	0.17 Ha	1.4%
Shrubs	0.13 Ha	1.1%
Tree Plantations	0.09 Ha	0.8%

Source: Food and Agriculture Organization of the United Nations, “Atlas of Malawi Land Cover and Land Cover Change 1990-2010,” published October 10, 2013. Accessed at: http://www.fao.org/3/a-be893e.pdf.

1.7.1 Agricultural Land

Agricultural land exists in every district of Malawi. More than three quarters of Malawi’s total available land is classified as agricultural (82% or 7.7 million ha), with 4.7 million ha currently in use for agricultural purposes. In 2010, there were an estimated 6 million smallholder farmers, with the average farm size being less than 1.2 hectares. Smallholder farmers cultivate crops largely for subsistence requirements, focusing mainly on maize, cassava, and sweet potatoes. Estate farms in Malawi focus on higher value cash crops, such as tobacco, tea, sugar, coffee, and macadamia nuts. The estate subsector is comprised by approximately 30,000 estates, which cultivate an estimated 1.1 million ha of land.[14]

1.7.2 Forest and Woodland

Forest and woodland areas can be found throughout Malawi, many of them interspersed with, and adjacent to, agricultural areas. There are five national parks and four wildlife reserves in Malawi, with the largest concentrations of forested areas being Nyika (320,078 ha), Kasungu (228,147 ha), Nkhotakota (178,568 ha), and Lengwe (100,198 ha). Customary forests[15] cover approximately 1.1 million ha (or 11.7% of total land area). Private forests in are either freehold, leased, or privately owned forests on customary land. There are no current data regarding the extent of privately owned forests in Malawi, however these areas are largely held by tobacco and tea estates and are estimated to cover approximately 275,000 ha.[16]

1.7.2.1 Natural Forests

No recent, comprehensive, country-wide forest assessment has been conducted. Natural Zambezian Miombo (Brachystegia) forest and woodland, however, are the major vegetation cover of Malawi and can be found within most forest reserves and on customary land. Other types of natural forest and woodland include evergreen forests, eucalyptus, and gmelina.[17]

1.7.2.2 Plantation Forests

The majority of forest plantations in Malawi are owned by the government, covering approximately 90,000 ha. The largest government plantation is Viphya, followed by Chongoni, Dedza, Zomba, and Mulanje. Nearly all government plantations have been estimated in forest reserve areas.[18]

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[14] Ministry of Natural Resources, “Malawi State of Environment and Outlook Report,” 2010. Accessed at: https://www.undp.org

[15] Customary forests are located on unallocated common access land and Village Forest Areas under the jurisdiction of Traditional Authorities (TAs). Malawi’s Forest Act of 1997 allows for communities to form Village Natural Resource Management Committees for the management of these forested areas.

[16] Ministry of Natural Resources, “Malawi State of Environment and Outlook Report,” 2010. Accessed at: https://www.undp.org

[17] Ministry of Natural Resources, “Malawi State of Environment and Outlook Report,” 2010. Accessed at: https://www.undp.org

[18] Ministry of Natural Resources, “Malawi State of Environment and Outlook Report,” 2010. Accessed at: https://www.undp.org

1.7.3 Developed Land

Urban land development in Malawi is generally concentrated in the four major cities of Blantyre, Lilongwe, Mzuzu, and Zomba. As of 2018, 16% of the population was located within developed urban areas, while 84% was dispersed throughout surrounding towns and villages (rural areas). At present, Malawi remains the least urbanized country in Southern Africa, but has a higher urban population growth (5.2%) than the regional average (3.5%).[19]

1.8 Surface Water

Malawi has extensive surface water features, including a network of rivers and four major lakes. Malawi's major rivers are the Shire, Ruo, Bua, South Rukuru, Linthipe, Songwe, and Dwangwa. The Shire River is the largest river (18,945 km^2 drainage area) in the country and the only outlet of Lake Malawi.

By far the largest lake in Malawi is Lake Malawi, which is approximately 560 km long and 75 km across at its widest point. The lake has a total surface area of approximately 28,750 km^2, which is approximately 20% of the country's total surface area. The maximum depth is approximately 700 m in a major depression in its north-central portion. It is the fourth largest fresh water lake in the world by volume, ninth largest lake in the world by area, and third largest and second deepest lake in Africa. Lake Malawi is inhabited by more species of fish than any other lake, including at least 700 species of cichlids.[20] The lake experiences marked seasonal variations in wind, temperature, and precipitation.[21]

Lake Malawi's only outlet is the Shire River, which is the largest river in Malawi. The Shire River issues from the southern end of the lake. It flows for approximately 12 miles before entering Lake Malombe. Lake Malombe is approximately 303 km^2 and is shallow, with an average depth of 4 m. The Shire River exits Lake Malombe to the south and eventually flows into the Zambezi River in Mozambique. The Shire River has a total length of approximately 250 miles. Malawi's two other major lakes are Lake Chilwa, which is approximately 721 km^2 and is located on Malawi's eastern border with Mozambique, and Lake Chiuta, which is approximately 200 km^2 and is also located on Malawi's eastern border with Mozambique. These two lakes are separated by a 20-25 m high sand bar, with Lake Chilwa to the south and Lake Chiuta to the north.[22]

1.9 Drainage

Malawi's drainage system has been divided into 17 Water Resource Areas (WRAs). Fifteen of these drain into the Lake Malawi/Shire River system, and the remaining two drain into Lake

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[19] Malawi population and housing census report, 2018

[20] Turner, Seehausen, Knight, Allender, and Robinson, 2001, "How many species of cichlid fishes are there in African lakes?" *Molecular Ecology* 10:793-806.

[21] Ministry of Natural Resources, "Malawi State of Environment and Outlook Report," 2010, https://www.undp.org.

[22] B. Halle and J. Burgess, "Country Environmental Profile for Malawi," Draft Report, Commission of the European Communities, August 2006.

Chilwa and Lake Chiuta. The Project Site is located within the South West Lakeshore WRA, which drains into Lake Malawi.[23]

1.10 Groundwater

Malawi has three major aquifer systems. The first is "the extensive but low yielding weathered Precambrian basement complex aquifer of the plateau area," the second is "the high yielding alluvial aquifer of the lake shore and the lower Shire valley and the lake Chilwa – Mphalombe plan," and the third is "the medium yielding aquifer of the fracture zone in the rift valley escarpment."[24]

Rural areas in Malawi are highly dependent on groundwater to support their livelihoods. One of the main challenges related to groundwater in Malawi is the over-exploitation of groundwater resources due to inadequate control measures. Another is poor water quality as a result of pollution caused by cities, industries, and agricultural practices.[25]

2 BIOLOGICAL BASELINE

2.1 Terrestrial Ecoregions

Biogeographically, the proposed Project Site is located where the Central Zambezian Miombo Woodland and the Zambezian Mopane Woodland ecoregions intergrade on the Rift Valley Plain. In their natural state, these are savannah communities featuring scattered trees and an understory or ground layer comprised mainly of grasses and occasional shrubs. The canopy, when present, is typically 10 to 20 m in height. Dominant canopy species in the Zambezian Miombo Woodland would include the genera Brachystegia (miombo), Julbernardia and Isoberlinia. The Zambezian Mopane Woodland is characterized by slightly lower average annual precipitation than the Miombo Woodland, and the dominant tree is the mopane (Colophospermum mopane). The landscape in the Project Area, however, including on the Project Site, has been largely converted to Modified Habitat, supporting crop lands and pasture.

3 SOCIO-ECONOMIC BASELINE

3.1 Demographics

3.1.1 Population

According to recent estimates, the estimated population of Malawi in 2018 was 19.8 million people.[26] The population is estimated to have grown on average 2.9% per year between 2008

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[23] Geoffrey Mudolole Simeon Chavula, "Malawi," in *Groundwater Availability and Use in Sub-Saharan Africa: A Review of 15 Countries*, edited by Pavelic, Giordano, Keraita, Ramesh, and Rao, pp. 78-90. International Water Management Institute, Sri Lanka, 2012.

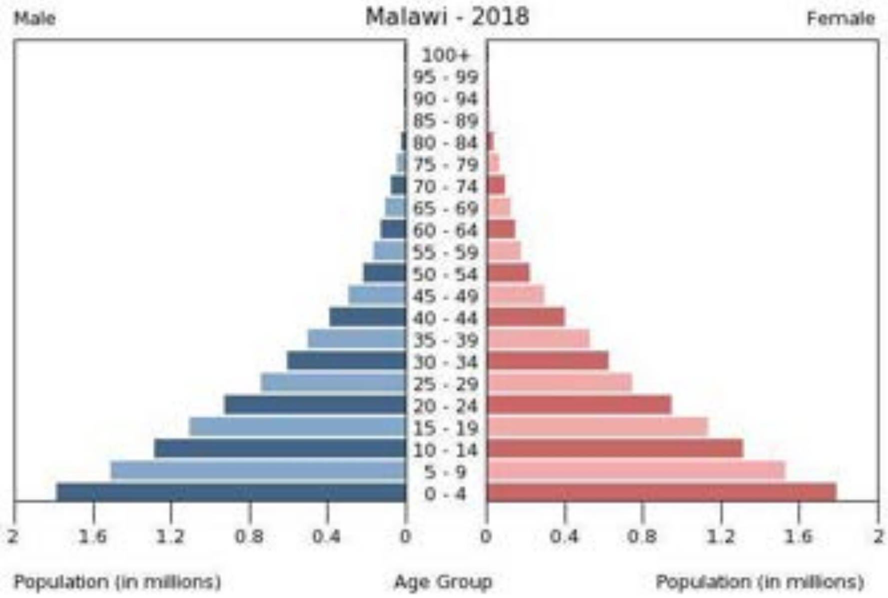
[24] 24 Geoffrey Mudolole Simeon Chavula, "Malawi," in *Groundwater Availability and Use in Sub-Saharan Africa: A Review of 15 Countries*, edited by Pavelic, Giordano, Keraita, Ramesh, and Rao, pp. 78-90. International Water Management Institute, Sri Lanka, 2012, page 82.

[25] Republic of Malawi (2010), Nkhotakota District Social Economic Profile, Nkhotakota District, Nkhotakota.

[26] CIA, The World Factbook. Available at https://www.cia.gov/library/publications/the-world-factbook/geos/mi.html (accessed May 2019)

and 2018.[27] Between 1966 and 2012, the population grew by more than ten million people, and population is projected to reach 23 million in 2025.[28] Malawi is predicted to experience an average annual urban population growth rate of 4.2% from 2013 to 2030.[29] This is reportedly due to a decline in the mortality rate resulting from improvements in healthcare and nutrition, and an ongoing high fertility rate with an average of six children per family.[30] As reflected by the fertility rate, Malawi has a young population, with 46% of the total population under the age of 15 and only 3% aged 65 years and older (Figure 3-1).[31]

Figure 3-1: Population Pyramid by Age and Sex.



Source: CIA World Factbook.

According to 2017 estimates, the population in Dedza District was 770,108 people. At the time of the 2018 census, there was an average of 4.6 people per household.[32] According to the 2015-2016 Malawi Demographic and Health Survey (MDHS), the fertility rate in Dedza was 4.4 births per woman for the three year period prior to the survey, a number equal to the national

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[27] National Statistical Office, 2018 Malawi Population & Housing Census, Preliminary Report. Available at http://www.nsomalawi.mw/images/stories/data_on_line/demography/census_2018/2018%20Population%20and%20Housing%20Census%20Preliminary%20Report.pdf (accessed March 2019)

28 Department of Population and Development, Ministry of Economic Planning and Development (nd) Why Population Matters to Malawi's Development. Available at https://assets.prb.org/pdf12/malawi-population-matters.pdf (accessed March 2019)

29 Government of Malawi, Health Sector Strategic Plan 11 (2017-2022). Available at http://www.nationalplanningcycles.org/sites/default/files/planning_cycle_repository/malawi/health_sector_strategic_plan_ii_030417_smt_dps.pdf (accessed March 2019)

30 Department of Population and Development, Ministry of Economic Planning and Development (nd) Why Population Matters to Malawi's Development. Available at https://assets.prb.org/pdf12/malawi-population-matters.pdf (accessed March 2019)

[31] CIA, The World Factbook. Available at https://www.cia.gov/library/publications/the-world-factbook/geos/mi.html (accessed May 2019)

32 Malawi population and housing census report, 2018

average but higher than the average of 3.8 in the capital of Lilongwe. This is likely due to the rural nature of the district in combination with high levels of poverty and low levels of education. The MDHS reasons that the average number of births per woman tends to decrease as wealth of the household increases.[33]

3.1.2 Migration

At the end of 2008, Malawi had approximately 11,600 refugees and asylum-seekers originating from Rwanda, Democratic Republic of the Congo, and Burundi.[34] Since then, the number of people who have fled to Malawi has risen from almost 17,000 in 2013 to more than 37,000 in March 2018.[35] Most refugees live in Dzaleka refugee camp, near the capital Lilongwe, which has a population of nearly 34,000 people. In addition, more than 3,000 Mozambican asylum-seekers are in Luwani refugee camp, located in the south of the country.

