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FINAL REPORT

Environmental & Social Impact Assessment Study of 20 MW Solar Power Project at Madhugiri, Tumkur District, Karnataka

Ref No. 10015789; Final V.01/ February 2019

Prepared for:

M/s. Clean Solar Power (Tumkur) Pvt. Ltd. (CSPTPL)

Prepared by:

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QUALITY ASSURANCE

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Information contained in this report is based on the observations during survey and interview with stakeholders. The interpretation of data and judgment is based on the professional experience and represent professional opinion of the interpreter.

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LIST OF ABBREVIATIONS

AC	Alternating Current
HFE	Hero Future Energies Pvt. Ltd.
CSPTPL	M/s. Clean Solar Power (Tumkur) Private Limited
ADB	Asian Development Bank
ANM	Auxiliary Nursing Midwife
MESCOM	Mangaluru Electricity Supply Company Limited
KPCL	Karnataka Power Corporation Limited.
KNNL	Karnataka Neeravari Nigam Limited
KSPDCL	M/s. Karnataka Solar Power Development Corporation Ltd
KPTCL	Karnataka Power Transmission Corporation Limited
BEE	Bureau of Energy Efficiency
BPL	Below Poverty Line
CGWB	Central Ground Water Board
CHNC	Community Health & Nutrition Cluster
CPCB	Central Pollution Control Board
CPR	Common Property Resources
CSR	Corporate Social Responsibility
CTE	Consent to Establish
CTO	Consent to Operate
DC	Direct Current
DISCOM	Distribution Company (India)
DMHO	District Medical & Health Officer
DWCRA	Development of Women and Children in Rural Areas
E&S	Environmental and Social Risk
ECC	Emergency Control Centre
EHS	Environmental Health and Safety
EIA	Environment Impact Assessment
EPC	Engineering, Procurement & Construction
EPFI	Equator Principles Financial Institutions
ESDD	Environment & Social Due Diligence
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental Social Management Plan
ESMS	Environmental Social Management System
ESSG	Environmental Social Safety and Governance
FI	Financial Institutions
GHG	Green House Gases

GHI	Global Horizontal Irradiation
GRM	Grievance Redressal Mechanism
GSS	Grid Substation
IFC	International Finance Corporation
IFC PS	International Finance Corporation Performance Standards
ILO	International Labour Organization
IUCN	International Union for Conservation of Nature
KLD	Kilo Litre per day
LA	Livelihood Assessment
LIA	Livelihood Impact Assessment
Lpcd	Litre per capita per day
LRP	Livelihood Restoration Plan
MNRE	Ministry of New and Renewable Energy
MOEFCC	Ministry of Environment, Forest and Climate Change
NAAQS	National Ambient Air Quality Standards
NABARD	National Bank for Agriculture and Rural Development
NABL	National Accreditation Board for Laboratory
KREDL	Karnataka Renewable Energy Development Limited
NTPC	National Thermal Power Corporation Limited
O&M	Operation and Maintenance
OEM	Original Equipment Manufacturer
OHS	Occupational Health and Safety
PAP	Project Affected People
PGCIL	Power Grid Corporation of India Limited
PPA	Power Purchase Agreement
PPE	Personal Protective Equipment
PS	Performance Standard
PUC	Pollution under control certificate
PV	Photo Voltaic
R & R	Rehabilitation & Resettlements
RF	Reserve Forest
SBM	Swachh Bharat Mission
SECI	Solar Energy Corporation of India
SGWD	State Ground Water Department
SH	State Highway
SHG	Self Help Groups
SOP	Standard Operation Procedures
SPCB	State Pollution Control Board
SPD	Solar Power Developer

SPHO	Senior Public Health Officers
SPPD	Solar Power Park Developer
TDS	Total Dissolved Solids
USDA	United States Department of Agriculture
WPA	Wildlife Protection Act

EXECUTIVE SUMMARY

Background	**M/s. Clean Solar Power Tumkur Private Limited (CSPTPL),** a 100% Subsidiary of **Hero Future Energies Pvt. Ltd (Here after Known as HFE)**, have proposed to develop 20 MW solar Power Project at Malagondanahalli Village, Madhugiri mandal, Tumkur District, Karnataka. As per HFE 113 acres will be purchased via willing to buy willing to sell basis on a 100% private land. HFE has appointed "**Arcadis India Private Limited**", as an independent consultant to carryout "Environmental & Social Impact Assessment Study" for 20MW solar power project, following the performance standards of "International Financial Corporation".
Site Setting	The proposed site (77°16'1.67"E, 13°50'24.77"N) for 20MW Solar project lies within Madhugiri taluka of Tumkur district in the state of Karnataka at approximately 25 km North of Madhugiri City. The project site is connected by NH-3 from Madhugiri. The project site is located at Malagondanahalli Village, Madhugiri mandal, Tumkur District of Karnataka
Present Project Status	As per HFE Around 113 acres of land have been purchased exclusively for 20 MW Solar Power Project. Power Grid Corporation has their Grid Substation at Medigeshi pooling substation which is located 4 km (Areal distance) from pooling substation towards south west.
PS1: Social and Environmental Assessment and Management Systems	The project will have environmental and social impacts due to generation of onsite noise, domestic wastes from site office and rest rooms, and generation of hazardous wastes from the construction site. HFE follows its corporate level Environmental and Social Management System (ESMS) to manage the risks associated with its operations. This ESIA report includes evaluation of project specific environment and social risks arising from the project activities along with recommended mitigation measures. HFE has appointed qualified E&S personnel with appropriate responsibility to implement/ oversee/ monitor the following: *Construction Phase* • Performance of contractors on labour and health & safety aspects *Operation Phase* • Periodic monitoring of social and environmental performance • Internal and third-party audit • Management review *Both for Construction and Operation Phase* • The implementation of the ESMP • Community engagement and grievance redressal system/ mechanism • Regular training of employees and contractors • Emergency preparedness and response

	Periodic reporting of E&S performance to the management. **PS1 is therefore applicable for the project.**
PS2: Labour and Working Conditions	**During construction phase** Local as well as migrant labours are involved in civil construction and erection of solar panels. Along with labours technical staff would be involved. Labour camps have been set up for migrant labours to avoid major interaction with locals. Accommodation to the technical and other non-local labours is provided at Tumkur. **During operation phase** Technically skilled personnel are hired for the operation and maintenance activities of the respective solar power plant. Locals are hired as security guard. **PS2 is therefore applicable for the project.**
PS3: Resource Efficiency & Pollution Prevention	The project involves use of natural resources like land and water. Improper handling of broken and damage solar panel may result in soil contamination. Improper handling of spent oil may lead to contamination of soil and ground water. **During construction phase** The project sites are proposed in agricultural land and hence impact on scare resource i.e. land is envisaged. Top soil management is required. Construction activities may lead to air and noise emission which needs to be managed. Broken / damaged solar panels may result in contamination of soil and ground water. Change in drainage pattern may impact ground water recharge / flooding. Construction and demolition waste along with waste water from labour camp and solid waste needs to be managed properly. Water will be used in construction and at labour camp **During operation phase** Water resource would continue to be in use during the operation phase for cleaning of solar modules but will use water tankers procured from authorized dealers. As per the CGWB categorization the proposed project sites falls under "**Semi-Critical**" zone. In addition to this, broken / damaged solar panels may result in contamination of soil and ground water. Diesel / transformer oil/ spent oil may also contaminate soil and water. As a mitigation measure HFE has taken paramount care to store and dispose off all hazardous waste generated due to the project as per the requirements of the Hazardous Waste (Management, Handling and Trans-Boundary Movement) **PS3 is therefore applicable for the project.** Water has been sourced through tankers from local vendors through borewells. There is a borewell at the site which is used to extract minimal quantity of water. NOC for ground water extraction is in process.
PS4: Community Health, Safety and Security	This Performance Standard is applicable to projects which entail potential risks and impacts to the health and safety of affected communities from project activities. **During construction phase**

	The project envisages influx of labours from nearby villages and migrant labours, who will be accommodated in the labour camp. These labours are expected to interact with community. Heavy vehicles carrying solar panels and equipment would use village roads to access the respective sites. Health and safety concern of worker needs to be addressed. Proper barricading of safety practices at construction site would impact exposure of community to site related risk. Common property may be utilised during construction phase. Access may be restricted / rerouted. **During operation** The project will generate electrical energy and transmitting the same through high voltage power line, thereby exposing the community to electrical injury. Construction of boundary wall may result in restriction of access / increased distances from common property. Disagreements over common property usage between project site officials may lead to anxiety among the community. Improper handling of hazardous waste including but not limited to broken / damaged solar panel may contaminate land and groundwater with heavy metal (including but not limited to cadmium) thus impacting the community using groundwater. Impact on community due to frequent visits of people from outside the community with diverse cultural background would be envsaged. **PS4 is therefore applicable for the project.**
PS 5: Land Acquisition and Involuntary Resettlement	As informed by the representative that most of the land purchased for 20 MW Project are 100% private lands. Private lands are being procured on willing to buy and sale basis and at mutually agreed price. **Hence, PS5 is not applicable.**
PS 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources	**During construction** Vegetation clearance will be undertaken in and around the square where the pilling is undertaken. Minimal trees have been uprooted, instead tree planting at the site has been initiated. **During operation** There is no national park, wildlife sanctuary, biosphere reserve within 10 km of the study area, hence no impact is envisaged to the fauna during operation phase. **Therefore PS 6 is not applicable for the project.** Measures are already being taken like construction of fencing along the project boundary.
PS 7: Indigenous Peoples	Private land is having been procured for the project, but no land belongs to ST community. **Hence, PS 7 is not applicable.**
PS 8: Cultural Heritage	No notified or non-notified cultural heritage site is located near the project areas. **Hence, PS8 is not applicable.**
Key Findings	• Water for the project will be from tankers provided by authorised vendors withdrawn from bore wells. The site also contains a borewell from which

minimal amount of water will be withdrawn. As per HFE NOC for ground water extraction is in process.

- No resettlement and rehabilitation involved in the project.
- Community is aware about the project and does not show any unwillingness for the project due to clean technology. Further, adequate disclosure has been made by HFE during land acquisition process.
- Based on the discussion with the community during consultation, it can be concluded that the local people are welcoming the project along with allied infrastructural development of the area ushered with the solar project.
- Emphasis must be given to keep natural drainage uninterrupted and conservation of top soil. During construction and operation period, emphasis must be given to keep the channel uninterrupted to keep natural water flow unhindered.
- The CSR plan focused on community development shall be implemented by the HFE.
- There is no health facility in the project affected area. Hence a supplementary support can be planned in the CSR activities by the project proponent. Medical Camps can be a suitable alternative
- Due to the non-availability of employment opportunity, villagers aspire for employment generation and consecutive opportunity for them in or in allied activities of the project.