Changes in weather patterns have influenced migration. For example, in 2015, floods affected 1,101,364 people, displaced 230,000 people, and killed 106 people.[36] According to Malawi's National AIDS Control Program, male migration is more common, but the report notes that both males and females (adults and youth) are increasingly mobile as they pursue trading activities.[37]

According to the most recent Dedza District Socio-Economic Profile, over a five year period from 2007 to 2011 Dedza District received approximately 25,973 visitors and 34,885 returning residents annually, with 2008 marking record high numbers of visitors (35,209) and returning residents (42,122).[38]

3.1.3 Ethnicity, Religion and Language

Although English is the official language in Malawi, Chichewa is the national language spoken by 57% of the population.[39] According to the 1998 Population and Housing Census (the latest data regarding language), 91% of the population in the Central Region, where Dedza District is located, uses Chichewa as the language of communication in the household. Chitumbuka and

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[33] Government of Malawi, 2015-16 Demographic and Health Survey. Available at https://dhsprogram.com/pubs/pdf/SR237/SR237.pdf (accessed March 2019)

[34] World Refugee Survey 2009 – Malawi. Cited on Refworld, available at http://www.refworld.org/docid/4a40d2ac58.html (accessed March 2019)

[35] United Nations High Commissioner for Refugees, Malawi. Available at http://www.unhcr.org/malawi.html (accessed March 2019)

[36] International Organisation for Migration. Malawi 2017, Humanitarian Compendium. Available at https://humanitariancompendium.iom.int/appeals/malawi-2017 (accessed March 2019)

[37] International Organisation for Migration. No date. Briefing Note on HIV and Labour Migration in Malawi. Available at https://www.iom.int/jahia/webdav/site/myjahiasite/shared/shared/mainsite/events/docs/Briefing_Notes_HIV_Malawi.pdf (accessed March 2019)

[38] Dedza District Socio-Economic Profile 2013-2018. https://issuu.com/dedzaeast/docs/dedza_sep_final (accessed March 2019)

[39] The language spoken in Malawi.-study country.com. Available at http://www.studycountry.com/guide/MW-language.htm (accessed March 2019).

Chiyao (approximately 3% each) are other languages commonly used for communication in households in the Central Region.[40] Approximately 77% of the population in Malawi is Christian, 15% is Muslim, and most of the remaining 8% practice traditional African religions.[41] The religious makeup is similar in Dedza District, with the local population reported as being 79% Christian and 10% Muslim, with 7% reported as not practicing a religion and 4% reported as "other."[42]

3.2 Gender Context

High levels of poverty and traditional structures have created high levels of gender inequality and discrimination in Malawi. In addition, customary law has legitimised practices such as polygamy, early marriage, and wife inheritance in both matrilineal and patrilineal communities. These practices have reinforced stereotypes that consider women inferior to men.[43]

Table 3-1 shows several key gender indicators. At the national level, while males outpace females in certain employment and education indicators, such as labour force participation (72% of females compared to 82% of males) and progression to secondary education (84.4% of females compared to 90.6% males), the gaps are less pronounced than in other categories, such as in decision making/government positions[44] The adolescent fertility rate is notably high in comparison to other countries in the region – 141 per 1,000 births in Malawi, compared to 86 in Zambia, 105.8 in Zimbabwe, and 116.6 Tanzania.[45]

Table 3-1: Gender Indicators.

Indicator	Females	Males
Labour force participation rate by sex (% of population ages 15+) (2017)	72%	82%
Unemployment rate (% of labour force, modelled International Labour Organisation estimate) (2017)	7.0%	4.9%
Life expectancy at birth (years) (2016)	65.8	60.6
Prevalence of HIV (% ages 15-24) (2016)	4.7%	1.9%
Women's share of the population ages 15+ living with HIV (2016)	60.8%	-
School enrolment, secondary (%net) (2016)	30.8%	32.1%

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[40] 1998 Population and Housing Census .Available at http://www.nsomalawi.mw/images/stories/data_on_line/demography/census_98/final_report.pdf (accessed March 2019)

[41] The Malawi Religion Project Data collection and selected analyses, 2009. Available at https://www.jstor.org/stable/pdf/26349346.pdf?refreqid=excelsior%3A50a45abb6e6c5edb2ca126079124a204 (accessed March 2019)

[42] Dedza District Socio-Economic Profile 2013-2018. https://issuu.com/dedzaeast/docs/dedza_sep_final (accessed March 2019)

[43] FAO (2011) Gender Inequalities in Rural Employment in Malawi. Available at http://www.fao.org/docrep/016/ap093e/ap093e00.pdf (accessed March 2019)

[44] World Bank Gender Data Portal. Available at http://datatopics.worldbank.org/gender/country/malawi (accessed March 2019)

[45] World Bank Gender Data Portal. Available at http://datatopics.worldbank.org/gender/country/malawi (accessed March 2019)

Indicator	Females	Males
Progression to secondary school (%) (2000)	84.4%	90.6%
Proportion of seats held by women in national parliaments (%) (2017)	16.7%	-
Proportion of women in ministerial level positions (%) (2017)	22.2%	-
Adolescent fertility rate (births per 1,000 women ages 15-19) (2016)	141.0	-
Fertility rate, total (births per woman) (2016)	4.6	-

Source: World Bank Gender Data Portal.

Despite these figures, Malawi has made steps to address gender inequality and promote women's rights. Malawi has ratified the main international gender conventions, including the Convention on the Elimination of All Forms of Discrimination Against Women and the Protocol to the African Charter on Human and Peoples Rights on the Rights of Women in Africa. Malawi also adopted a National Gender Policy covering the period 2007-2011, focusing on eight key areas, including reproductive health, governance and human rights, and gender-based violence.

3.2.1 Challenges Faced by Men and Women

Domestic violence is generally a major problem in Malawi. According to the MDHS survey, 47% of women experienced spousal violence in the Central Region. In addition, the survey suggests 60% of married women report that their husband insists on knowing where they are at all times, which reflects dynamics reported in the villages in the Project Area (described further below).[46] According to data collected by the Social Welfare Office in Dedza District, which registers cases of gender-based violence, this situation may be improving given that over a five year period between 2008 and 2012, registered cases of gender-based violence against females decreased steadily.[47]

3.3 Governance, Security and Human Rights

3.3.1 Governance and Security

According to the 2018 Global Peace Index, an independent think-tank ranking of countries' relative peacefulness regarding ongoing domestic and international conflict, societal safety and security, and militarization, Malawi ranks as having a "high" state of peace. It is the 44th most peaceful country of 163 countries reviewed and the 7th most peaceful in Sub-Saharan Africa.[48] Results from a national crime victimization survey undertaken in 2012 suggest that the most common crimes in rural areas in Malawi are related to theft of crops (primarily maize) and theft

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[46] Government of Malawi, 2015-16 Demographic and Health Survey. Available at https://dhsprogram.com/pubs/pdf/SR237/SR237.pdf (accessed March 2018)

[47] Dedza District Socio-Economic Profile 2013-2018. https://issuu.com/dedzaeast/docs/dedza_sep_final (accessed March 2019).

[48] Institute for Economics and Peace, Global Peace Index 2018. Available at http://visionofhumanity.org/app/uploads/2018/06/Global-Peace-Index-2018-2.pdf (accessed March 2019)

of livestock (18.3% and 8.9% of survey respondents, respectively).[49] The survey also suggests that the most common crime in urban areas is corruption – 13.1% in urban areas compared to 4.3% in rural areas.[50] Burglary and petty crime/theft of personal property is also most common in urban areas due to lower rates of poverty and higher standards of living compared to rural areas.

3.3.2 Human Rights Context

According to the 2018 Malawi Human Rights Country Report, the most significant human rights issues prevalent in the country include: extrajudicial killings, torture, and arbitrary detention abuses committed by official security forces; harsh and life threatening prison and detention centre conditions; criminal libel; corruption; lack of investigation and enforcement involving cases of violence against women, including rape and domestic violence, partly due to weak enforcement; criminalization of same-sex sexual conduct; and child labour, including worst forms.[51] The report also highlights some of the challenges in relation to labour and working conditions, which are listed and briefly described below.

Freedom of Association and the Right to Collective Bargaining: The law allows workers, except for military personnel and police, to form and join trade unions of their choice without previous authorization or excessive requirements. In relation to the formal sector, freedom of association and the right to collective bargaining were adequately respected, however the law does not apply to the vast majority of workers who are in the informal sector. Informal sector workers organized in the Malawi Union for the Informal Sector lacking standing to bargain collectively with employers have worked with district councils to address issues affecting them. According to the *2013 Malawi Labour Force Survey*, of the 7.8 million persons in the working population, 88.7% were in the informal sector.

Prohibition of Forced or Compulsory Labour: The law prohibits all forms of forced or compulsory labour, and although convictions for forced labour are punishable with fines or imprisonment, the report suggests that children were sometimes subjected to domestic servitude and other forms of forced labour, including cattle herding; bonded labour on plantations, particularly on tobacco farms; and menial work in small businesses.

Prohibition of Child Labour and Minimum Age for Employment: The law sets the minimum age for employment at 14, and children between the ages 14 and 18 may not work in hazardous jobs or jobs that interfere with their education. Nevertheless, child labour remained a serious and widespread problem, as evidenced in the *2015 National Child Labour Survey,* which found that 38% of children ages five to 17 were engaged in some form of child labour. This was most

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[49] Eric Pelser, Patrick Burton & Lameck Gondwe (July 2004) Crimes of Need – Results of the Malawi National Crime Victimisation Survey. Available at https://oldsite.issafrica.org/uploads/CRIMES3PUBLIC.PDF (accessed March 2019)

[50] Eric Pelser, Patrick Burton & Lameck Gondwe (July 2004) Crimes of Need – Results of the Malawi National Crime Victimisation Survey. Available at https://oldsite.issafrica.org/uploads/CRIMES3PUBLIC.PDF (accessed March 2019)

[51] US Department of State. Malawi Human Rights Report 2018. Available at https://www.state.gov/documents/organization/289227.pdf (accessed March 2019)

prevalent on farms and in domestic service. Many boys worked as vendors, and young girls in urban areas often worked outside of their families as domestic servants, receiving low or no wages.

Discrimination with Respect to Employment and Occupation: Discrimination in employment and occupation occurred with respect to gender and disability. Despite the law against discrimination based on gender or marital status, discrimination against women was pervasive, and women did not have opportunities equal to those available to men. Women had significantly lower levels of literacy, education, and formal and non-traditional employment opportunities. Few women participated in the limited formal labour market, and those that did represented only a very small portion of managerial and administrative staff. Households headed by women were overrepresented in the lowest quarter of income distribution. Lesbian, gay, bisexual, transgender, and intersex individuals faced discrimination in hiring and harassment, and persons with disabilities faced discrimination in hiring and access to the workplace.

Acceptable Conditions of Work:

- **Minimum wages**: The minimum wage is currently 1346 MWK (USD 1.28) per day, lower than the World Bank's poverty income level of USD 1.90. During the year, the World Bank estimated that 69% of citizens lived below the poverty line. There was no exception to the requirement of paying the minimum wage for foreign or migrant workers. Official minimum wages apply only to the formal sector and thus did not apply to most citizens, who earned their livelihood outside the formal wage sector. Wage earners often supplemented their incomes through farming activities. No government programs provided social protections for workers in the informal economy.
- **Working hours**: The maximum legal workweek is 48 hours, with a mandatory weekly 24-hour rest period. The law requires premium payment for overtime work and prohibits compulsory overtime. The law provides for a period of annual leave of no less than 15 working days. The workweek and annual leave standards were not effectively enforced, and employers frequently violated statutory time restrictions.
- **Occupational health and safety**: The law includes extensive occupational health and safety standards, but the number of labour inspectors was insufficient to enforce the law effectively. Workers, particularly in industrial jobs, often worked without basic safety clothing and equipment. Workers have the right to remove themselves from dangerous work situations without jeopardy to continued employment, but workers are unlikely to exercise this right for fear of retribution.

Child labour is particularly common in rural areas of Malawi due to high levels of poverty. According to the 2015 National Child Labour Survey (NCLS), 47% of children aged 5 to 17 years were reportedly to be involved in economic activities in the last seven days prior to the survey, while 52% (2.9 million) of the children were working in the last 12 months. Involvement in economic activities is higher in rural areas compared to urban settings (49.7% vs. 38.3%).[52]

Figure 3-2 illustrates the distribution of working children aged 5-17 in Malawi.

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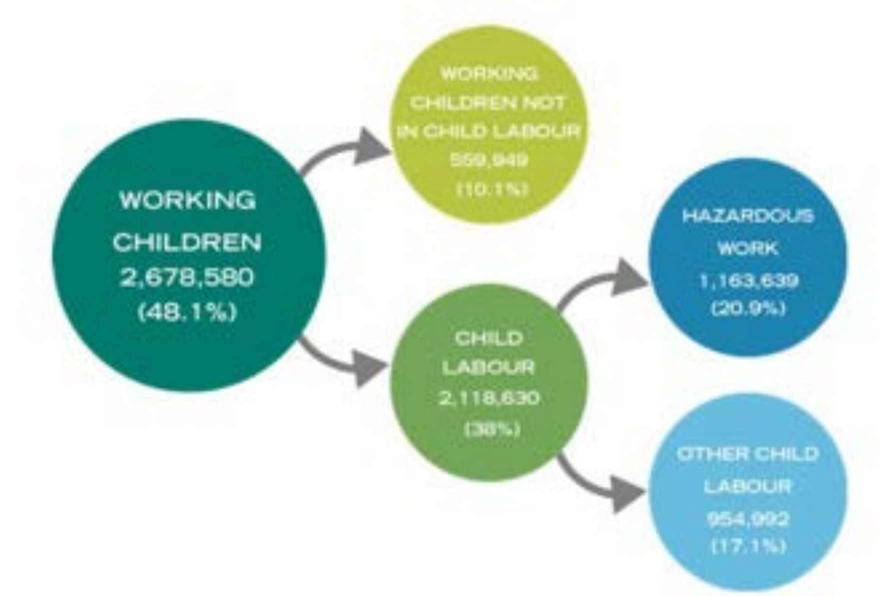
[52] International Labour Oganisation. National Child Labour Survey, 2015. Available at http://www.ilo.org/ipec/Informationresources/WCMS_IPEC_PUB_29055/lang--en/index.htm (accessed March 2019)

Figure 3-2: Distribution of Working Children Aged 5-17 Years in Malawi.



Source: National Child Labour Survey, 2015.

Among children engaged in child labour, 60% were in hazardous work (e.g., working in hazardous industries, hazardous occupations, and/or for long hours of work or night work). According to the NCLS report, of the children aged 5-17 engaged in hazardous work, 66.2% worked in the agriculture, forestry, and fishing industries, 27.5% worked in domestic work, and 6.3% worked in other industries.[53]

3.4 Education and Literacy

3.4.1 Education System

As illustrated in Figure 3-3, Malawi has an 8-4-4 education system, which is organized around eight years of primary school, four years of secondary school, and four years of tertiary education.[54]

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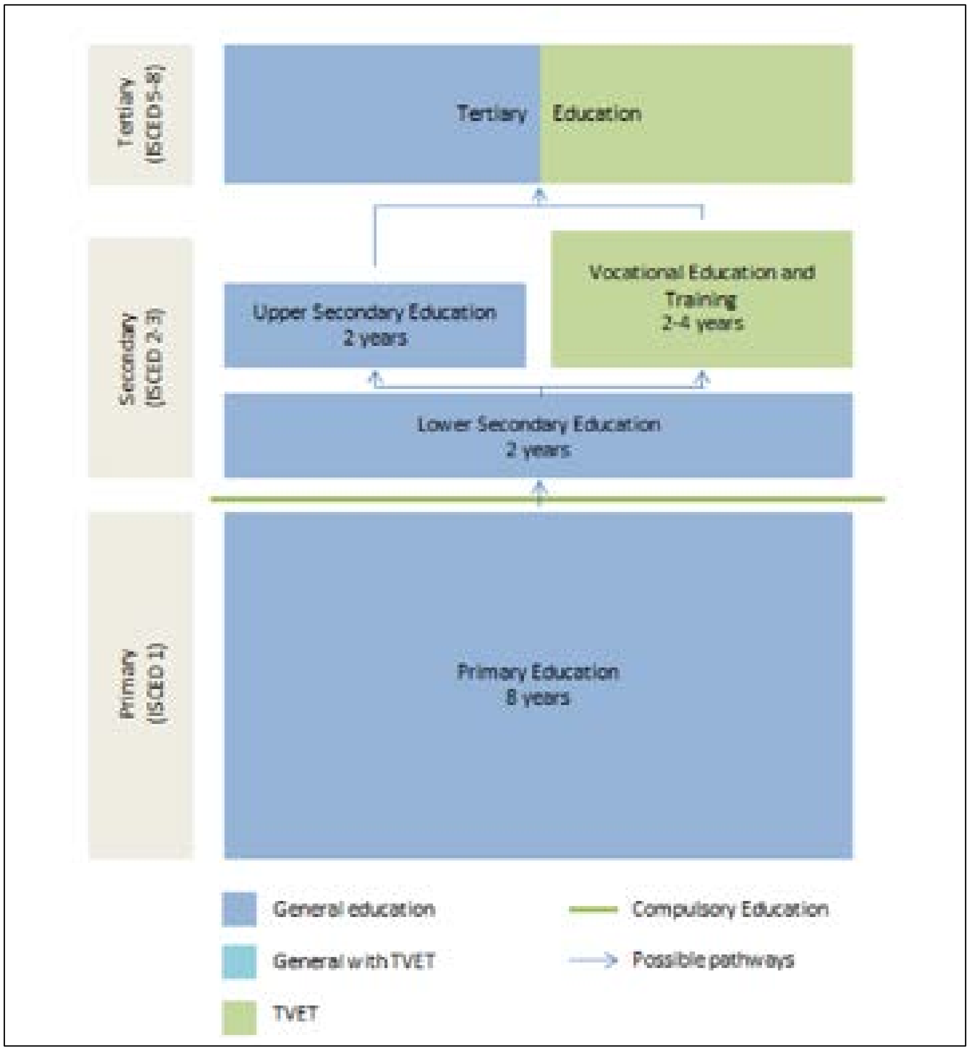
[53] International Labour Oganisation. National Child Labour Survey, 2015. Available at http://www.ilo.org/ipec/Informationresources/WCMS_IPEC_PUB_29055/lang--en/index.htm (accessed March 2019)

[54] UNESCO-UNEVOC International Centre for Technical and Vocational Education and Training (August 2012). Available at http://www.unevoc.unesco.org/wtdb/worldtvetdatabase_mwi_en.pdf (accessed March 2019)

Figure 3-3: Education System.



Source: UNESCO-UNEVOC.

There are many technical colleges and training centres throughout Malawi. This is partly because a branch of the national government, the Technical, Entrepreneurial, and Vocational Training Authority, is mandated to promote and facilitate such training in order to promote the country's economic growth. In addition, there are three main universities in Malawi: the Catholic University, Mzuzu University, and University of Malawi.[55]

3.4.2 Access to Education

Dedza District is divided into 13 main education zones. At the time of the Dedza District Socio-Economic Profile (2013-2018), there were 228 public primary schools in the district, of which 52

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[55] Education System in Malawi. Available at http://www.sdnp.org.mw/Education2010/Edu-system.html (accessed March 2019)

were solely government schools, 175 were schools with a mission such as churches, and one school was private.[56]

The 2012, total enrolment for primary education in Dedza was 189,361, with roughly equal enrolment between boys and girls. The number of trained teachers rose steadily from 2008 to 2012, with 1,832 trained teachers in the district compared with 504 untrained teachers in 2012. With regards to secondary education, there are 38 secondary schools in the district with at least one government secondary school in all of the Traditional Authorities. There are still some critical gaps, however, as some students travel more than 15 km to the nearest community secondary school. In 2010, there were 9,093 pupils enrolled in secondary school. Secondary school enrolment rates show disparities between males and females, including that girls' enrolment was lower than boys' across four years, and girls dropped out in greater numbers each year.[57]

3.4.3 Literacy Levels

At the time of the 2018 Population and Housing Census, 71.6% of males and 65.9% females aged 5 years and over in Malawi were literate.[58] At the district level, Dedza's literacy rate in the age 5 and above population was just 57%.[59]

3.5 Economy and Livelihoods

3.5.1 Economic Context

Malawi has low human development and is ranked 171 out of 189 on the human development index, which measures average achievements in the following key dimensions of human development: a long and healthy life, being knowledgeable, and have a decent standard of living.[60]

In 2017, Malawi had a per-capita Gross National Income of USD 320, the second lowest in the world for that year.[61] Over past decades, the country's development has been negatively affected by both governance challenges and climate-related disasters, such as the large-scale floods of 2015 and a serious drought in 2016, which had a major impact on growth.[62]

The economy is predominantly agricultural, contributing 28% of Gross Domestic Product in 2015. According to a 2013 National Labour Force Survey, 89% of employed persons in Malawi

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[56] Malawi population and housing census report, 2018

[57] Malawi population and housing census report, 2018

[58] Malawi population and housing census report, 2018

[59] Malawi population and housing census report, 2018

[60] UNDP Human Development Index, 2018. Available at http://hdr.undp.org/en/countries/profiles/MWI (accessed March 2019)

[61] World Bank national accounts data, and OECD National Accounts data files. Available at https://data.worldbank.org/indicator/ny.gnp.pcap.cd (accessed March 2019)

[62] Malawi Economic Development document- IMF Country Report. July 5, 2017. Available at https://www.imf.org/en/Publications/CR/Issues/2017/07/05/Malawi-Economic-Development-Document-45037 (accessed March 2019)

are engaged in informal employment.[63] As of 2010, 71.7% of Malawians lived below the poverty line. Between 2004 and 2010, extreme poverty, defined as the inability to satisfy food needs, increased from 24% to 28%.[64] Poverty rates are higher in rural areas relative to urban areas.[65]

In Dedza District, the economy is primarily agriculture-based, engaging approximately 81% of the workforce in and approximately 48% of the land in 2010. Major crops grown in the district include maize, beans, groundnuts, soybeans, potatoes, sweet potatoes, cassava, and rice. There are two cropping seasons, the summer cropping season (from October to March) and the irrigated, winter cropping season (from April to September). Most households keep chickens, while other livestock rearing in the district includes cattle, goats, sheep, pigs, rabbits, guinea fowl, ducks, and doves. The district usually experiences higher food shortages in the months of January and February. Over a three year period from 2007 to 2010, percentages of farm families experiencing food shortages during those months ranged from 8-24%.[66]

The mean per capita income in Dedza District in 2005 was MWK 20,671, with a poverty headcount ratio of 54.6% and an ultra-poverty headcount of 20.9%, according to National Statistical Office measures.[67] These figures show that the population in the district tends to live in serious poverty.

3.6 Land Ownership and Use

3.6.1 Land Ownership

Malawi's 1965 Land Act and the 2002 Land Policy recognize the following three categories of land:

- Public land;
- Private land; and
- Customary land.

In rural areas, Malawi predominantly has a customary land ownership system whereby chiefs administer land on behalf of the government. Between 65% and 75% of land in Malawi is customary land.[68] In Dedza District, customary land falls within the jurisdiction of a Traditional

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[63] National Statistical Office, 2014. Malawi Labour Force Survey 2013. Available at http://www.ilo.org/surveydata/index.php/catalog/1355/download/10327 (accessed March 2019)

[64] Malawi Economic Development document- IMF Country Report. July 5, 2017. Available at https://www.imf.org/en/Publications/CR/Issues/2017/07/05/Malawi-Economic-Development-Document-45037 (accessed March 2019)

[65] Government of Republic of Malawi (2017) Health Sector Strategic Plan II, 2017-2022. Available at http://www.health.gov.mw/index.php/policies-strategies?download=47:hssp-ii-final C

[66] Dedza District Socio-Economic Profile 2013-2018. Food shortages are calculated based on households without maize. Available at https://issuu.com/dedzaeast/docs/dedza_sep_final (accessed March 2019)

[67] Malawi Statistics. Available at http://malawi.opendataforafrica.org/# (accessed March 2019)

[68] USAID, USAID Country Profile, Property Rights and Resource Governance, Malawi. Available at https://www.land-links.org/wp-content/uploads/2016/09/USAID_Land_Tenure_Malawi_Profile.pdf (accessed March 2019)

Authority, which has been granted to a person or group and used under customary law. This land is held in trust and administered by chiefs on behalf of people in a community.

3.6.2 Land Use

Approximately 49% of Malawi's total land area is dedicated to agricultural use, with only approximately 2% of the cropland being irrigated. Large scale farms (in the range of 10-500 hectares) are relatively unusual and tend to focus on the production of cash crops such as tobacco. Meanwhile, small farms are responsible for most of Malawi's agricultural production, and the majority of the country's 2 million small farms are rain fed, cultivating on less than one hectare. Forested areas make up approximately 36% of Malawi's total land area, with approximately 19% of it protected.[69]

Land in Dedza District is mainly used for agriculture (48%), followed by forest (30%) and settlement and lake (22%). The total cultivated crop area in Dedza District grew each year between 2007 and 2012, according to the District Agriculture Office, reaching approximately 238,474 cultivated hectares in 2012. Between 2011 and 2012, the most prominent crops in terms of percentage of cultivated land were maize (42%), beans (21.7%), groundnuts (9.1%), potatoes (6%), and soy beans (5.8%).[70]

3.7 Health

3.7.1 Healthcare System and Access to Healthcare

Malawi has a three-tier health care delivery system based on three levels of health care, which are listed and briefly described below.