This Executive Summary should be read in conjunction with the full report and reflects an assessment of the site based on information received by Arcadis at the time of reporting.

1 INTRODUCTION

T**he Jawaharlal Nehru National Solar Mission (JNNSM)** launched in 2010 with an ambitious target of deploying 20,000 MW of grid connected solar power by 2022. The mission aims at reducing the cost of solar power generation in the country and to achieve grid tariff parity by 2022 through

- Long term policy measures;
- Large scale deployment goals;
- Aggressive R&D; and
- Domestic production of critical raw materials, components and products. Currently the mission is in Phase–2 (2013–2017) of its implementation.

Hero Future Energies Pvt. Ltd. (HFE), one of the leading Independent Power Producers, poised to integrate renewable energy in the energy mix of the country by identifying the best solutions and install renewable energy systems bench marked against the best-in-class engineering standards. HFE which came into existence in the year 2012, carries an illustrious legacy of the Hero Group. The company is focused on futuristic and clean energy. HFE has presence in nearly ten states of India such as Rajasthan, Karnataka, Telangana, Andhra Pradesh etc., with high quality operating asset base of Solar Power Projects.

The present **20MW Madhugiri Solar Power Project**, is developed by **M/s. Clean Solar Power Tumkur Private Limited (CSPTPL),** a 100% Subsidiary of Hero Future Energies Pvt. Ltd, at Malagondanahalli Village, Madhugiri mandal, Tumkur District, Karnataka. The Land has been purchased through willing to sell - willing to buy basis.

Arcadis India Pvt Ltd (Arcadis) has been appointed as an independent Environment consultant by **Hero Future Energies Pvt. Ltd** for preparing the environmental and social impact assessment (ESIA) for the project as per the requirements, as applicable for the proposed 20 MW solar power project. The ESIA was conducted to assess any potential impacts (both negative and positive) that may arise from the construction and operation of the proposed project.

1.1 Background

The **Hero Future Energies Pvt. Ltd. (HFE)** carries an illustrious legacy of the Hero Group. This is a strategical decision of the group to enter the domain of power generation from clean and non-polluting sources of energy. The young company is an Independent Power Producer (IPP) with growth plans to invest progressively in wind, Hydro sector over the years.

HFE has the vision of harnessing the sunlight to produce the “Planet Positive Power” and provide access to clean and affordable power to the masses. To solve the twin problem of power deficit and access to power, HFE adopted a two-pronged strategy,

- Develop megawatt size solar plants to produce clean and economical energy
- Provide rooftop and off grid solutions for decentralized generation.

HFE has successfully commissioned 10 MW solar PV plant under JNNSM Phase-II Batch-I program. There is implementation of 43 MW Project in Karnataka under the state policy and another 40 MW project in Telangana under state policy.

At the Madhugiri 20MW solar power project Multi-Crystalline technology has been used.

The Environmental and Social Impact Assessment (ESIA) study for the project has been undertaken in accordance with International Finance Corporation’s (IFC) Performance Standards (PS) on Social and Environmental Sustainability, 2012; Environment, Health and Safety Guidelines, Equator Principles; ADB Safeguard Policy Statement (SPS) (2009), relevant ILO conventions covering labor standards.

The study will also assess the sustainability of the project with respect to the local and national regulations relevant to the project.

A solar power plant is clean option for power generation in comparison to non-renewable fossil fuels. Ministry of Environment, Forest and Climate Change (MoEFCC) in its **Office Memorandum No. J-11013/41/2006-IA-II (I) dated 13th May 2011** (Appendix A) stated that the solar power projects are not covered under the ambit of EIA Notification, 2006 and therefore does not require prior environmental clearance. In addition to this, CPCB issued notification vide **File No. KSPCB/717/COC/2016-17/1232 dated 14th July 2016** [1] regarding harmonisation of classification of industrial sectors under Red/Orange/Green/White categories which states that solar power generation is a "White Industry" (Part-A, Serial Number 35) and does not require Consent to Establish and Consent to Operate. Only intimation to the concerned regional officer of State Pollution Control Board (SPCB) shall suffice.

The ESIA report has been carried out, including the reconnaissance survey of the site, baseline monitoring, data analysis, public consultations and discussions with relevant stakeholders. The assessment will identify the significant environmental and social risks associated with the project and recommend the appropriate mitigation measures to comply with the requirement of the specified reference framework.

A site visit was undertaken by Arcadis and Hero team in the second week of December 2017, to understand the site conditions and assess the environment and social impacts due to construction and operation of the project. A brief snapshot of the project is presented in **Table 1-1.**

Table 1-1: A Brief of the Project

S. No	Particulars	Description
1	Project Site	Malagondanahalli village, under Bedattur panchayat
2	Tehsil/ Mandal	Madhugiri
3	District Name	Tumkur
4	Name of the State	Karnataka
5	Site Elevation	The average elevation of the site is 700m
6	Geographical coordinates	77°16'1.67"E, 13°50'24.77"N
8	Road Accessibility	State Highway – 33 from Tumkur; Connecting Madhugiri town (north side). Through State Highway 3 from Madhugiri an internal road connects to the site.
9	Nearest Airport	Kempegowda Airport Bengaluru (Approx. 86 Km)
10	Nearest Railway Station	Hindupur Railway Station is 26 kms East (aerial distance) Yesvantpur Junction Railway Station is 96 km South East (areal distance)
11	Type of Terrain	Rocky hard surface with occasional undulations
12	Ownership of land	100% private acquisition for a total of 113 Acres land approximately
13	Present land use	Fallow land occasionally used for opportunistic cultivation and grazing,
14	Arrangement of land	As per HFE approximately 113 Acres of land at Malagondanahalli has been procured through willing –buyer –seller basis and good faith negotiation by HFE for the 20 MW solar power project. It was observed that the land is almost a contiguous stretch of land, only with an interval of a Nallah passing through the site.

[1] *http://kspcb.kar.nic.in/Notification_1232.pdf*

S. No	Particulars	Description
15	Capacity Unit proposed	20MW
16	Proposed Technology	Multi-crystalline Solar PV
17	Present Status of the Project	The Project is almost in completion of construction and nearing commission. Finishing work of SCADA room and inverter rooms as well as levelling of land at some areas at the site is being carried out. Finishing Ancillary work is in progress
18	Project Life	25 years

1.1 Project Location

The proposed site (77°16'1.67"E, 13°50'24.77"N) for 20 MW Solar Power project lies within Madhugiri tehsil of Tumkur district in the state of Karnataka at approximately 60 km North-East of Tumkur City and 130 Km North-East of Bangalore. The project site is in Malagondanahalli village in Madhugiri Tehsil, Tumkur District of Karnataka.

Road Connectivity – State Highway – 33 from Tumkur; connecting Madhugiri town (north side). Through State Highway 3 from Madhugiri an internal road connects to the site.

Railway Connectivity – Hindupur Railway Station is 26 kms East (aerial distance), Yesvantpur Junction Railway Station is 96 km South East (areal distance)

Air Connectivity – Kempegowda Airport Bangalore (Approx. 86 Km)

Figure 1-1: Site Pictures

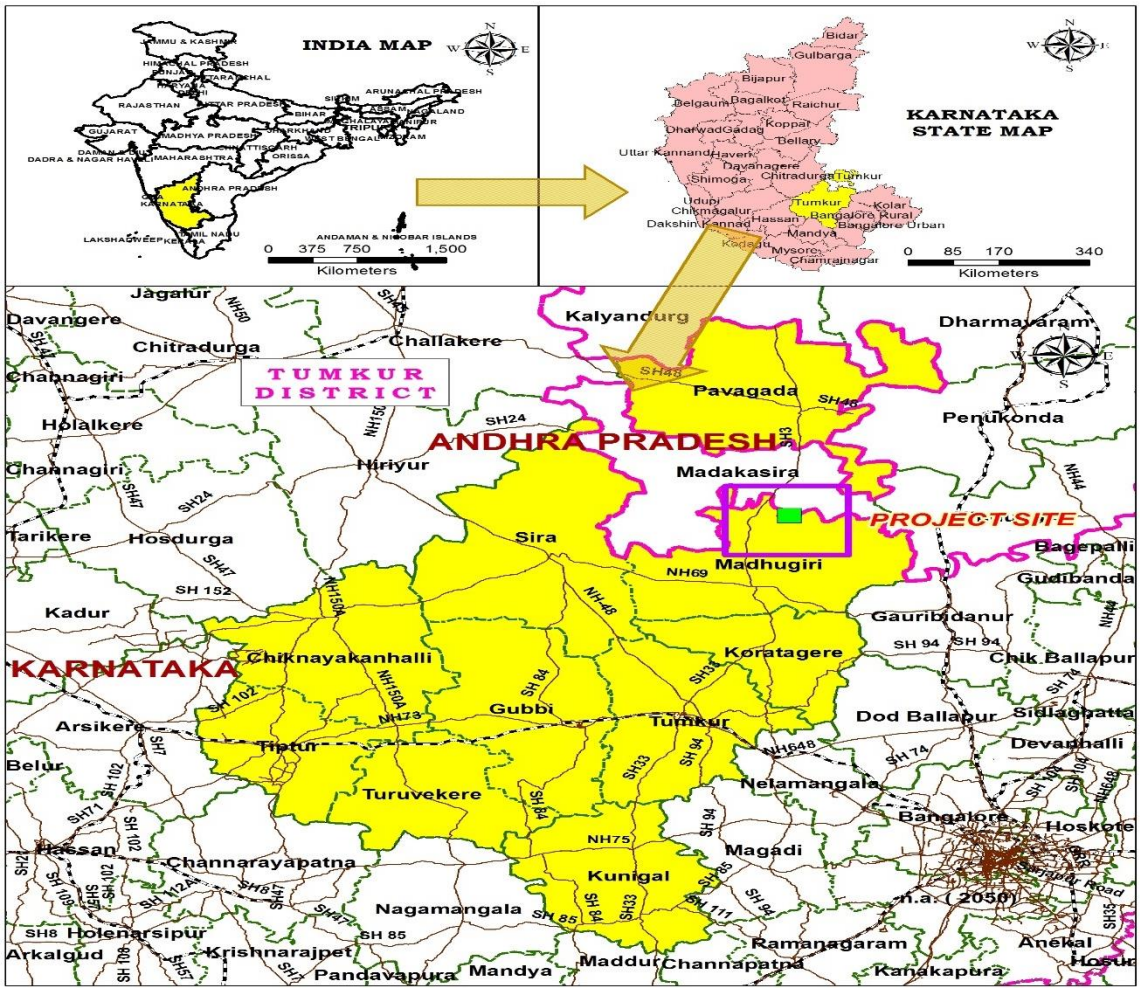
1.2 Project Phase and Status of Permits

The Project is almost in completion of construction and nearing commission. Finishing Ancillary work is in progress. Work of SCADA room and inverter rooms as well as levelling of land at some areas at the site is being carried out. The land procurement by HFE for proposed 20 MW solar power plant Madhugiri had been completed during the ESIA study. Procurement (bought) has been carried out directly from land owners through locally appointed land aggregator. The required permits and approvals for the construction and operation of the project are summarized below:

Table 1-2: Required Permits & Approvals for the Project

S. N	Permits/Approvals	Status
1	Consent to Establish from Karnataka Pollution Control Board	Not required. However, Karnataka Pollution Control Board have been informed while starting the project.
2	Consents (CTE/ CTO) if applicable for establishing batching plant	Not Applicable
3	Power Purchase Agreement	Power Purchase Agreement has been signed between BESCOM and CSPTPL. **(Appendix M)**
4	Approval for extraction of ground water	NOC from CGWA is not required for extraction of less than 100 m3/day as per the notification No: 21-4/guidelines/CGWA/2012-4777 dated October 26, 2012.
5	Land procurement	The Land has been purchased through willing to sell - willing to buy basis by HFE.

Figure 1-2: Project Location Map



1.3 Purpose of ESIA Study

The main purpose of the ESIA study is to identify, evaluate and manage environmental and social impacts that may arise due to implementation and operation of the project. The document has been made to comply with the requirements of IFC's Performance Standards, IFC's general guidelines for EHS, as well as applicable local and national regulations. The objectives of ESIA study are:

- To identify and establish the baseline environmental and socioeconomic conditions, to analyse the environmental and social risk and impacts of the project and its associated components (facilities like transmission line, access road etc.)
- To prepare an inventory of biodiversity (flora and fauna) of project site prior to implementation of the project to evaluate the possible impacts on flora &fauna.
- The purchased/ leased land through suitable survey using acceptable socioeconomic tools. This will help in assessing the impact of the project on the community/ villagers.
- Socio-economic survey involving consultation with local community, stakeholders, household surveys to identify the needs and problems of community with respect to the project activities.
- To suggest appropriate safeguards for the associated environmental and social risk, which may not lead to project investment and activities at risk.

1.3.1 Approach and Methodology of the ESIA Study

The approach and methodology applied for undertaking the environmental and social impact assessment study is as provided.

- Desktop review of project related documents.
- Reconnaissance survey to understand site specific issues.
- Discussion with the local community in the project influenced villages to understand their perception of the project and identification of key issues.
- Baseline noise level, air, water, ecology & biodiversity of the site through primary and secondary sources.
- Identification of environmental and social risks associated with the project (including associated facilities) during construction, operation and decommissioning stage.
- Preparation of an environmental and social management action plan (with timelines & responsibilities) & Environmental monitoring plan to manage these risk and impact.

1.3.2 Limitations

The ESIA study has been carried out based on project planning information and documents provided by the project proponent, stakeholder consultation and observations during ESIA study. Any major changes in the proposed activities may result in significant deviations of outcomes or impacts.

Major limitations for the ESIA study include:

- The site contains a borewell from which extraction of ground water is carried out. As per the client in notification No: 21-4/guidelines/CGWA/2012-4777 dated October 26, 2012, extracting ground water up to 100 m^3/day in "**safe Area**" will be exempted from obtaining NOC from CGWA. But the area falls under "**Semi Critical**" zone.
- NOC from Panchayat is yet to be received.
- Agreement to sale needs to be received by client.

1.3.3 ESIA Team

Arcadis has mobilized a diverse team of multidisciplinary experts for conducting the ESIA study. A number of these experts are accredited professionals by Quality Council of India to conduct regulatory EIA. Combination of these experts have provided consultancy services to over 50 solar power projects across India with over 3000 MW installed capacity. The experts have been continuously working with funding agency and understand the modalities and procedures of evaluating and addressing environment and social risk associated with large scale investment.

2 PROJECT DESCRIPTION

The 20 MW Solar power project has been developed at Malagondanahalli in Madhugiri by CSPTPL. As per HFE the project is spread over an area of 113 acres. The Solar panels have already been set up and the project is at the pre-commissioning stage. The project is predicted to be commissioned by January 2018. The land is an agricultural land and has been purchased from the owners via willing to sell-willing to buy basis.

Produced power will be evacuated through 66kV power evacuation line to the pooling substation located within the project boundary. After stepping up voltage power will be transmitted to 66/11 kV grid substation, 4 km (Areal distance) from pooling substation towards south west at Medigeshi substation.

Multi-crystalline silicon technology based solar PV modules is proposed for the project. Multi-crystalline silicon technology has an efficiency of 15-18% with an annual deration of 25%.

Table 2-1: Technical Features of Project

Particulars	Details
Type of Project & Project Capacity	Solar Photovoltaic Project of 20 MW capacity
PV Module	Multi-crystalline Silicon Modules Number of Modules – 69842 Capacity of each module- 310-320 Wp 15-18% efficiency
Inverter	Central inverters- 1000-1250kW as per system capacity of 10 MW 20 Inverters Maximum MPP (Maximum Power Point) fluctuates during operation in an interval depending upon the radiation, cell temperature and the cell type. It is tracked by the inverter controller unit. Specification to reduce problems caused by dust, sand and heat. Grid Managing kit to ensure perfect grid integration
Mounting System	Different tilt angle capability Mounting Structure Galvanized Aluminium

2.1 Present Status of Project

Presently the project is in pre-commissioning stage. The Solar Structures with the panel have already been set up. Presently construction and finishing work of SCADA and inverter room as well as levelling of land at some areas at the site is being carried out. 100% private land has been purchased through willing to sell - willing to buy basis by HFE and the process has already been completed.

Figure 2-1: Construction of Transformer Area

Figure 2-2: Land Levelling Work

Figure 2-3: Construction Activities at the Site

Figure 2-4: Array Layout Showing the Project Site

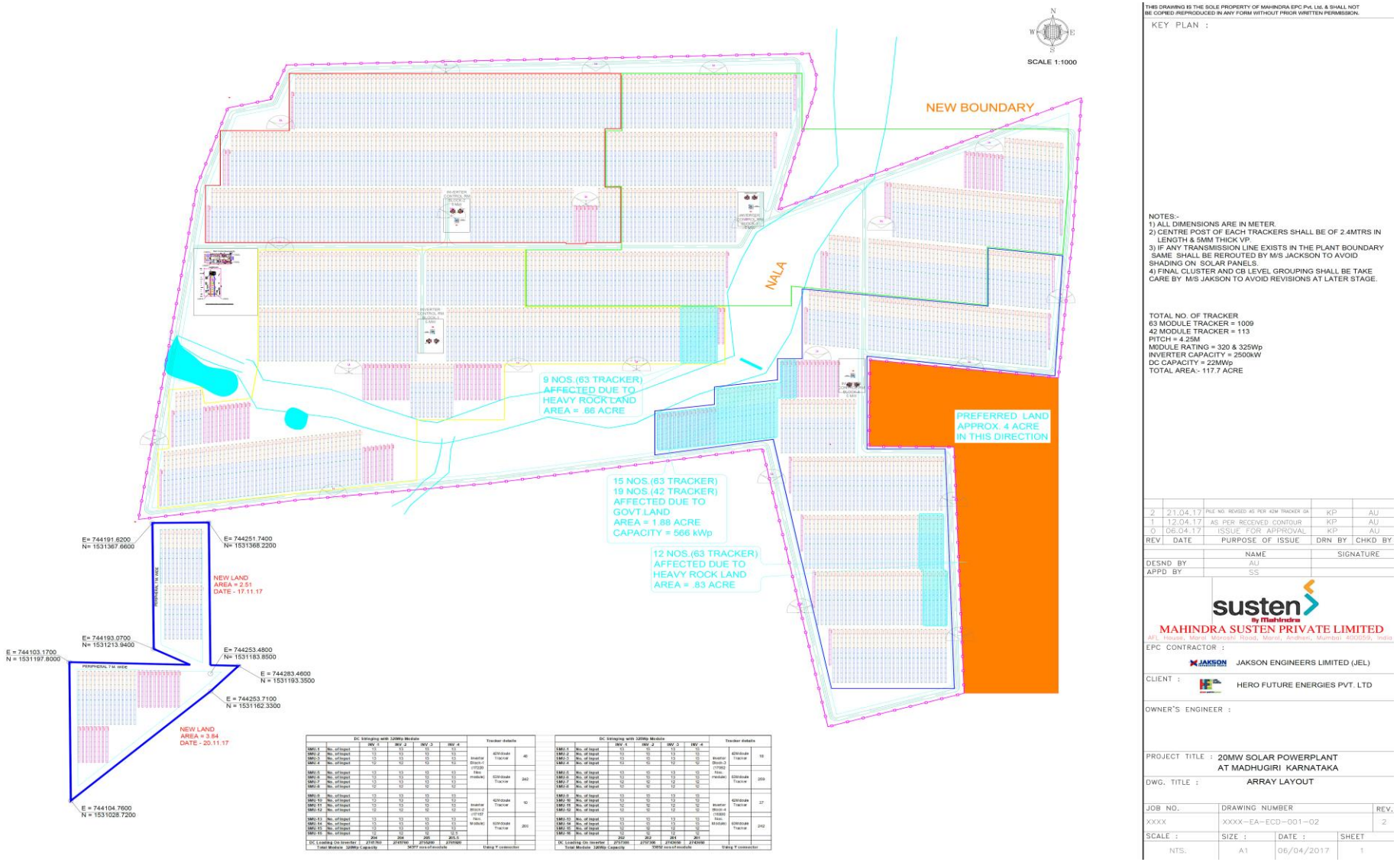
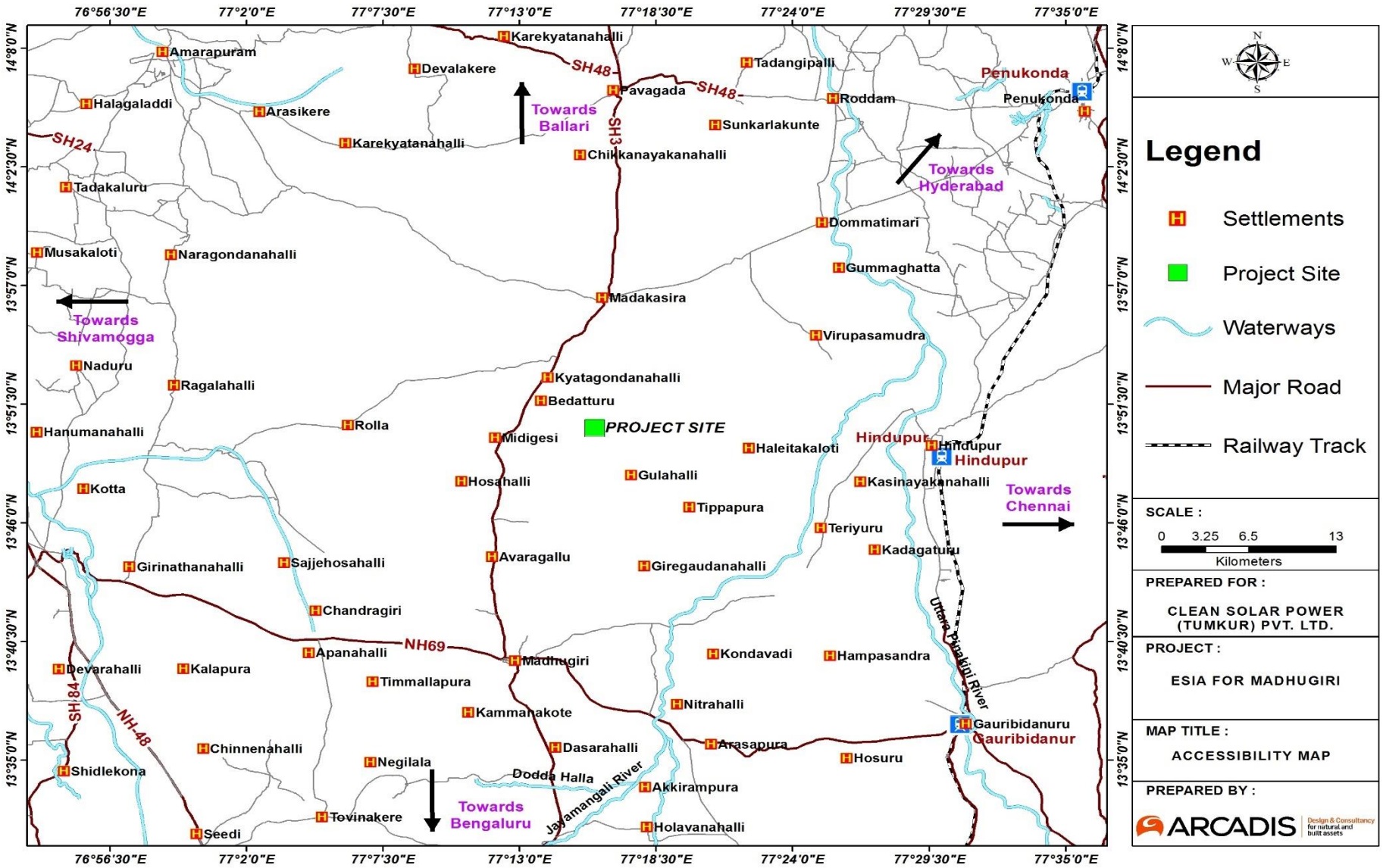