- **Primary health care or community care**: Consists of community initiatives, health posts, dispensaries, maternity units, health centres, and community and rural hospitals.
- **District hospitals**: Constitute the secondary level of health care. They provide specialized services to patients referred from the primary health care level, through outpatient and inpatient services and community health services. These services are enhanced by provision of adequate specialized supportive services, such as laboratory, diagnostic, blood bank, rehabilitation, and physiotherapy services.
- **Tertiary health care**: Consists of highly specialised services and are provided by central hospitals and other specialist hospitals delivering care for specific disease conditions or specific groups of patients.[71]

Malawi's Ministry of Health is responsible for healthcare in Malawi, and the majority of services are provided by the government, with the Christian Health Association of Malawi (CHAM)

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[69] USAID, USAID Country Profile, Property Rights and Resource Governance, Malawi. Available at https://www.land-links.org/wp-content/uploads/2016/09/USAID_Land_Tenure_Malawi_Profile.pdf (accessed March 2019)

[70] Dedza District Socio-Economic Profile 2013-2018. Available at https://issuu.com/dedzaeast/docs/dedza_sep_final (accessed March 2019)

[71] Africa Health Observatory. Malawi. Available at http://www.aho.afro.who.int/profiles_information/index.php/Malawi:Service_delivery_-_The_Health_System (accessed March 2019)

providing a large proportion of services in rural areas. The Ministry of Health recognizes the role of traditional healers in the delivery of health services. As such, a Traditional Medicine Policy has been developed to guide the practice of traditional medicine in the country.[72]

At the time of the most recent Socio-Economic Profile, there were 34 health facilities in the Dedza District, including two hospitals, 23 health centres, eight dispensaries, and one maternity ward. The government runs most of these facilities (22), followed by CHAM (11) and private facilities (1). The facilities offer health services to the general public, including community health, family health, prevention and control of diseases, curative, rehabilitative, maternal health, child health, and health promotion.[73]

The health facilities in Dedza District have a total of 850 beds, providing inadequate capacity for the population they serve in the district, totalling 671,137 people. The Socio-Economic Profile also suggests that the facilities are understaffed, with only 15% of the health facilities meeting standard staffing norms.

3.7.2 Health Prevalence Rates

Table 3-2 provides an overview of the World Health Organisation (WHO) health indicators for Malawi. As the table indicates, the average life expectancy for men is 61 and for women is 67. This is in line with other countries in the region, but low compared to the rest of the world. Malaria is the most common cause of death among children under the age of five (14% of causes in 2013). HIV/AIDS is the leading cause of death among adults (27% of the total causes in 2012).[74]

Table 3-2: WHO Health Indicators for Malawi.

Indicator	Statistic
Life expectancy at birth m/f (years, 2016)	61 / 67
Under-five mortality rate (per 1,000 live births (2013)	68
Maternal mortality ratio (per 100,000 live births) (2013)	510
Deaths due to HIV/AIDS (per 100,000 population) (2012)	256.6
Deaths due to malaria (per 100,000 population) (2012)	59.6
Deaths due to tuberculosis among HIV-negative people (per 100 000 population) (2013)	9.3

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[72] Africa Health Observatory. Malawi. Available at http://www.aho.afro.who.int/profiles_information/index.php/Malawi:Service_delivery_-_The_Health_System (accessed March 2019)

[73] Dedza District Socio-Economic Profile 2013-2018. Available at https://issuu.com/dedzaeast/docs/dedza_sep_final (accessed March 2019)

[74] World Health Organisation, Country Data & Statistics. Available at https://www.who.int/countries/mwi/en/ and http://www.who.int/gho/countries/mwi.pdf?ua=1 (accessed March 2019)

Source: World Health Organisation, 2015.

Although the above figures are poor, the heath situation is improving due to investment in the health sector and the government's and NGOs' aim to achieve related Sustainable Development Goals.

According to a 2010 demographic and health survey, the life expectancy at birth for Dedza District is 44 years for males and 47 years for females, indicators falling well below the national averages. The under-five mortality rate is 140 per 1,000 live births, also comparing poorly to national averages. The Socio-Economic Profile indicates that the major causes of death in the general population include malaria, respiratory tract infections, pneumonia (tuberculosis and pneumonia), malnutrition, and anaemia, with malaria contributing to 25% of all deaths in the district during the survey year. The major causes of death for the population under five years of age include malaria, gastroenteritis, HIV and AIDS related infections, respiratory tract infection (tuberculosis and pneumonia), and malnutrition.[75]

3.7.3 Water and Sanitation

In rural areas in Malawi, the main source of water is groundwater from boreholes, and to a more limited extent, shallow wells and surface water. Despite challenges, Malawi has improved access to drinking water coverage in years past. In 2008, 77% of the population in rural areas in Malawi had access to safe drinking water, which increased to 82% in 2011. Access to sanitation over the same period remained relatively constant at approximately 55%.[76]

In Dedza District, water sources are comprised of surface and groundwater. Surface water resources are in abundant supply, and include Lake Malawi in Dedza East, as well as major rivers such as Linthipe, Bimbili, Mwachikula, Nadzipulu, Livulezi, and Lifidzi. Groundwater is primarily accessed through boreholes, hand dug wells, and to a lesser extent natural springs, and is mostly used for domestic purposes. According to a 2011 survey, the district had a total of 1,843 boreholes, 2,679 shallow wells (of which 407 are protected), and 128 springs (of which 28 are protected). About 65% of households in the district have access to safe drinking water. In terms of sanitation, the district has 83% coverage for ordinary pit latrines, 11% latrines with san plats and 16% with hand washing facilities, according to estimates from 2010.[77] A san plat (Sanitation Platform) latrine is a small locally prefabricated concrete slab designed for improvement of floor conditions around the drop hole of the latrine, these tend to thus be more durable and more hygienic as they are easier to keep clean.[78]

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[75] Dedza District Socio-Economic Profile 2013-2018. Available at https://issuu.com/dedzaeast/docs/dedza_sep_final (accessed March 2019)

[76] UNICEF, Evaluation of the Water and Sanitation (WASH) Programme in Malawi (2007-2013). Available at: https://www.unicef.org/evaldatabase/files/Evaluation_of__Malawi_WASH_Programme_Malawi_2016-001.pdf (Accessed March 2019)

[77] Dedza District Socio-Economic Profile 2013-2018. Available at https://issuu.com/dedzaeast/docs/dedza_sep_final (accessed March 2019)

[78] Björn Brandberg, 1991: The SanPlat System Lowest Cost Environmental Sanitation for Low Income Communities based on experiences from Mozambique, Malawi and Angola. https://www.ircwash.org/sites/default/files/321.4-91SA-7465.pdf (Accessed August 2019)

4 CULTURAL HERITAGE BASELINE

Tangible cultural heritage resources can be seen as significant due to their scientific value in providing information about the prehistory or history; association with historical events, persons, and themes important at the local, regional, national, and/or international level; and/or their association with long standing cultural or traditional practices. Table 4-1 provides a brief historical context of Malawi in order to contextualize discussions of tangible cultural heritage resources and assess the scientific, historic, and traditional significance of cultural heritage found across the country, in the districts of Dedza and Ntche, and within the Project Site. The summary is divided into significant periods based on the prehistoric and historic periods defined by the Malawi Department of Antiquities.

Table 4-1: Malawi Cultural Context.

Period	Description
Early Stone Age (2,500,000-250,000 B.C.)	The Earlier Stone Age of southern Africa comprises two culture-stratigraphic units--the Oldowan stone tool tradition between roughly 2 and 1.7-1.5 million years (my) ago and the Acheulean stone tool tradition between 1.7-1.5 my ago and 250-200 thousand years ago. During the Early Stone Age, Malawi was populated by early human ancestors such as Homo rudolfensis (ca. 2.5 million years ago) and later Homo erectus.[79]
Middle Stone Age (250,000-40,000 B.C.)	During the Middle Stone Age, the earliest clear archaeological evidence for the appearance of modern humans in southern Africa. The Middle Stone Age is defined by the significant presence of prepared stone core technology and early forms of symbolic expression such as rock art. Malawi populated by small bands of hunter gatherers.[80]
Late Stone Age (40,000 B.C.-A.D. 300)	The Late Stone Age is marked by the appearance of new, microlithic stone tools and the proliferation of modern human behaviours such as rock art. Malawi continued to be populated by small bands of hunter-gatherers.[81]
Iron Age (A.D. 300-1480)	The Iron Age begins with migration of Bantu speaking people into Malawi from central Africa. The first wave of migrations during this period originated from the Uluba area of the Democratic Republic of Congo. The Bantu speaking introduced iron smelting and tool production and agriculture to Malawi.[82] Archaeological surveys have identified a large number of small, Iron Age village sites across Malawi.[83]
Maravi Empire (A.D. 1480-1720)	Maravi Confederacy, also called Maravi Empire, centralized system of government established in ca. A.D. 1480. The members of the confederacy were related ethnolinguistic groups who had migrated from the north into what is now central and southern Malawi. The capital of

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[79] Klein, Richard G. 2000. The Earlier Stone Age of Southern Africa. *The South African Archaeological Bulletin* 55:107-122.

[80] Wright, David K., Jessica C. Thompson, Flora Schilt, Andrew S. Cohen, Jeong-Heon Choi, Julio Mercader, Sheila Nightengale, Christopher E. Miller, Susan M. Mentzer, Dale Walde, Menno Welling, and Elizabeth Gomani-Chindebvu. 2017. Approaches to Middle Stone Age landscape archaeology in tropical Africa. *Journal of Archaeological Science* 77:64-77.

[81] Bicho, Nuno, Jonathan Haws, Mussa Raja, Omar Madime, Célia Gonçalves, João Cascalheira, Michael Benedetti, Telmo Pereira, and Vera Aldeias. 2015. Middle and Late Stone Age of the Niassa región, northern Mozambique: Preliminary Results. *Quaternary International*. Wadley, Lyn. 1993. The Pleistocene Later Stone Age South of the Limpopo River. *Journal of World Prehistory* 7(3):243-296.

[82] Huffman, Thomas N. 1982. Archaeology and Ethnohistory of the African Iron Age. *Annual Review of Anthropology* 11:133-150. Ministry of Tourism, Wildlife, and Culture. 2005. *National Cultural Policy*.

[83] Juwayeyi, Y.M. 1993. Iron Age settlement and subsistence patterns in southern Malawi. In The Archaeology of Africa: Food, Metals, and Towns. Edited by Thurstan Shaw, Paul Sinclair, Bassey Andah, and Alex Okpoko. Routledge, New York.

	the Maravi Empire was at Mankhamba near Mtakataka in Dedza District, Malawi. The Maravi Empire expanded south and eastward to the Indian Ocean between the 14th and 16th century. A contemporary kingdom was founded by the Ngonde in northern Malawi ca. A.D. 1600.[84]
Independent Kingdoms (A.D. 1720-1880)	During the 18th and 19th century Malawi contained a number of small, independent kingdoms. The development of the slave trade by Arab and Swhaili traders on the east coast of Africa had a significant impact on the region. Islam spread into Malawi from the east coast, brought into Malawi by Swahili-speaking slave traders. Christianity was introduced in the 1860s by David Livingstone and by other Scottish missionaries who came to Malawi after Livingstone's death in 1873.[85]
Colonial Period (A.D. 1880-1964)	Great Britain established a colonial government in Malawi after occupying the region in the 1880s and '90s. In 1891 the British established the Nyasaland Districts Protectorate which included modern Malawi. Under the colonial regime, roads and railways were built, and the cultivation of cash crops were introduced. In the 1950s a growing African nationalist movement led by Hastings Kamuzu Banda eventually lead to full independence in 1964. On July 6, 1966, Malawi became a republic, and Banda was elected president; in 1971 he was made president for life.[86]

Source: ERM, 2019.

The Monuments and Relics Act of 1991 (MRA) is the primary piece of cultural heritage legislation in Malawi. The MRA contains provisions for the Minster of Antiquities to declare any monument or group of monuments or any relic or collection of relics to be a nationally protected cultural heritage resource. Monuments and relics protected by the government under the MRA are listed in the National Gazette. In addition to the monuments and relics that have been added to the National Gazette, the Directorate of Antiquities maintains a list of monuments and relics that are recognized as significant at the district and local levels but have not been added to the National Gazette.

The types of monuments and relics protected at the national level by the government of Malawi provides a framework for assessing the significance or sensitivity of cultural heritage that may be affected by the proposed Project. Table 4-2 provides summary information on the cultural heritage protected by the government under the MRA and those that were subsequently listed in the National Gazette.

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[84] Ministry of Tourism, Wildlife, and Culture. 2005. *National Cultural Policy*.

[85] https://www.britannica.com/print/article/359614.

[86] https://www.britannica.com/print/article/359614.

Table 4-2: Nationally Protected Cultural Heritage Resources.