Figure 2-5: Accessibility of the Project Site

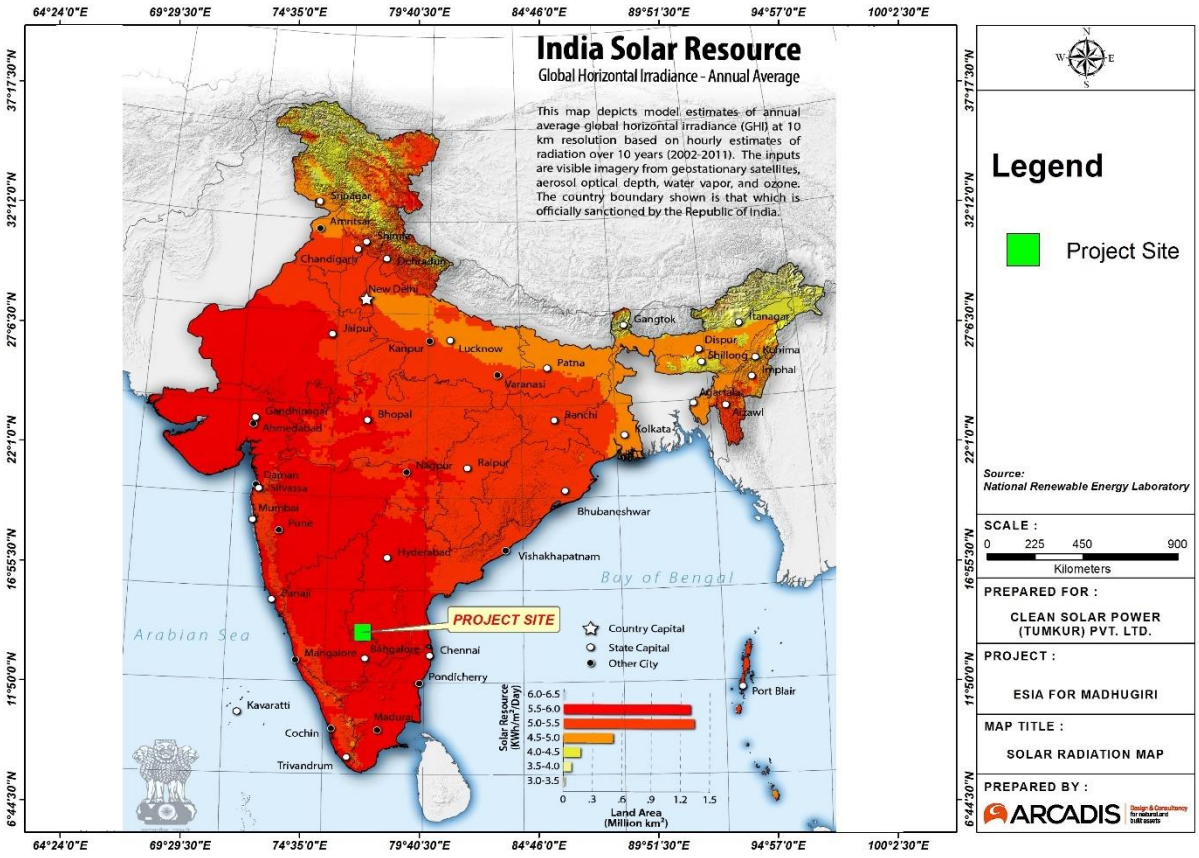


2.2 Site Suitability and Justification of Project

Following analysis describes the site suitability for a Solar PV power plant development, these analyses include:

- **Solar radiation at the site:** Average annual solar radiation at the proposed site at horizontal surface is 1900 kWh/m^2 to 2100 kWh/m^2 which is potentially adequate for the installation of the PV plant. Solar radiation map of India indicates that Karnataka receives a global horizontal irradiation (GHI) in the range of 5 to 5.5 kWh/m^2/day. This insolation is suitable for generation of Solar Energy.

Figure 2-6: Solar Resource Potential Map



Source: http://www.nrel.gov/international/images/india_ghi_annual.jpg

- **Land Use:** Land is mostly barren devoid of agricultural activity making it suitable for solar power project instead of agricultural land.
- **Topography:** The area is generally open barren land with mild slope and undulations. This would ensure usage of a waste land in the most optimum way.
- **Substation proximity:** Power from the solar photovoltaic plant of 20 MW capacity will be evacuated through 66kV power evacuation line to the pooling substation located within the project boundary. After stepping up voltage power will be transmitted to 66/11 kV grid substation, 4 km (Areal distance) from pooling substation towards south west at Medigeshi substation
- **Accessibility**: The site is located about 60km North-East from Tumkur town and is accessible through NH-33

- The site was devoid of any habitation.

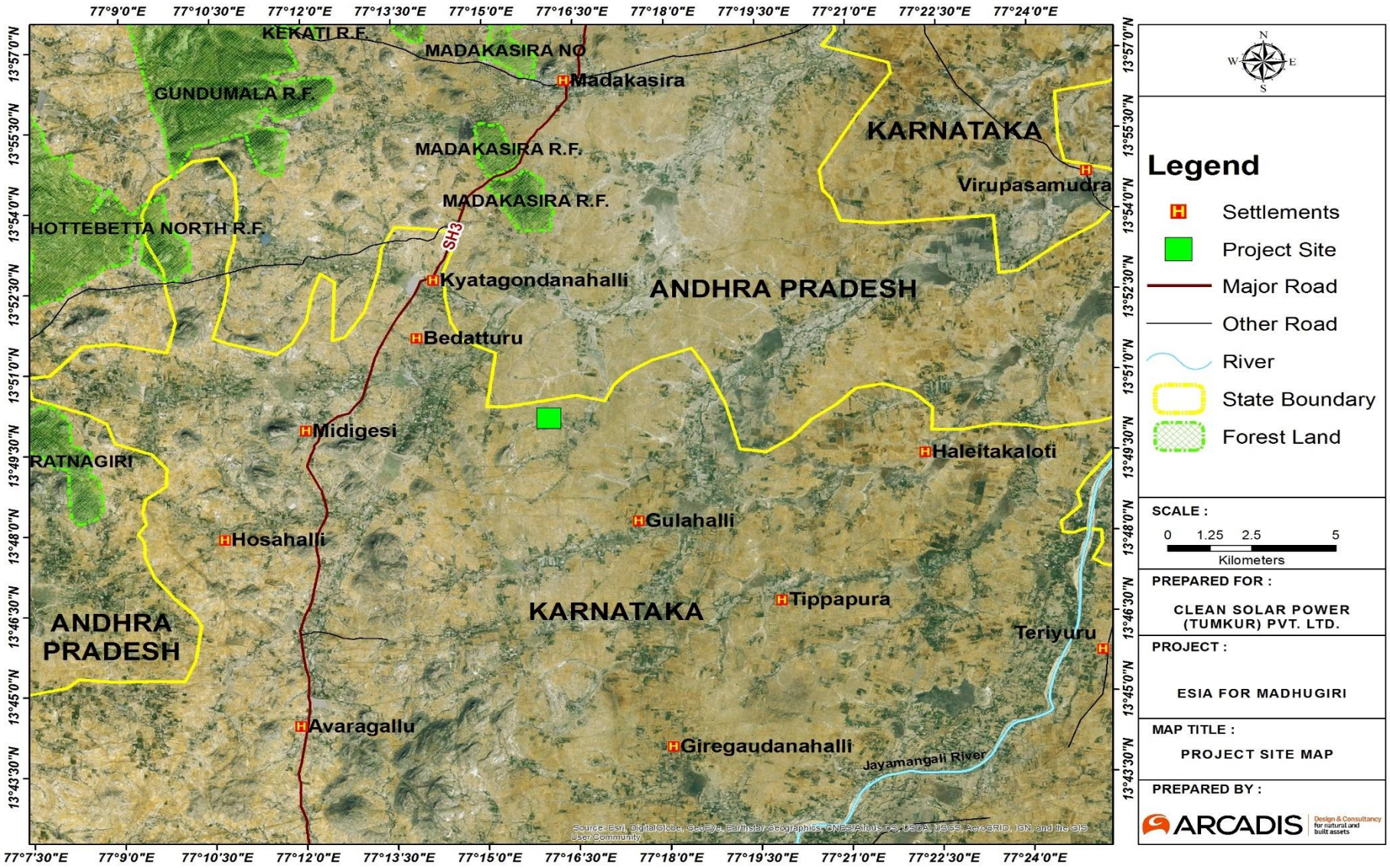
Considering above justification, the site has been found to be technically feasible for a solar power development.

2.3 Project Settings

The key physical features of the project site have been described below:

- Project site is a mixed terrain with rocky, hard and barren mostly devoid of vegetation. Elevation of the study area gradually rises from east to west. With patches of elevated land in the west and a relatively similar elevation in the east. Elevation of the study area varied from 650 m towards west to 850 m towards east.
- The land parcel has moderate undulation and hence small amount of excavation and levelling of land has been carried out.
- There are no shading elements such as mountains or huge trees available on the site. Bushy vegetation is present in and around the site with sporadic trees.
- A seasonal drainage channel is passing through northern part of site towards the south cutting the project site into two distinctive halves. Water flows in this channel from west to east direction. Drainage channel remains dry for most of the year, water only flows after rainfall. It has been reported that the rainfall in these regions is less, hence the water level in the channel does not rises drastically causing no situation of flooding at the site. An access road has been constructed through the natural drain with a culvert to let the movement of water along the channel.
- The artificial drains are going to be built along the periphery of the site or depending on the slope of the land parcel where there could be a possible accumulation of water. This drain is then going to be emptied into integrated drain and won't be affecting other nearby land parcels.
- No forest area falls in and around the buffer area (10 km radius from the site).

Figure 2-7: Environmental Setting Map



2.4 Project Design, Technology and Component

The 20 MW solar power plant will be based on Poly Crystalline solar PV technology. The main equipment's of a PV Project are PV modules, inverters, mounting systems, PSS and GSS. The system consists mainly of the following components:

PV Modules: PV modules use light energy (photons) from the sun to generate electricity through the photovoltaic effect. PV modules technologies are divided in two main groups:

- *Crystalline Modules:* PV modules are composed of several cells electrically connected. Cells are made by crystalline or polycrystalline silicon. This technology is predominantly used in large scale PV facilities due to its high performance under different climatic conditions, maturity, low cost and considerable number of manufacturers.
- *Thin film:* Thin film PV modules are composed by a layer of PV material deposit over an isolating base. PV material could be made by various products, but only TeCd has got a relevant market share and is suitable for large scale PV plants. This technology has a good production under low radiation and elevated temperature conditions, but on the other hand there are few manufacturers and limited track record.
- For this project, Multi-crystalline Silicon Modules with 72 cells module, 16.5% efficiency and 315Wp expected unitary power will be used.

Inverters: A solar inverter, or PV inverter, converts the variable direct current (DC) output of a PV solar panel into a utility frequency alternating current (AC) that can be fed into a commercial electrical grid. The synchronization happens automatically with available grid voltage and frequency and it starts to feed output from plant into grid.

Second important job of the solar power inverter is to operate the PV system at its, maximum power point (MPP) and extract maximum generation. The MPP is defined as the operating point where combined value of the voltage and current result in maximum power output. The MPP fluctuates during operation in an interval depending upon the radiation, cell temperature and the cell type. It must be tracked by the inverter controller unit.

The inverter for the 20 MW SPV power plant will be a grid connected which will be a combined unit comprising of inverter and necessary protections.

Central inverters with following specification will be used for this project

- 10 MW output power of each inverter (20 Inverters will be installed)
- Schneider/Sungrow/Hitachi/ equivalent made inverters will be used
- MPP (Maximum Power Point) Tracker to increase production
- Specification to reduce problems caused by dust, sand and heat
- Grid Managing kit to ensure perfect grid integration

Mounting System: PV modules must be attached to a structure. This structure could be fix or may have a movement to follow the sun path.

- *Fix Structure: No movement of the module. Structure has some inclination for improving the production.*
- *One axis tracking system: Structure has a movement from east to west, to follow sun path. Tilt of the module is fixed.*

- *Two axis tracking system: Structure could be moved in two axes making the module surface perpendicular to solar radiation every moment, and therefore get the maximum radiation.*
- *The array frames proposed for the site would typically utilize design with a different tilt angle capability. This is typically achieved by changing the length of the rear support leg and the spacing between the front and rear footing. The array frames are made of MS and is protected against salt mist corrosion and other environmental impacts and conforming IS 2062.*

Grid Connection: The planned grid connection point is in the 66-kV level in Bandalli substation. Project will be connected to 66/11 kV grid substation at Medigeshi. Maximum output power in connection point will be 20 MW.

Grid Stability: PV systems have customizable control features that allow them to provide grid management. This allows PV systems to stabilize power grids. Advanced power electronics and communication components ensure compliance with all PV power plant grid requirements. The ability to reduce the feed-in rate within seconds of a frequency increase and to provide reactive power and short-circuit current when an error occurs, allows PV power plants to accurately control the amount of power they supply to the grid. Main functionalities of the system will be:

- *Remote controlled power reduction:* To avoid temporary overloads in the power distribution grid, grid operators prescribe specific active power values that inverters are required to achieve with minimal delay. These target values could be transmitted via a ripple control receiver.
- *Active Power Control*: If there is a frequency spike in the transmission line, the inverters respond by automatically reducing their active power output according to a characteristic curve. The inverters can therefore play a decisive role in stabilizing power frequency.
- *Voltage control with reactive power:* To keep line voltage constant, inverters supply lagging or leading reactive power to the grid. The grid operator specifies whether the reactive power value is fixed or dynamic. The Power Plant Controller is used to analyse and manage the process. The reactive power, or displacement factor, can also be controlled along a characteristic curve in relation to the supplied active power, the line voltage or an absolute value.
- *Reactive power at night:* Reactive power compensation reduces the load on power grids while ensuring decentralized voltage stability.
- *Low Voltage Ride-Through:* Through dynamic grid support the inverters remain connected to the grid during voltage dips that last no longer than a few seconds and support the grid by feeding in reactive power. They immediately resume normal feed-in operation once the voltage exceeds a defined minimum threshold.

Monitoring System: Advanced photovoltaic monitoring system allows management of the production, grid parameter, and communication with Grid Operator includes O&M management system.

Approach Route: The approach route for the transmission line will be based on a criterion to reduce the environmental and socioeconomic footprint of the transmission line. The shortest feasible route after considering these factors will be selected for the transmission lines:

- Transmission line route does not fall under any habitations and thick vegetation.
- No households or community structures are in the route of the transmission line.
- All environmentally sensitive sites, archaeologically significant sites, areas of ecological and cultural significance were avoided while selecting the route.
- Right of way/ access roads will be shared with residents of the area wherever possible.

2.5 Resource Requirement

2.5.1 Land

The solar power is proposed on private land. The project site is an open vast area with mild undulations. Land in the project influenced area was predominantly dry designated as agricultural land. Grazing activities are very limited to post-monsoon months, while meagre amount vegetation is present. Agriculture in the area is totally dependent on rainfall and substantial portion of the land remains dry most part of the year. Also, irrigation facilities are very poor in the area. Advent of the new solar projects in the region will open opportunities for utilization of barren/ dry waste land which is left unused otherwise. Letter to KREDL for Land Conversion is given in **Appendix L.**

Type of Land

As per the interaction with HFE management around 113-acre land for Hero Future Energies (HFE) 20 MW solar power project is contiguous. The topography of the project site is largely plain in an open vast area with mild undulations. As observed during ESIA study the land in the project influenced area is unused dry land with shrubs within the plot. The substantial portion of the land remains dry for most part of the year.

Land Scenario: It has been informed by the HFE representative, that due procedures were followed for the land procurement process as per the government regulations (Land conversion, notification, consultations, local community consultations, Panchayat approval, etc.). HFE representative has also informed that the owners of private lands were offered a compensation amount which is higher than the circle rates.

Land for Access Route: Land for access route was decided and demarcated by HFE. The land for the 20 MW solar project is located at Malagondanahalli village. Project site relates to Mdenahalli road (also the Pune-Bengaluru Highway) and village approach roads connecting with Main District Road leading towards Tumkur as well as Madhugiri. No human activities or structure was noticed in the project site. Hence it is assumed that no issue may rise for the access route in future.

An exclusive access to the construction site is usually required prior to mobilization of manpower and machinery. The land for access roads is also purchased. The construction of access road primarily involves removal of vegetation and modification of topography. As observed, the land area is dry undulated land with occasional and scanty shrubs, hence only scanty vegetation is seen in the form of shrubs around the project site. The existing kutcha roads or village roads connecting to the nearest villages viz. Pulomachi Appenahalli etc. village from the project site was used as an access route.

The locals have access to the bus services at Medigeshii, which connects to big cities like Bengaluru, Tumkur and Anantapur at Andhra Pradesh etc. There is no railway network in the study area. Nearest railway station is in Hindupur in Andhra Pradesh more than 100 Km by roadways from the project site. It can hence be concluded that even in the presence of good approach roads, the communication facilities are not satisfactory in this region.

Land for Transmission line:

The few pertinent factors for the route of the transmission line from PSS to GSS are as follows:

- One Pooling Substation (PSS) has been constructed for the 20 MW Solar Power Project
- The route has been identified based on movement of project vehicles which, would not include narrow village road and road passing through cluster of settlements.
- Transmission line is planned without any habitation or cultivation field or without any hindrance along the route;
- House or community structures is not located under the transmission line;

- No vegetation area should fall under the transmission route.
- The transmission route is not devoid of any environmental sensitive area.

Right of Way (RoW) for the transmission route would be done after completion of boundary marking. No cultivation land nor any habitation should come on the way of transmission route.

Land Procurement Procedure: The 20 MW Solar power project is at completion stage. As observed during ESIA study, it is assumed that lands in the study area is private ownership. A general procedure for land procurement is followed for solar/wind power projects in India.

A brief general procedure of land purchase is given below:

- Based on micro siting land has been identified by the project proponent/ developer.
- The title of the property, ownership of land and registration documents has been checked and verified in the office of the sub-registrar of the circle in the proposed project area.
- A search of the records and documents that may affect the registration, ownership and title of the land may be carried out at the sub-registrar's office.
- The land records are found in proper order, the developer/ land team then proceeded for negotiation with owners of private lands.
- Compensation/ selling rates was mutually agreed by both seller and buyer parties on good faith negotiation.
- Based upon the fixed rate through agreement process for land transfer in favour of buyer was initiated.
- Mutation and registration of the lands, through Agreement to Sale (ATS), must be made in buying company's name in the revenue records.
- A percentage on basic land value is charged (as per Sub Registrar Office of the circle) for transfer and conversion of the land.