Monuments Protected Under the Monuments and Relics Act		Monuments Added to the National Gazette	
Resource	District	Resource	District
Chongoni Rock Art Heritage Site	Dedza	Blantyre Old Boma	Blantyre
Kamuzu mausoleum	Lilongwe	Queen Victoria Memorial Hall	Blantyre
Zomba War Memorial	Zomba	St. Michael's & All Angles C.C.A.P. Church	Blantyre
Providence Industrial Mission	Chiradzulu	Resident of H.E. the President	Blantyre
National Memorial Tower	Lilongwe	Mandala Manager's House and Compound	Blantyre
Nguludi Slave House	Chiradzulu	Independence Arch	Blanytre
Nguludi Fathers house	Chiradzulu	Memorial to U.M.C.A. Missionaries	Chikwawa
Old Diamphwe Bridge Built 1923	Lilongwe/Dedza	Grave of Richard Thornton, Livingstone's geologist	Chikwawa
Saint Peter's Cathedral	Likoma Island	Chencherere Rock Shelters with Paintings	Dedza
Fort Mangochi	Mangochi	Mtunthama Monument Rea (Kachere Tree, Drum Tree and Chiwengo)	Kasungu
Embangweni Old Bandawe Church	Mzimba	War Memorial	Lilongwe
Martyrs graves, 1959	Nkhatabay	Queen Victoria Memorial Tower, Vipya Memorial& Hotchkiss Gun from "Guendolen"	Mangochi

Monuments Protected Under the Monuments and Relics Act		Monuments Added to the National Gazette	
Resource	District	Resource	District
All Saints Anglican Church Dedicated in 1896	Nkhotakota	Old Livingstonia Missionary Site, Missionary Graves & Otter Point	Mangochi
Kombo (Jumbe) Mosque	Nkhotakota	Mwalawa Mphini (chiselled/incised geological structure)	Mangochi
Livingstone Trees a) The one next to Anglican Church b)The one which is in Kombo village	Nkhotakota	Ekwendeni C.C.A.P. Church	Mzimba
Chamare (Mua)	Dedza	Memorial to Chief GomaniChikuse	Ntcheu
		Fort Lister	Phalombe
		Livingstonia C.C.A.P. Church, Old Post Office, "Stone House", Industrial Block and House No.1	Rumphi
		Mwalawolemba(Rock Paintings on Mikolongwe Hill)	Thyolo

Source: www.culture.gov.mw/index.php/divisions/department-of-antiquities, accessed on 20-May-19.

In addition to being protected on the MRA, the Chongoni Rock Art Heritage Site is listed on the United Nations Educational, Scientific and Cultural Organisation (UNESCO) World Heritage List.[87]

The monuments protected by the government of Malawi under the MRA and those subsequently provided protection through listing in the National Gazette are a mix of archaeological, built heritage, and living heritage sites. The protected archaeological resources include pictographic rock art and incised designs on rock faces. Protected built heritage resources include historic Colonial Period churches, administrative buildings, government buildings, and 20th century buildings associated with the life of the first president of Malawi, Dr.

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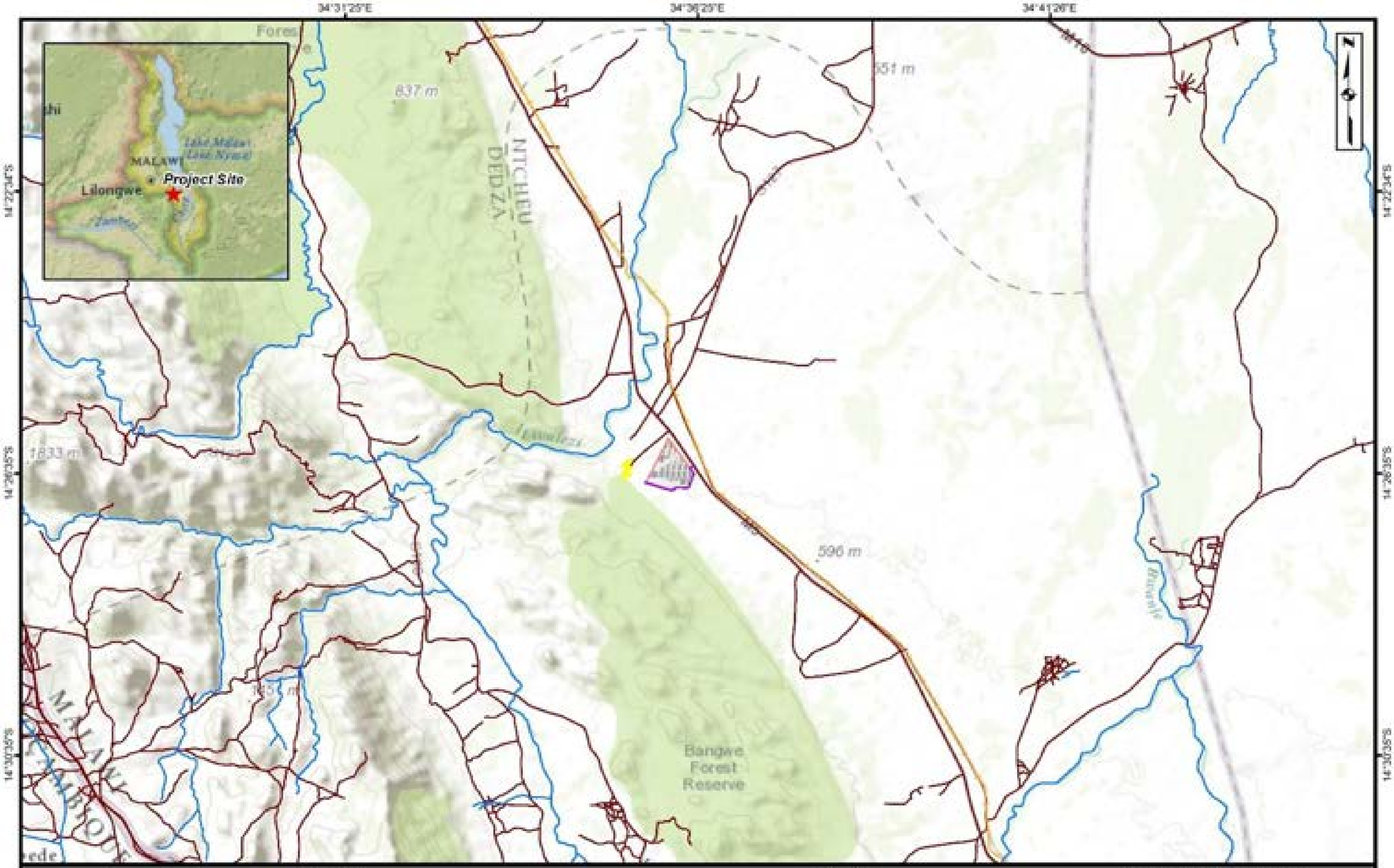
[87] https://whc.unesco.org/en/list/476.

Hastings Kamuzu Banda. Protected resources that serve as built and living heritage resources include monuments dedicated to Malawi’s independence, the graves of early Christian missionaries, memorials to those who died during the First and Second World Wars, monuments to pre-colonial kings, and memorials or sites associated with the 19th century explorer and missionary Dr. David Livingston. A number of the Colonial Period protected built and living heritage resources are associated with the introduction of Christianity to Malawi and sites associated with European colonial efforts to end the slave trade.

APPENDIX M MAPS



NOTES:

Imagery: World View 2, 6/21/2018

Reproduced under license in ArcGIS 10.3

Projection: WGS 1984 UTM Zone 36S

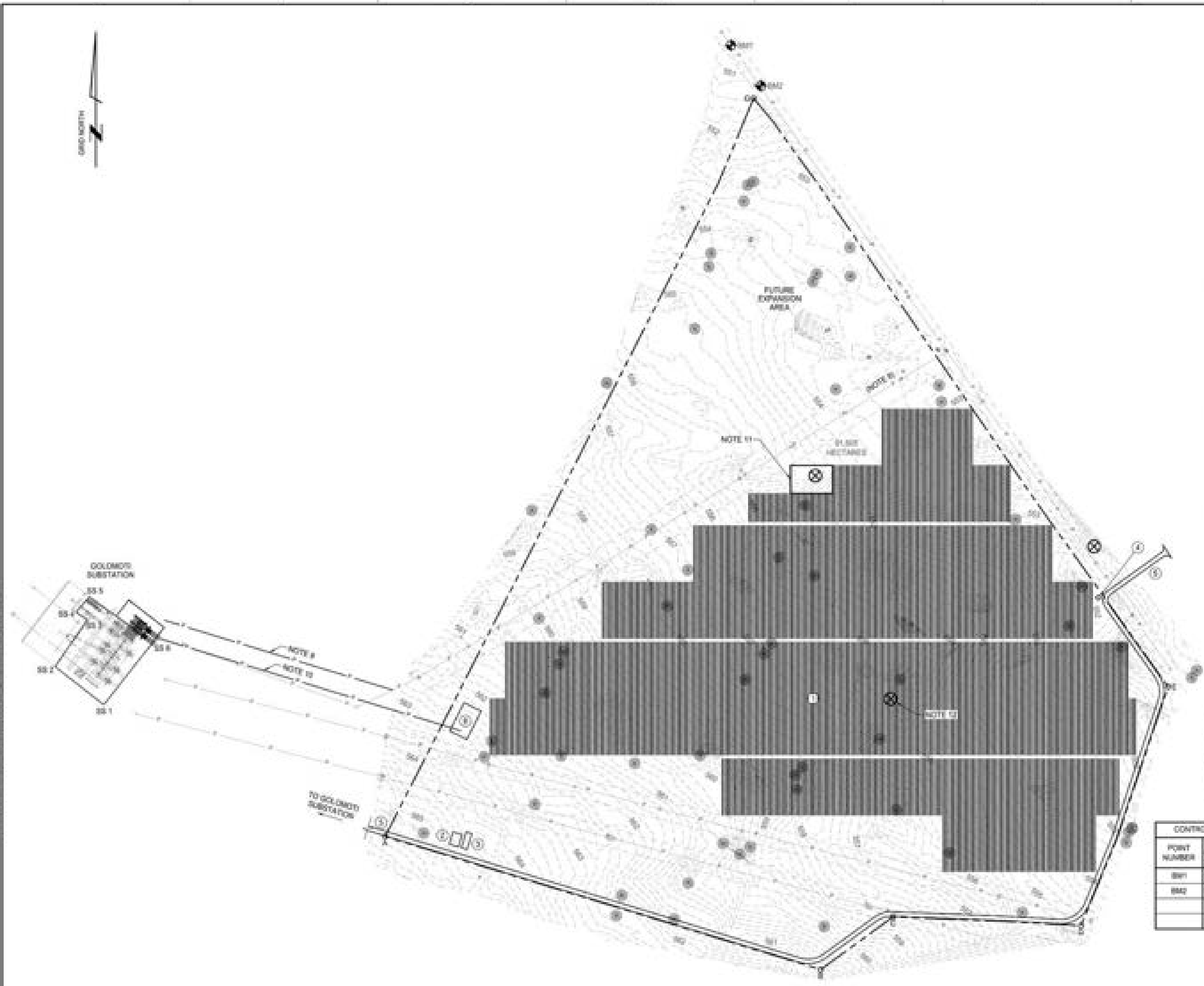
Basemap: ESRI World Topographic Map

Inset Basemap: National Geographic World Map

Topographic Map of Project Location

Golomoti, Solar Project ESIA

ERM



LEGEND

— — — —	PROPERTY BOUNDARY
	EXISTING CONTOURS, 2 METER INTERVAL
	EXISTING OVERHEAD POWER LINE
	RECOMMENDED OVERHEAD POWER SETBACK
	EXISTING ESCOM POLE
	EXISTING PYLON TOWER
●	EXISTING TREE
⊗	EXISTING MATURE BAOBAB TREE
	BENCHMARK, CONTROL POINT
EL	ELEVATION

NOTES

1. EXISTING FEATURES ARE DEPICTED BY LIGHTER WEIGHT (SCREENED) LINES. NEW STRUCTURES AND FACILITIES ARE SHOWN IN HEAVIER LINE WEIGHTS.
2. COORDINATES AND ELEVATIONS ARE GIVEN IN METERS.
3. CONTRACTOR SHALL BE RESPONSIBLE TO PERFORM ALL SURVEYING TO EXECUTE THE WORK AND TO VERIFY ALL COORDINATES AND ELEVATIONS SHOWN ON THIS SITE PLAN. CONTRACTOR SHALL ESTABLISH CONSTRUCTION CONTROL BENCHMARKS, FROM CONTROL POINTS SHOWN HEREIN, TO LOCATE AND LAY OUT THE PLANT WORKS.
4. THE CONTRACTOR SHALL BE RESPONSIBLE FOR LOCATING AND VERIFYING THE LOCATION OF ALL EXISTING BURIED UTILITIES.
5. CONTROL POINTS AND TOPOGRAPHY ARE TAKEN FROM SURVEY INFORMATION RECEIVED FROM GEOCONSULT ON 01/14/19 WITH FILE NAME : ACAD-Golomoti-Model.dwg
6. COORDINATES PROVIDED ARE BASED ON UTM COORDINATES, GRID NORTH AS INDICATED AND BENCHMARKS BM-1 AND BM-2, SHOWN ON THIS DRAWING.
7. THE BASIS OF BEARING FOR THE SURVEY IS AS FOLLOWS :

   BASIS OF UTM COORDINATES
   DATUM : ARC 1950 (MALAWI)
   PROJECTION : UTM 36 SOUTH
   DISTANCE : METERS
   ELLIPSOID : CLARKE 1880 MODIFIED
8. SHOWN CORRIDOR REFERENCES THREE ESCOM 33KV TRANSMISSION LINES.
9. EXISTING 33KV DISTRIBUTION LINES TO BE RELOCATED TO THE NORTH. (LOCATION TO BE DETERMINED BY ESCOM)
10. NEW 132KV SOLAR INTERCONNECT TO FOLLOW WAY LEAVE OF EXISTING 33KV LINES. (LOCATION TO BE DETERMINED BY ESCOM)
11. EXISTING BAOBAB TREE TO REMAIN. NO PV PANELS IN EXCLUSION AREA 66 M x 44 M.
12. EXISTING BAOBAB TREE TO BE REMOVED.