As retrieved from the website portal of department of stamp & registration, Government of Karnataka the circle rates of the study area are provided below

Table 2-2: Village Wise Govt. Circle Rate of Land in Study Area

Taluk & District	Village Name	Land type and unit		
		Wet (Assured Water Supply from Government Tanks/Canals), One Crop (Per Acre)	Dry, No Source of Irrigation, Other (Per Acre)	Bagayat, Dry (Per Acre)
Madhugiri taluk, Tumkur District	Malagondanahalli	125000.00	107000.00	150000.00

Source: Sub registrar office Madhugiri

2.5.2 Water Requirement

During the project construction phase, water is required for preparing RCC foundations for module mounting structures, building control room and security rooms, and domestic purposes such as drinking and washing by the construction workers and staff. During operations, water will be required for cleaning of solar panels and for domestic purposes for the operations staff. The estimated quantity of water required during the construction and operation phases is presented below;

Table 2-3: Water Requirement during Construction and Operation Phase

Phase	Activity	Max. Consumption	
Construction	Civil works water requirement	11.6 KLD	Through water tanker (Authorize vendor) and Bore well.
	Domestic use – considering 150 labours	13.95 KLD	water tanker (Authorize vendor) RO water through authorize vendor for drinking purpose
Operation	Washing of solar panels (1.938 m2 each panel)	Reportedly 0.5 to 1 litre per module per month Considering 1 lit each for 69840 nos of modules, the water requirement comes around 69.84 KL per month.	Water tanker (Authorize vendor)
	Domestic use	2 KLD (approximate)	RO water through authorized vendor for drinking

Water for the project during construction as well as operation phase will be outsourced to local vendors which are going to utilize the ground water resources through borewells. There is a borewell at the site which is used to extract minimal quantity of water. Drinking water for both phases will be through Government based RO plant located at the Madigeshi Village.

2.5.3 Manpower Requirement

Construction Phase

About 150 labors comprising of 40 skilled and 110 unskilled labors, were employed in the peak construction phase which involved the foundation structural work, fencing, cleaning and erection of mounting structure. No female workers were engaged. Some workers were sourced from the nearby villages depending on their skills and capabilities.

These (semi-skilled and unskilled) labors are supervised and monitored by 40 skilled personnel from EPC contractor in the peak construction phase. HFE personnel were deployed directly on-site during construction.

Operational Phase

During operational phase, a few personnel is required onsite including security guards, operation and maintenance officer and site engineers etc.

HFE would deploy technical, skilled persons as per the requirement on site during operation. Additionally, labors, comprising of semi-skilled and unskilled, would be deployed for security, module cleaning, vegetation abatement, module tilting etc.

2.5.4 Raw Materials

The construction related materials viz. stone aggregates, sand and bricks etc. for the project is likely to be sourced from Madhugiri.

2.5.5 Waste Water Treatment and Disposal System

During the construction phase, the waste water or sewage from site office toilets will be disposed in a chamber of soak pit. At labor camps the domestic waste water is also disposed off in a soak pit. Waste water will be generated during the operation phase due to solar module washing on regular basis.

Proper storm water channels have been constructed along the periphery of the project site for draining of site run off. As per HFE dry washing of solar panels will only be carried out if the settled dust is not of a huge amount. If wet washing is required mist washing will take place which would not generate large quantities of waste water. The domestic waste water would be managed through Soak Pits.

2.5.6 Logistic Arrangement

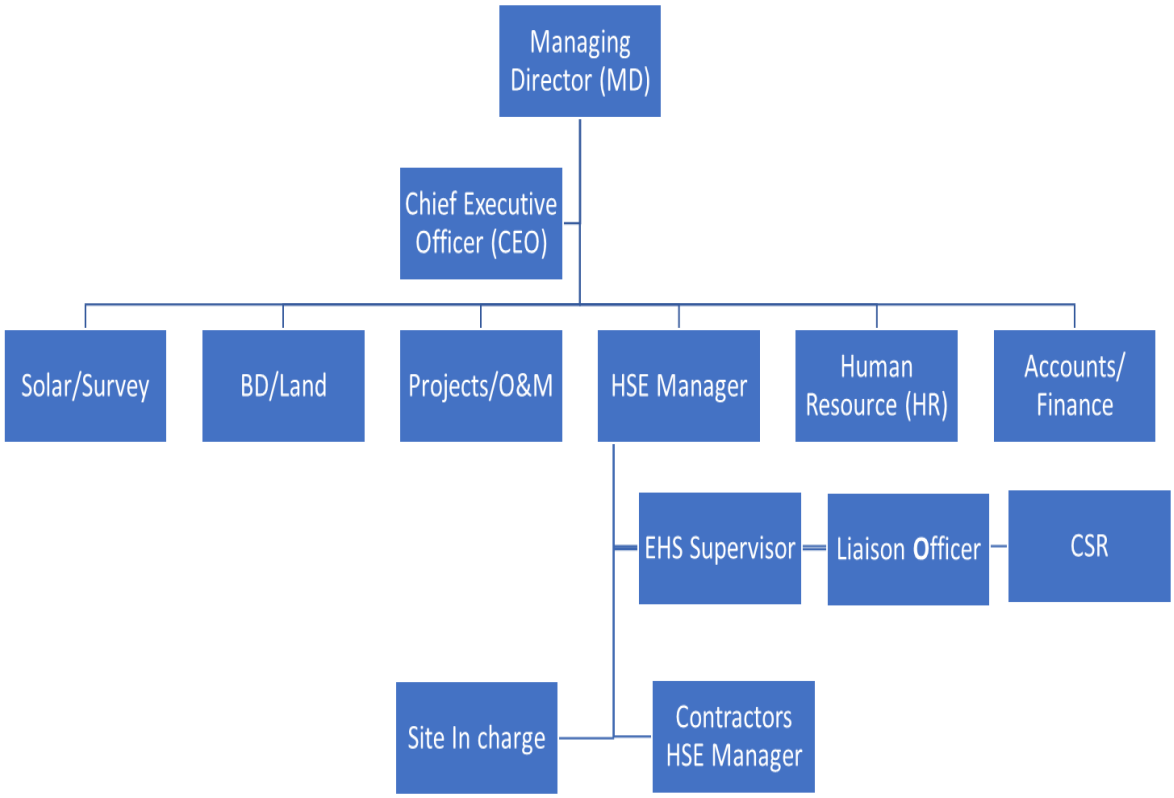
Labor Camp: The project is in the Pre-Commissioning stage and finishing work of SCADA room and other control room along with levelling of land at some areas was being carried out during the site visit. The company hired unskilled labors locally for reducing the requirement of labor camp. Onsite labor camp was constructed as per project requirement. Labor camp accommodated 60 migrant labors during peak construction. At present only 20 labors are accommodated till the completion of construction phase. All the basic amenities such as drinking water, kitchen, toilet facilities, etc. were provided in the labor camp following the ILO recommendations.

Project Vehicles: Project vehicles such as water tanker, tractors, JCB, and cars will be engaged to support various activities during construction phase and further efforts will be made to hire vehicles from local community.

2.5.7 Organizational Structure

To ensure smooth completion of various operations or activities of project during construction and operational phase, HFE has its own Integrated Management System policy. During the project phase, project operations will be managed by Project Manager and environmental, health & safety issues will be monitored by HFE regional EHSS Officer.

Figure 2-8: Organizational Structure



2.5.8 Implementation Schedule for the Project

The construction work is expected to be completed by the end of December 2017 and commissioning to begin in Mid-January 2018.

3 APPLICABLE REGULATIONS, GUIDELINES AND STANDARDS

This section describes regulations, statutory guidelines and obligatory standards that are applicable to the social and environmental performance of the project.

3.1 National Regulations

In India, the Ministry of Environment, Forests and Climate Change (MoEFCC) is the apex administrative body for

- Regulating and ensuring environmental protection;
- Formulating the environmental policy framework in the country;
- Undertaking conservation & survey of flora, fauna, forests and wildlife; and
- Planning, promotion, co-ordination and overseeing the implementation of environmental and forestry programs.

Several laws have been framed for protection of environment and for Occupational Health & Safety in India by the Central Government. The relevant regulation pertaining to the project activity has been discussed as under. The compliance to all environmental, health, safety and social regulation have been presented in **Table 3-1**.

Table 3-1: Applicable Environmental, Health, Safety and Social Regulation

S.N.	National Environment, Health & Safety Regulation	Agency Responsible	Requirement	Applicability
1	Karnataka Solar Policy 2014-2021	Karnataka Electricity Regulatory Commission (KERC), Karnataka Power Corporation limited (KPCL), Karnataka Power Transmission Corporation limited (KPTCL), Karnataka Renewable Energy Development limited (KREDL),	As per the policy, KERC will decide the tariffs and to issue regulations regarding percentage of renewable purchase obligations and decide charges with respect to wheeling, bank subsidy, cross subsidy charges. Condition for getting accreditation to avail Renewable Energy Certification shall be governed by CERC and KERC regulations.	*HFE have followed the legal permissions and procedures and will comply with the obligations mentioned therein for the Solar Project site at Malagondanahalli village* in Madhugiri *for the 20 MW Solar Power Plant in Tumkur, Karnataka.*
2	The Air (Prevention & Control of Pollution) Act 1981	State Pollution Control Board (SPCB)	As per Karnataka Solar Policy, 2014-2021, Solar PV power projects will be exempted from obtaining any NOC/Consent for establishment under pollution control laws from Karnataka Pollution Control Board.	*Solar power plant is exempted to obtain CTO. However, SPCB needs to be informed by the project proponent while starting the project.*
3	The Water (Prevention & Control of Pollution) Act 1974	State Pollution Control Board (SPCB)	Development of solar power plant falls under white category and therefore it is exempted to obtain CTE and CTO from State Pollution Control Board.	*Solar power plant is exempted to obtain CTO. However, SPCB needs to be informed by the project proponent while starting the project.*
4	Forests (Conservation) Act, 1980 and Rules 1981	Forest Department	The Forest Conservation Act and Rules mandate projects requiring diversion of forest land for non-forest purposes to seek Forest Clearance from the Ministry of Environment and Forests.	*Not Applicable* *As reported, no forest land is involved for the development of this project.*
5	The Environmental (Protection) Act 1986 and Rules	MoEF&CC CPCB APPPCB	Requirement of the law states that establishing the project should ensure that there is no impact or minimal impact on the environment due to project activity.	Applicable during construction & operation Phase
6	Environmental Impact Assessment (EIA) Notification 2006 & MoEFCC Office	MoEFCC	The EIA Notification 2006 and thereafter the MoEFCC Office Memorandum dated, 13th May 2011 exempts solar power project from obtaining prior Environmental Clearance from the regulatory authorities. But, under the provision of	*Not Applicable.*