① PV PANELS
② CONTROL BUILDING
③ WAREHOUSE
④ GUARD HOUSE
⑤ ACCESS ROAD
⑥ 132KV SWITCHYARD

CONTROL POINTS TABLE (UTM 36 SOUTH)

POINT NUMBER	UTM COORDINATES		ELEVATION
	NORTHING	EASTING	
BM1	8404037.604	672418.455	550.742
BM2	8403944.114	672466.238	551.157

BOUNDARY COORDINATES

POINT NUMBER	UTM COORDINATES	
	NORTHING	EASTING
A	8402760.308	671872.758
B	8402550.480	672269.745
C	8402633.519	672673.952
D	8402619.762	672970.308
E	8402996.371	673107.688
G	8403924.260	672453.988
SS 1	8402968.000	671429.000
SS 2	8403028.000	671352.000
SS 3	8403102.000	671403.000
SS 4	8403114.000	671385.000
SS 5	8403138.000	671406.000
SS 6	8403066.000	671506.000

INTER-DISCIPLINE REVIEW

DISC	ARCH	CIVIL	ELECT	I&C	MECH	STRUCT
DATE	-	-	-	-	07/OCT/19	-
INIT	-	-	-	-	ML	-

REV	REVISIONS	DATE	DRN	DSGN	CKD	APPD
B	UPDATED WITH JCM COMMENTS	07/OCT/2019	WMT	ML	ML	ML
A	ISSUED FOR REVIEW	21/MAY/2019	WMT	ML	ML	ML

DSGN	ML	07/MAY/2019
DRN	WMT	07/MAY/2019
CKD	ML	14/MAY/2019
SCALE	1:3000	

POWER ENGINEERS

GOLOMOTI JCM SOLAR CORPORATION LIMITED

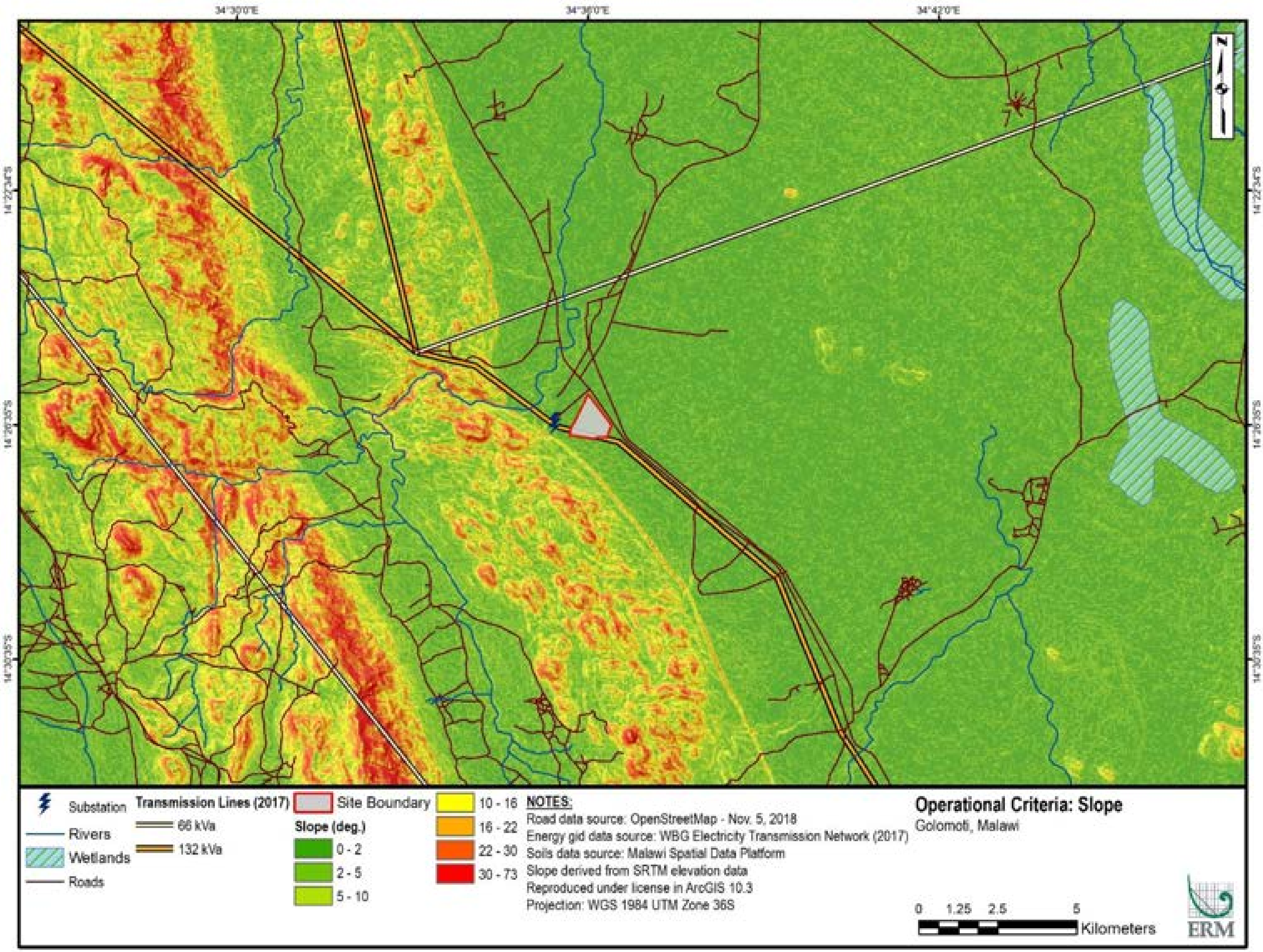
GOLOMOTI SOLAR PROJECT

20 MW CONCEPTUAL
SUBSTATION LOCATION PLAN

JOB NUMBER 154266

REV B

DRAWING NUMBER
CSK1-2



Operational Criteria: Slope

Golomoti, Malawi

NOTES:

Road data source: OpenStreetMap - Nov. 5, 2018

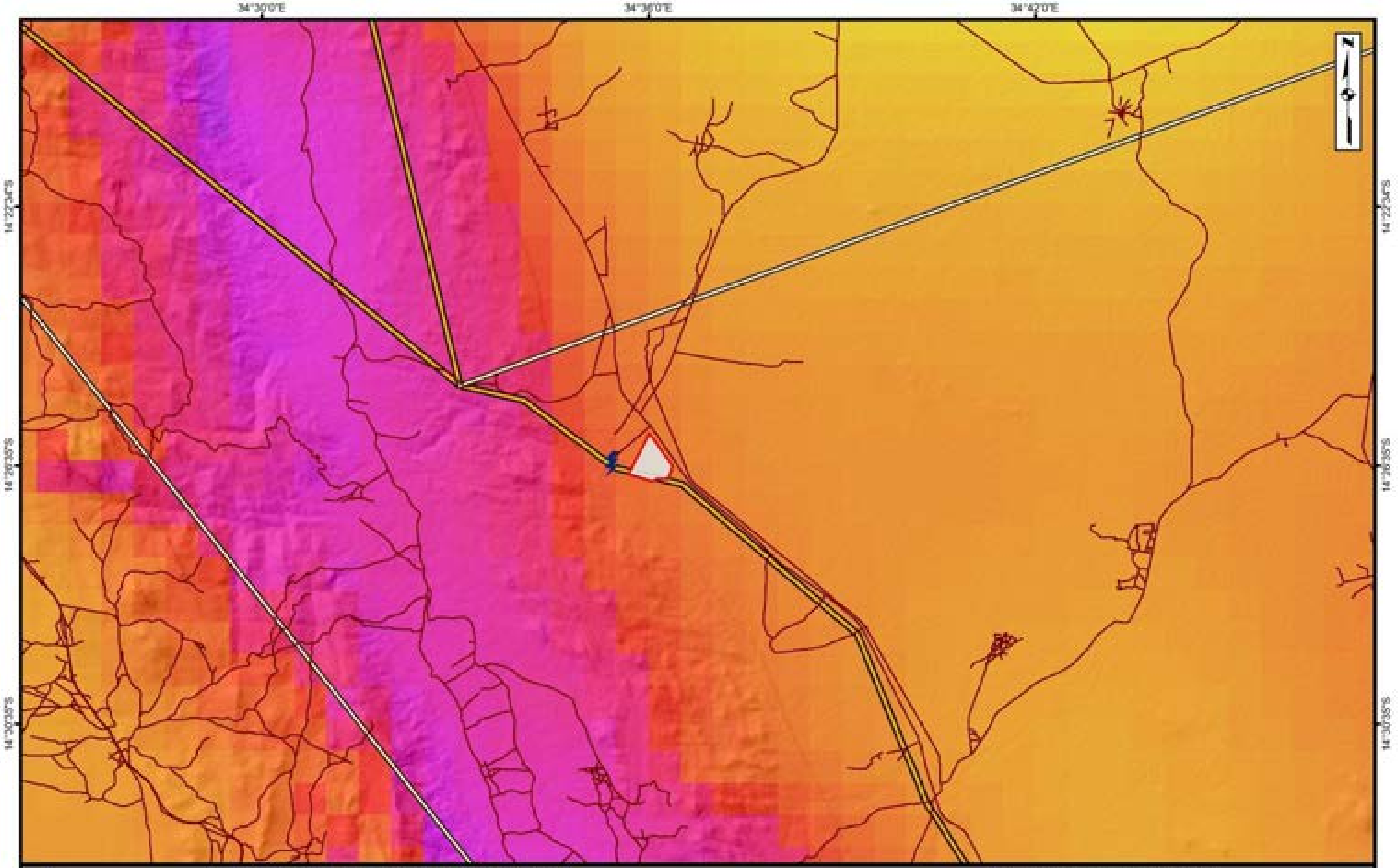
Energy gid data source: WBG Electricity Transmission Network (2017)

Soils data source: Malawi Spatial Data Platform

Slope derived from SRTM elevation data

Reproduced under license in ArcGIS 10.3

Projection: WGS 1984 UTM Zone 36S



NOTES:

Road data source: OpenStreetMap - Nov. 5, 2018

Energy gid data source: WBG Electricity Transmission Network (2017)

Annual PV Production: The World Bank Group longterm yearly average potential PV production dataset

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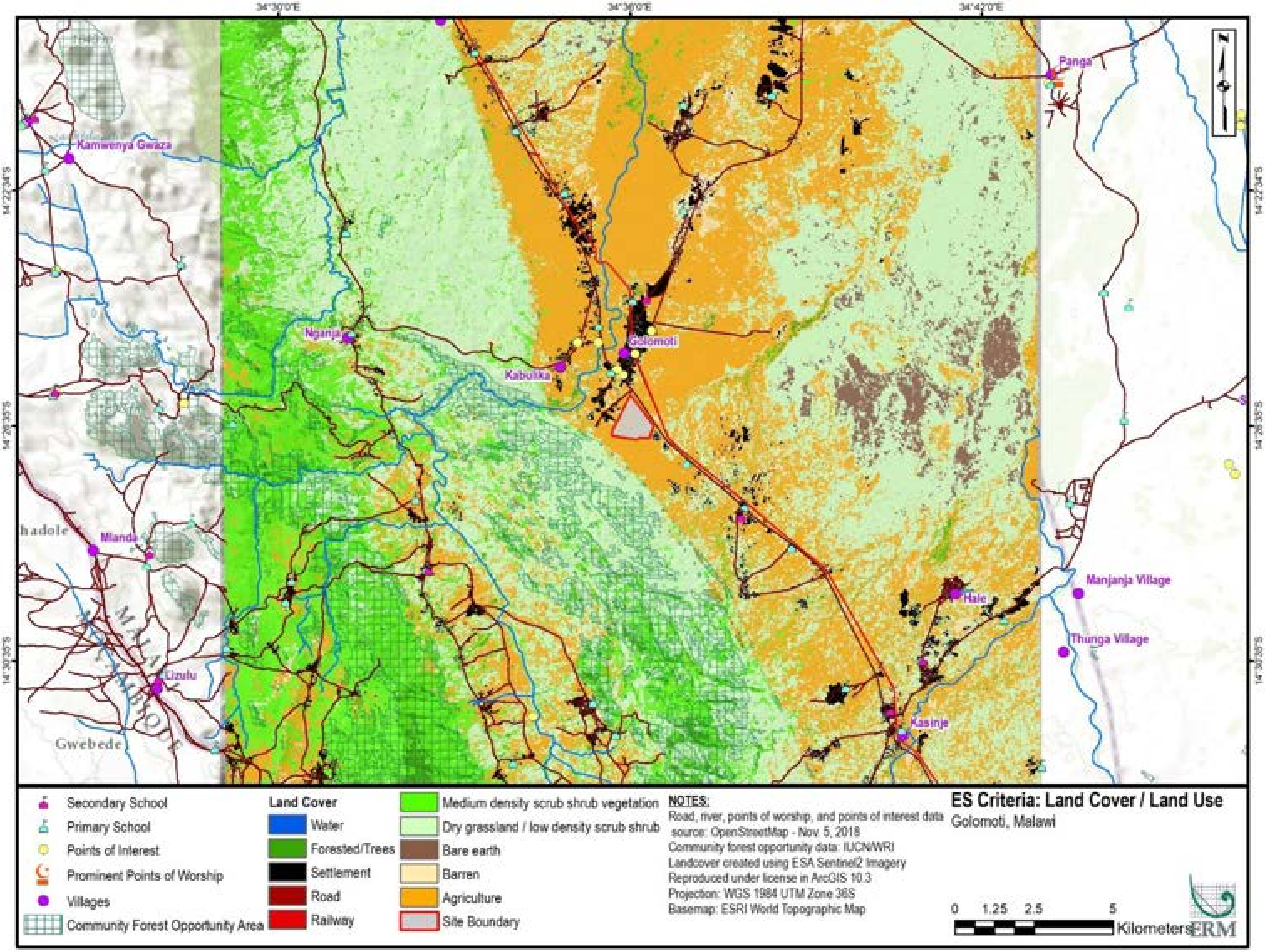
Projection: WGS 1984 UTM Zone 36S