S.N.	National Environment, Health & Safety Regulation	Agency Responsible	Requirement	Applicability
	Memorandum dated 30thJune'11.		MoEFCC office memorandum dated 30th June 2011, requisite permission is required to be obtained from competent authority for water and land usage.	
7	Environment (Protection) Seventh Amendment Rules 2009	CPCB	Ambient air quality monitoring must be carried out and the concentration limits for the air quality parameters should be in compliance with NAAQS 2009. Activities in the project especially during construction should not result in exceeding National Ambient Air Quality Standards (NAAQS) for ambient concentrations of air pollutants (such as particulate matter). If violation of the Rules takes place, then the penalty will be decided based on the parent Air Act 1981.	*Applicable during construction and operation phase.*
8	Noise (Regulation and Control) Rules 2000 amended in 2010	KPCB	The Rules stipulate ambient noise limits during day time and night time for industrial, commercial, residential and ecologically sensitive areas. The rules apply both during the construction and operation of the project. Violation of the standards for assessing the noise quality due to the project will lead to penalty as under the EPA Act 1986.	*Applicable during construction and operation phase.*
9	Hazardous Waste (Management, Handling and Transboundary Movement) Rules 2008 Hazardous and Other Wastes (Management and Trans boundary Movement) Amendment Rules, 2016.	KPCB	These Rules outline the responsibilities of the generator, transporter and recycler/re-processor of the hazardous wastes for handling and management in a manner that is safe and environmentally sound. Project proponent need to obtain consent from State Pollution Control Board for generation and storage of hazardous waste like transformer oil, etc. irrespective of quantity of waste. As per the law the occupier and the operator of the facility should be liable to pay financial penalties as levied for any violation of the provisions under these rules by the State Pollution Control Board with the prior approval of the Central Pollution Control Board.	*Applicable during construction phase.* *During the construction 1 DG sets of 7.5 kV was used for the civil work involved. The operation phase of the project will result in generation of some quantities of hazardous waste, mostly in the form of waste/used oil as well as broken solar panels. HFE needs to obtain consent from KSPCB for storage of transformer oil, if required. All the hazardous waste generated due to the project should be stored and disposed as per the requirements of the Hazardous Waste (Management, Handling and Trans-Boundary Movement) Rules, 2008/ Hazardous and Other Wastes (Management and Trans boundary Movement) Amendment Rules, 2016. i.e., on a paved surface in a designated area with adequate secondary containment, with adequate labelling and before it is disposed to an KSPCB approved vendor.*

S.N.	National Environment, Health & Safety Regulation	Agency Responsible	Requirement	Applicability
				Though not covered under the rule, the broken solar panel is recommended to be sent back to the manufacturer or an authorised recycler.
10	Environment (Protection) Second Amendment Rules 2002	MoEFCC	The DG sets installed during construction should comply with maximum permissible noise levels and noise control measures for diesel generators up to 1000 KVA capacity as specified in the Act.	*The power requirement during construction phase will be met through DG sets which will adhere to prescribed CPCB noise level limits and noise control measures.*
11	The Building and Other Construction Workers' (Regulation of Employment and Conditions of Service) Act 1996	Ministry of Labour and Employment	This Act provides for safety, health and welfare measures of buildings and construction workers in every establishment which employs or employed during the preceding year ten or more such workers. These measures include fixing hours for normal working day, weekly paid rest day, wages for overtime, provision of basic welfare amenities like drinking water, latrines, urinals, crèches, first aid, canteens and temporary living quarters within or near the work site. This Act also requires application of the following: Building or other construction workers' (regulation and Employment Conditions of Service) Central Rules 1998 & Workman's compensation Act, 1923 to buildings and other construction workers. These will be followed by contractor & developer during construction and operation phase.	*Applicable during construction phase.* *Project proponent will ensure through its contractors that basic amenities are provided to the labours. Project proponent through its contractors should also ensure all vendors employed should have valid labour license. Compensation to workers (own and vendors) should not be below daily wage rate as specified by Government. Master roll must be maintained. Employee ID card must be issued (own and vendors). Safety, health and welfare measures of building and construction workers as mentioned in the act needs to be complied with.* *Failure to comply results in financial penalty /imprisonment of the principal employer along with vendor and closure of project.*
12	Central Electricity Authority (Safety Requirements for Operation, Construction and Maintenance of Electric Plants and Electrical Lines) Regulations 2008, (CET)	Ministry of Power, Central Electricity Authority Karnataka Power Transmission Corporation limited (KPTCL	The Act is applicable for the solar power plant as the plant is going to be having electrical appliances and facilities installed for grid connected power generation. As per the act, all equipment's and system installed should comply with the provision of the statute, regulations and safety codes.	*Applicable both during construction and operation phase.* *Project proponent under provisions of the CET regulations ensure that the health and safety requirements and provisions for transmission lines specified under the rules are complied.*
13	Workmen's Compensation Act, 1923 & Rules 1924	Labour Welfare Board, Karnataka	The Act requires if personal injury is caused to a workman by accident arising out of and during his employment, his employer should be liable to pay compensation in accordance with the provisions of this Act.	*Applicable during both construction and operation phase.* *Project proponent should ensure through its contractors in case of any accident/ injury/*

S.N.	National Environment, Health & Safety Regulation	Agency Responsible	Requirement	Applicability
				loss of life the workmen should be paid a minimum compensation as calculated under this act both during construction and operation phase of the project. The reporting of accidents needs to be done in prescribed forms as per the act and the incident / accident register needs to be maintained accordingly. The Act also gives a framework for calculating amount of compensation and wages.
14	The Contract Labour (Regulation and Abolition) Rules, 1971 Contract Labour (Regulation and Abolition), 1973	Labour Welfare Board, Karnataka	The Contract Labour (Regulations & Abolition) Act, 1970 requires every principal employer of an establishment to make an application to the registering officer in the prescribed manner for registering the establishment. The Act and its Rules apply to every establishment in which 20 or more workmen are employed on any day on the preceding 12 months as contract labour and to every contractor who employs or who employed on any day preceding 12months, 20 or more workmen. It does not apply to establishments where the work performed is of intermittent or seasonal nature. An establishment wherein work is of intermittent nature will be covered by the Act and Rules if the work performed is more than 120 days in a year, and where work is of a seasonal nature if work is performed more than 60 days in a year.	*Applicable during both construction and operation phase.* *All vendors will be employed including contractors should have valid labour license. Compensation to contract workers (own and vendors) should not be below daily wage rate as specified by Government of India. Master roll must be maintained. Employee ID card must be issued (own and vendors). Safety, health and welfare measures of building and construction workers as mentioned in the act needs to be complied with such as arrangement for sanitation facilities, drinking water, first aid etc. Failure to comply results in financial penalty. Failure to comply results in financial penalty.* *HFE through its contractors should also ensure that conditions like hours of work, fixation of wages and other essential amenities in respect of contract labour are provided and in compliance with the standards.*
15	Minimum Wages Act, 1948	Labour Welfare Board, Karnataka	This Act provide for fixing minimum rates of wages in certain employments and requires the employer to provide to every worker engaged in a scheduled employment to be paid wages at a rate not less than the minimum rate of wages fixed by such notification for that class of employees in that employment without any deductions except as may be	*Applicable during both construction and operation phase*

S.N.	National Environment, Health & Safety Regulation	Agency Responsible	Requirement	Applicability
			authorized within such time and subject to such conditions as may be prescribed.	
16	The Child Labour (Prohibition and Regulation) Act, 1986	Labour Welfare Board, Karnataka	The Act prohibits employment of children in certain occupation and processes. The Act also specifies conditions of work for children, if permitted to work.	*Both EPC contractor and HFE have ensured that no child labour will be engaged at site for construction or operation works either directly or by the sub-contractors. HFE have included a clause in the subcontractor agreements prohibiting employment of child labour.*
17	Companies Act, 2013	HFE	According to Schedule 135 sub -section 1, the companies meeting the threshold criteria (Minimum net worth of rupees 500 Crore, Turnover up to "1000 Crore" and having a net profit of at least '5 crore') specified should spend in every fiscal year, at least 2% of the average net profits of the Company made during the three immediately preceding financial years in pursuance of CSR policy.	*The project will need to comply with the requirement as stated in the law.*
18	Panchayat (Extension to Scheduled Areas) Act 1996	HFE	Provisions of this rules are: A state legislation on panchayats in the scheduled area should take care of the customs, religious practices and traditional management practices of community resources. Every village shall contain a Gram Sabha whose members are included in the electoral list for the panchayats at village level. Planning and management of minor water bodies are entrusted to the panchayats. The Gram Sabhas have roles and responsibilities in approving all development works in the village, identify beneficiaries, issue certificates of utilization of funds; powers to control institutions and functionaries in all social sectors and local plans. Every Gram Sabha to safeguard and preserve the traditions and customs of people, their cultural identity, community resources and the customary mode of dispute resolution	*The project will need to comply with the requirement as stated in the law.*

3.2 Social and Environmental Performance Standards of the International Finance Corporation

The International Finance Corporation has laid down a set of eight Performance Standards (PS) and project developers need to comply with applicable PS while establishing the project. The provisions of the Performance Standards relevant to the solar power projects are summarized below:

Table 3-2: IFC's Environmental and Social Performance Standards

Title of Performance Standard	Performance Standard (PS) requirements in brief	Applicability to project (Compliance)	Actions Taken/Requirements
Performance Standard (PS) - 1 Assessment and Management of Environmental and Social Risks and Impacts	Conduct an Environmental and Social Impact Assessment (ESIA) of the project, appropriate to the nature of the project's environmental and social risks and potential impacts.	Arcadis has been appointed to undertake ESIA study to identify the environment and social risks that may arise due to the solar power project and recommend mitigation measures for the same as provided in **Chapter 6** The PS 1 is applicable to project with environment and/or social risks and/or impacts. The project is a solar power project and will have environmental and social impacts resulting generation of noise, construction activities etc. **PS 1 is therefore applicable for the project.**	HFE have developed an Environmental and Social Management System at the corporate level as well as adhered to the environment and social management plan recommended for its solar project at the ground level The Environment and Social policy is provided in Appendix R. the ESMS encompasses the following requirements: • Environmental and social action plan; • Identification of risks and impacts; • Management program; • Organizational capacity and competency; • Training for security and safety workers; • Emergency preparedness and response; • Stakeholder engagement/ grievance redressal; and • Monitoring, reporting and review.
	Establish Environmental and Social Management Plans commensurate with the findings of the ESIA and consultation with affected communities	An Environmental and Social Management Plan has been prepared and incorporated in **Chapter 7** of the ESIA report taking into consideration the potential social and environmental impacts or risks already identified & assessed in ESIA.	
	Establish Action Plans where specific mitigation measures and actions are required for the project to comply with applicable laws, regulations and the requirements of these Performance Standards	An ESMP has been prepared and incorporated in **Chapter 7,** of the ESIA report for implementation of mitigation measures in compliance with the statutory requirements and Performance Standards	
	Establish and maintain a timely process of community engagement, including a grievance mechanism, focusing on disclosure of information and consultation with local communities affected by project risks or adverse impacts that is free from external manipulation, interference or coercion to ensure relevant and understandable access to project information.	Considering substantial land will be acquired from the community for the project activity, a community engagement plan needs to be developed and implemented as well as adequate reporting needs to be done. This should aim to inform the community project related adverse impacts or risks. HFE's Grievance Redressal	