Solar Production Potential

Golomoti, Malawi

ERM



NOTES:

Road, river, points of worship, and points of interest data source: OpenStreetMap - Nov. 5, 2018

Community forest opportunity data: IUCN/WRI

Landcover created using ESA Sentinel2 Imagery

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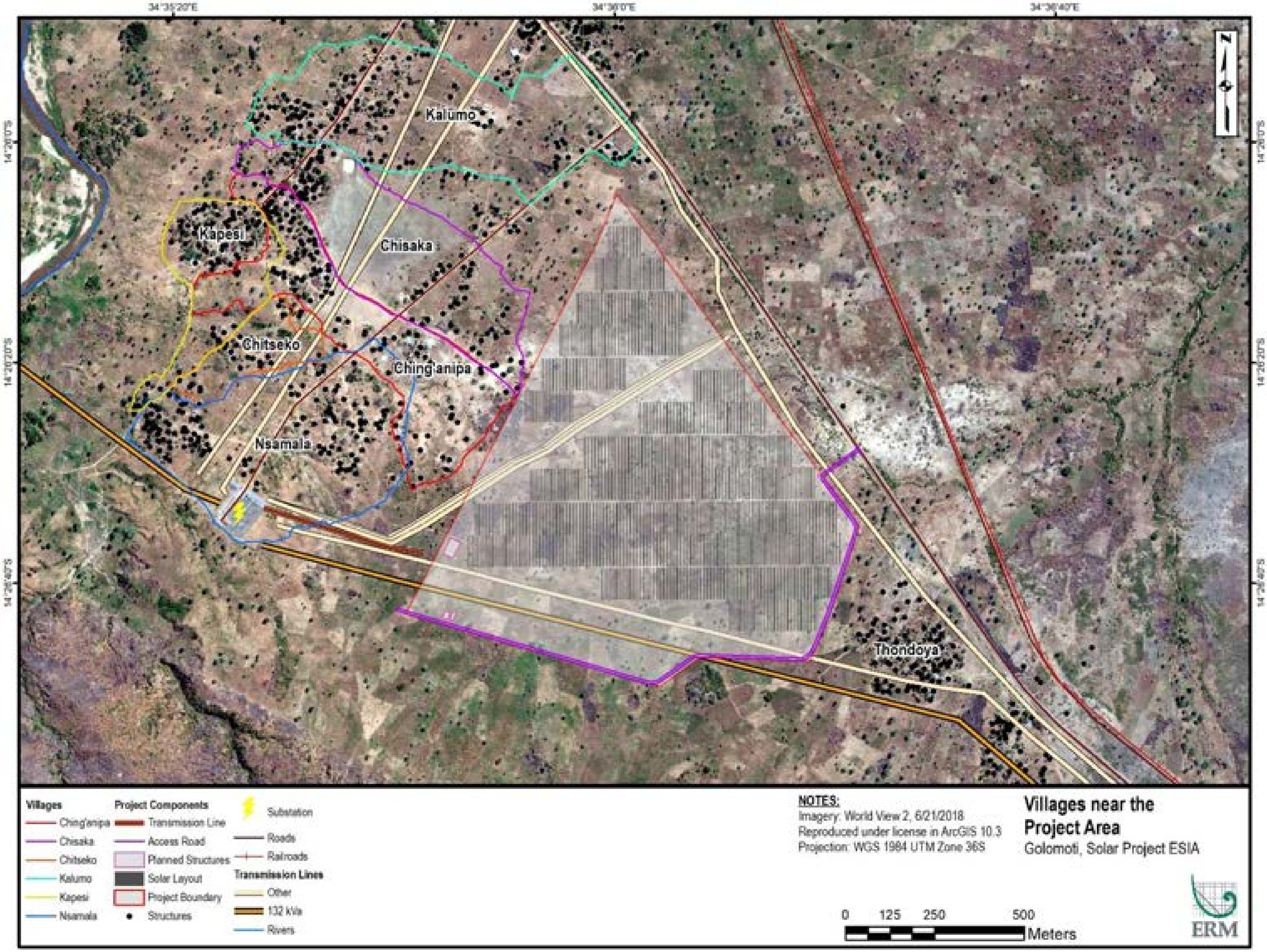
Projection: WGS 1984 UTM Zone 36S

Basemap: ESRI World Topographic Map

ES Criteria: Land Cover / Land Use

Golomoti, Malawi



NOTES:
Imagery: World View 2, 6/21/2018
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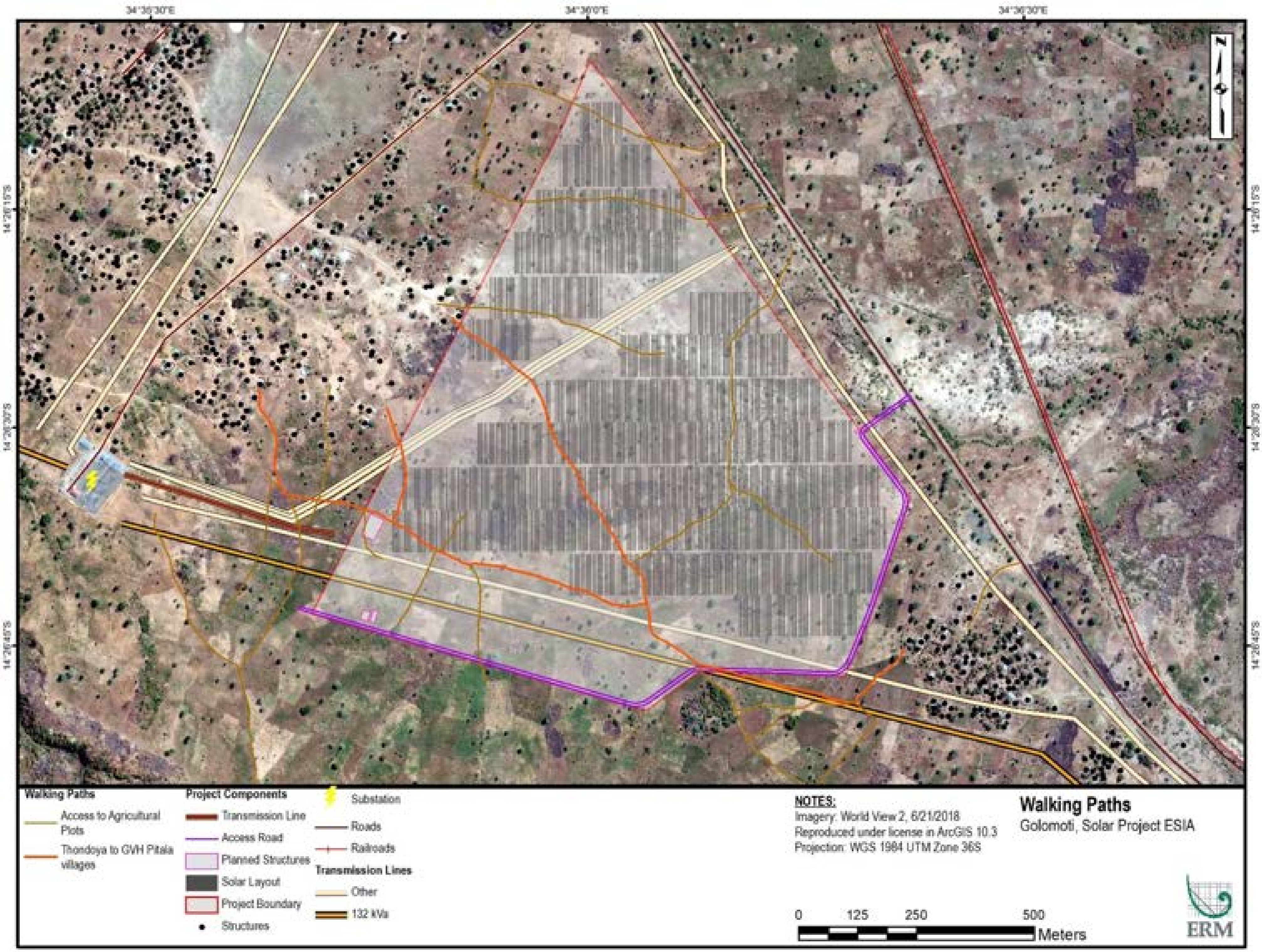
Projection: WGS 1984 UTM Zone 36S

Villages near the Project Area
Golomoti, Solar Project ESIA



NOTES:
Imagery: World View 2, 6/21/2018
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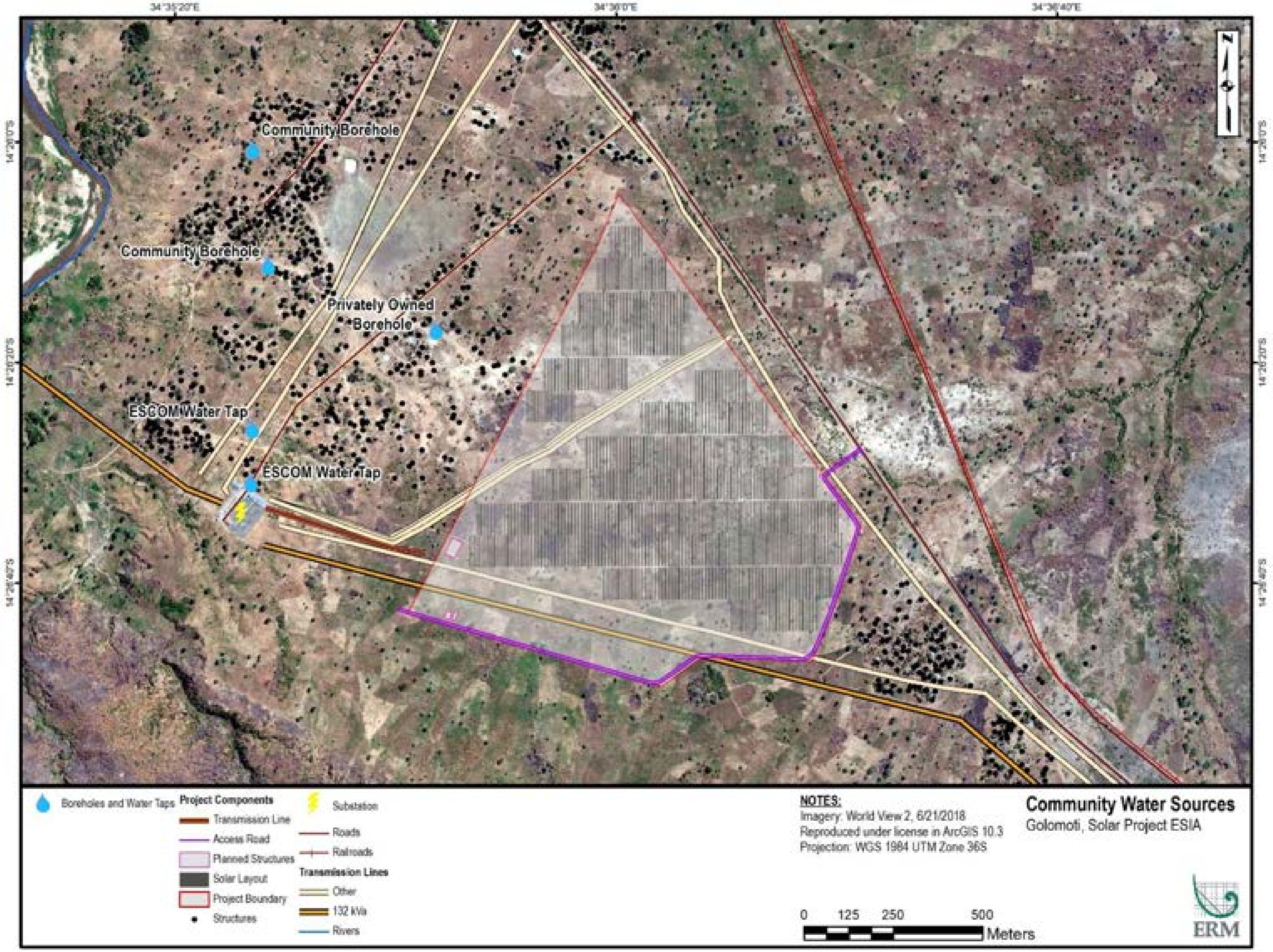
Projection: WGS 1984 UTM Zone 36S

Walking Paths
Golomoti, Solar Project ESIA



NOTES:
Imagery: World View 2, 6/21/2018
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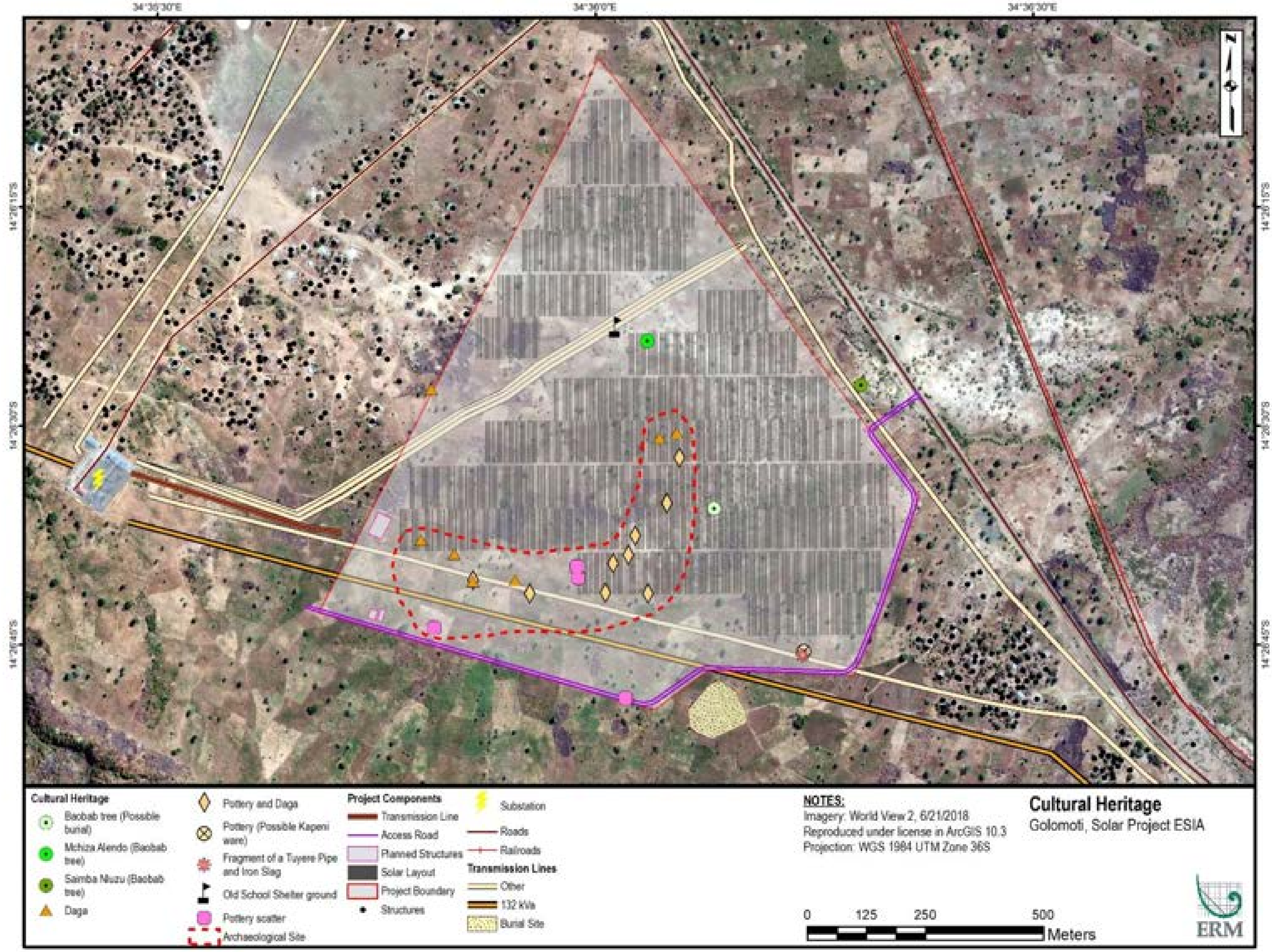
Community Water Sources
Golomoti, Solar Project ESIA



Cultural Heritage

Golomoti, Solar Project ESIA

NOTES:

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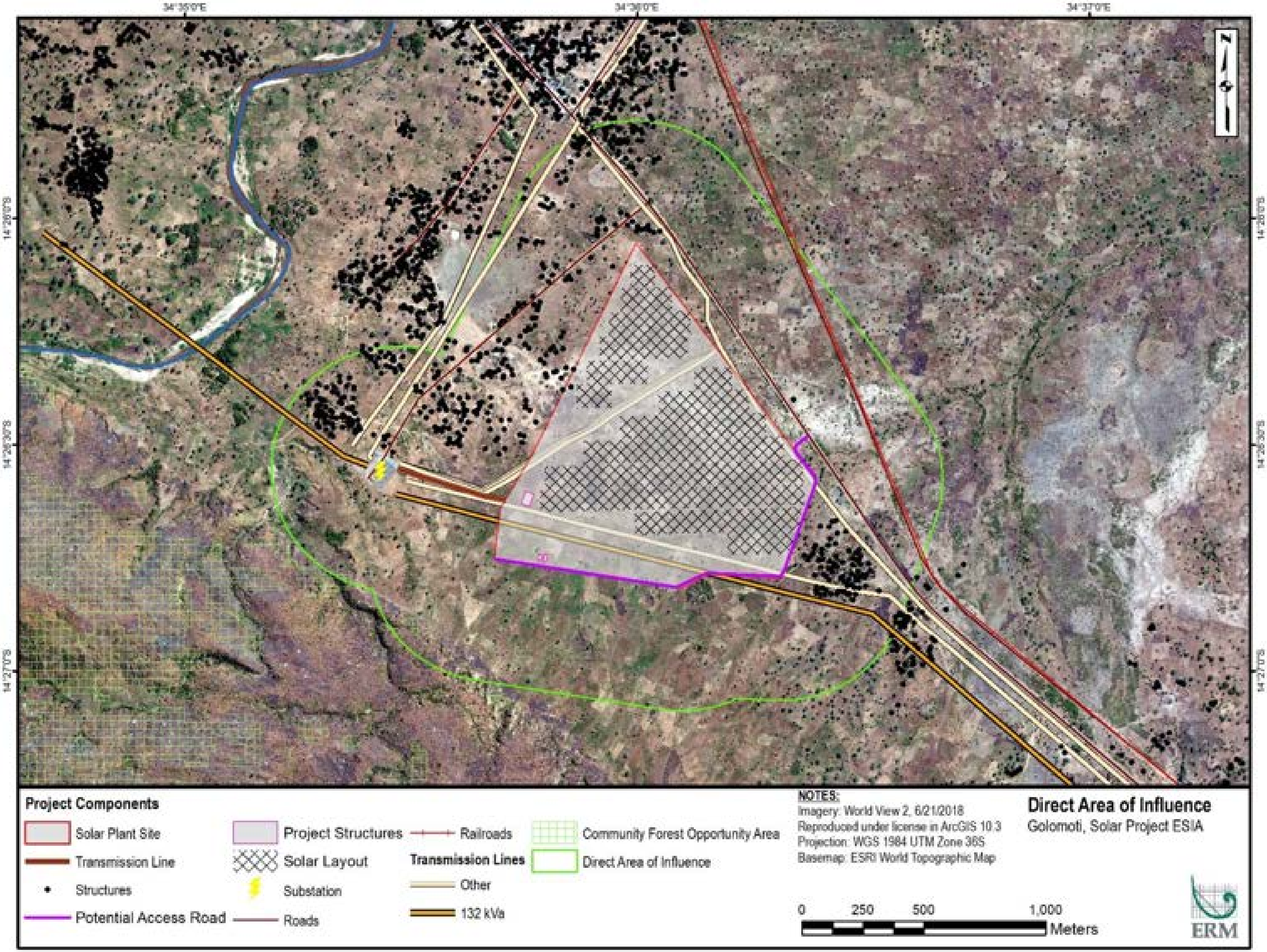

NOTES:

Imagery: World View 2, 6/21/2018
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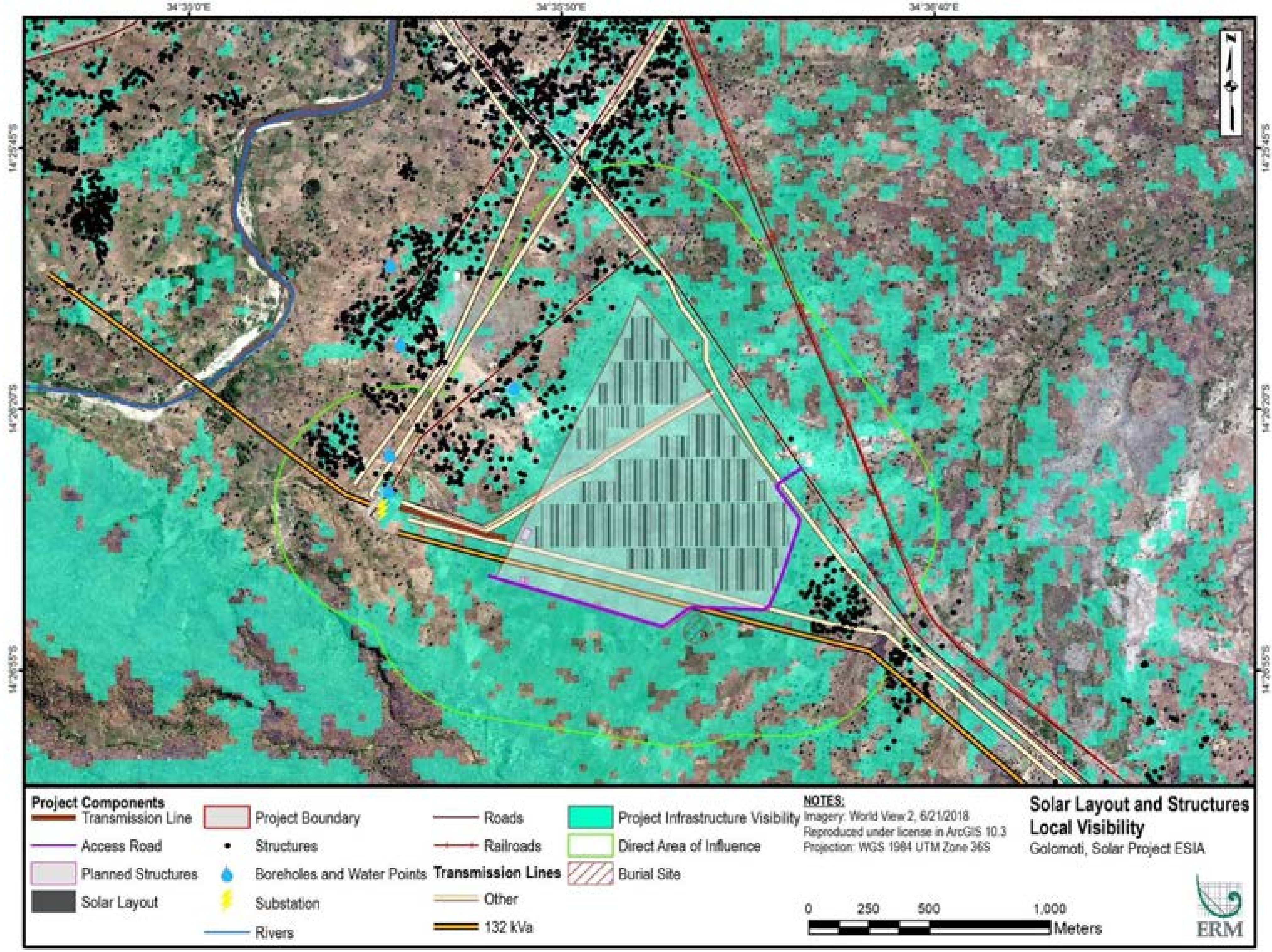
Projection: WGS 1984 UTM Zone 36S
Basemap: ESRI World Topographic Map

Direct Area of Influence

Golomoti, Solar Project ESIA


34°35'0"E
34°35'50"E
34°36'40"E
14°25'45"S
14°26'20"S
14°26'55"S
N
Project Components
Transmission Line
Access Road
Planned Structures
Solar Layout
Project Boundary
Structures
Boreholes and Water Points
Substation
Rivers
Roads
Railroads
Transmission Lines
Other
132 kVa
Project Infrastructure Visibility
Direct Area of Influence
Burial Site
NOTES:
Imagery: World View 2, 6/21/2018
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Projection: WGS 1984 UTM Zone 36S
Solar Layout and Structures
Local Visibility
Golomoti, Solar Project ESIA
0
250
500
1,000
Meters
ERM

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Environmental Resources Management (ERM)
1776 I Street, NW, Suite 725
Washington, DC 20006
United States of America

T: +1 (202) 466-9292
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