Title of Performance Standard	Performance Standard (PS) requirements in brief	Applicability to project (Compliance)	Actions Taken/Requirements
		Mechanism (GRM) will be implemented in this project	
	Establish procedures to monitor and measure the effectiveness of the environmental and social management program, including internal reporting of the program's effectiveness to the project's senior management, disclosure of Action Plans (including material changes to such Plans) to affected communities, and external reporting to affected communities on the results of Action Plans, commensurate with the concerns of the affected communities	System of monitoring with periodic audits will be established at the site.	
PS 2: Labour and Working Conditions	Performance Standard 2 recognizes that the pursuit of economic growth through employment creation and income generation should be accompanied by protection of the fundamental rights of workers. The requirements set out in this Performance Standard have been in part guided by many international conventions and instruments, including those of the International Labour Organization (ILO) and the United Nations (UN).	The PS 2 applies to workers directly engaged by the client (direct workers), workers engaged through third parties (contracted workers), as well as workers engaged by the client's primary suppliers (supply chain workers). The project will involve employment of direct and contracted workers during construction and operation phases. **PS 2 is therefore applicable for the project.**	HFE should ensure that adequate facilities and amenities are provided in the labour accommodation for construction workers including: adequate living/sleeping facilities and space per person; potable water that meets national standards and standards as laid down by ILO; toilets, washing and cleaning facilities; canteen/mess or fuel for cooking; locker/storage facilities; and facilities for management and disposal of garbage, sewage and other waste at the labour camp. The company will periodically review and monitor the condition of the labour camps at all the mentioned project sites. The worker accommodation standards as laid down by ILO is presented in **Appendix C** of the document. The company, as a part of oversight procedures will need regular monitoring of compliance to the aforesaid guidelines/requirements and ensure that these are met at project sites. Internal audits and follow up on corrective actions will also need to be undertaken to assess efficacy of the oversight system at the project site.

Title of Performance Standard	Performance Standard (PS) requirements in brief	Applicability to project (Compliance)	Actions Taken/Requirements
	Establishment of a Human Resources Policy consistent with the requirements of this Standard that informs employees of their rights under national labour and employment laws.		HFE have developed site specific HR policy in line with the HR Policy at their corporate level. They or their appointed contractor, have informed their employees about their rights under national labour and employment laws.
	Document and communicate to all employees' conditions and terms of employment.	Applicable during construction and operation phase at the project site at Unit-3	HFE would engage labours directly or through contractors. However, the management of labourers should be supervised by HFE so that the engagement of workers is in accordance to applicable rules and regulations.
	Practice non-discrimination and equal opportunity in making employment decisions	Applicable during construction phase	Equal opportunity to both men and women depending on their skills and capacity wages, work hours and other benefits have been practiced as per the national labour and employment Laws at the project sites.
	Provide a mechanism for workers to raise workplace concerns.	Applicable during construction and operation phase	Grievance Redressal Mechanism are framed under the ESMS and the same will be implemented at project level. (Appendix T) This is applicable both during construction and operation phase and should be supervised by HFE.
	Provide workers with a safe and healthy work environment, considering risks inherent to the project sector	Applicable during construction and operation phase.	Provide workers with a safe and healthy work environment, considering risks inherent to the project sector
PS 3: Resource Efficiency & Pollution Prevention		In case the solar panel contain any hazardous material, chances of ground water and soil contamination cannot be ruled out. HFE may be held accountable for activities of other developers in the same region. HFE needs to safeguard its liability by keeping record of mitigation measures to safeguard against any future liability. Waste oil and other hazardous chemicals released from construction activities may result in contamination of ground and nearby surface water.	During construction and operation phase water will be supplied by Locals from the village through borewells. Ground water will also be sourced from ground water from borewells present at the site. The extraction will be minimal. The approval is under process. Safe drinking water will also be supplied to the workers; through government-based RO plants at Madigeshi.

Title of Performance Standard	Performance Standard (PS) requirements in brief	Applicability to project (Compliance)	Actions Taken/Requirements
		PS 3 is therefore applicable for the project.	As such no impact on ambient air quality is expected because of this project. However, temporary impacts on ambient air quality and noise levels may be expected during construction phase. HFE should implement measures during construction: for management of excavated earth and construction rubble; and minimization of fugitive dust emissions. Further, HFE should ensure through its contractors that other wastes (packing material, metal, debris, cement bags, drums/cardboards etc.) are collected, stored and disposed off to re-users or in appropriate authorized debris disposal areas. Limited concreting work is expected for structure foundations, sub-station, and transmission towers. Cement concrete mixers will be expected to be used at site since significant concreting work is not expected. Concreting and other construction activities including use of earth moving equipment and increased traffic for material movement is expected to result in increase in ambient noise levels. However, this increase is short term during construction stage only. The construction work will be carried out only during day time and no noise generating equipment will be operated at night. No material impact on surface or groundwater resources is expected because of the project, except that the water sourcing requirement during the construction phase will need to safeguard the immediate and medium-term needs of water by the local communities. The sub-contractors should ensure that the water made available to workers and employees' meets national potable water quality norms. The project site

Title of Performance Standard	Performance Standard (PS) requirements in brief	Applicability to project (Compliance)	Actions Taken/Requirements
			if equipped with appropriate facilities for collection, treatment and disposal of sewage (septic tank and soak pit) which is used both during construction and operation phases should be provided.
	The project proponent should ensure that adequate control techniques are provided to minimize emissions or achieve a pre-established performance level and minimize pollution from project activities. The client will avoid the release of pollutants or, when avoidance is not feasible, minimize and/or control the intensity and mass flow of their release.	During the construction phase, the vehicles involved for hauling of equipment's and materials to the project site may increase the pollution level and dust in the air.	HFE through its contractors have ensured sprinkling of water to reduce dust in the air. Besides, HFE have also ensured use of vehicles having valid PUC certificates.
	The client will implement technically and financially feasible and cost-effective measures for improving efficiency in its consumption of energy, water, as well as other resources and material inputs, with a focus on areas that are considered core business activities.	During construction and operation phase.	HFE have planed and implemented pollution control measures. Practices like minimal release of waste, safe disposal of waste, wastewater management etc. will be considered in all phases of project life cycle.
PS 4: Community Health, Safety and Security	Performance Standard 4 recognizes that project activities, equipment, and infrastructure can increase community exposure to risks and impacts. In addition, communities that are already subjected to impacts from climate change may also experience an acceleration and/or intensification of impacts due to project activities. While acknowledging the public authorities' role in promoting the health, safety, and security of the public, this Performance Standard addresses the client's responsibility to avoid or minimize the risks and impacts to community health, safety, and security that may arise from project related-activities, with attention to vulnerable groups.	This Performance Standard is applicable to projects which entail potential risks and impacts to the health and safety of affected communities from project activities. The project will involve transportation of large components, which may pose safety risks to the affected communities. Impacts due Electrocution and Firing due to short-circuit, Accidents during cutting, chipping and piling, Physical injuries, Trip and fall hazards or by Diseases due to unhygienic condition etc. **The PS 4 is therefore applicable for the project.**	The applicability will be both to the construction and operation phase at Medigeshi and other nearby villages. In addition to the movement of heavy machinery / vehicles during the construction phase, effects due to glare effect generated due to solar panels will pose an impact on the community if properly not mitigated. The Action Plan and any other relevant project-related information is to enable the influenced communities and relevant government agencies to understand these risks and impacts, and will engage the influenced communities and agencies on an on-going basis consistent with the requirements of the PS.
	Evaluation of risks and impacts of the project on health & safety of the affected community during the project lifecycle and establish preventive/mitigation measures to reduce/minimize the impacts.	During Construction Phase	The potential occupational hazards arising from the project activities and the impacts on health & safety of the affected community

Title of Performance Standard	Performance Standard (PS) requirements in brief	Applicability to project (Compliance)	Actions Taken/Requirements
	Disclosure of action plans to affected community and the government agency.		have been identified and assessed in this report
	Design, construct, operate and decommission of Structural elements or components in accordance with good industrial practice to reduce impact on community health & safety.	During Construction Phase	An occupation health safety plan has been formulated in this report. All steps to reduce the impact on the health and safety of the community to minimal will be taken.
	Minimization of impacts on the health and safety of the community caused by natural hazards that could arise from the land use changes due to project activities.	During Construction Phase and Operational phase	A management plan has been formulated as part of ESIA process to address the issue.
	Prevent or minimize the potentials for community exposure to communicable diseases during project activities	During Construction Phase	CSR Plan and activities has been provided as a part of ESIA.
PS 5: Land Acquisition and Involuntary Resettlement	PS 5 is applicable when there is physical and/or economic displacement due to acquisition of land for the project. This PS does not apply to resettlement resulting from voluntary land transactions (i.e. market transactions in which the seller is not obliged to sell, and the buyer cannot resort to expropriation or other compulsory procedures if negotiation fails). The impacts arising from such transactions should be dealt with as under PS1, though sometimes, when risks are identified, the project proponent may decide to adhere to PS 5 requirement even in willing-buyer-seller cases	Private lands are being taken for the 20 MW Solar Power project. It was also told by the HFE representative that location falling on Private land for the 20 MW Solar Project are not resulting in any involuntary resettlement issue as the lands taken are being procured on good faith negotiations on willing to buy and sell basis and at mutually agreed price. It was further informed by HFE that there is no human habitation in the identified private land for the 20 MW solar project for HFE. **Hence considering that livelihood is not impacted, PS 5 is not applicable.**	No actions required.
	Avoidance or at least minimization of involuntary resettlement by exploring alternative project designs balancing environmental, social and economic costs and benefits; and by acquiring land through negotiated Settlements.	Not applicable	No resettlement of people is required.
	Compensation and benefits for displaced person as per Performance Standard	Not applicable	No locals will be displaced. However, proper compensation should be paid to the private land owner, whose land is Identified for

Title of Performance Standard	Performance Standard (PS) requirements in brief	Applicability to project (Compliance)	Actions Taken/Requirements
			access road or transmission line tower construction.
	Disclosure of all relevant information and consultation with affected persons and communities in decision making process related to resettlement.	Not applicable	No resettlement has taken place due to the project activity
	Establish a grievance mechanism to record and resolve communities' concerns and grievances about the relocation and compensation	During the construction and operation phase	HFE have developed an Environmental and Social Management System at the corporate level A GRM Policy has also be framed under the system. It incorporates procedures for lodging of grievances, processing of grievances, resolving grievances and closing of grievances. Grievance redressal framework for onsite implementation is being formulated. The grievances would be addressed through Suggestion Box, Community Meetings and Meetings with Authorities responsible for welfare and development of the village. There is a Grievance Redressal Cell (GRC) on site.
PS 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources	As a matter of priority, the client should seek to avoid impacts on biodiversity and ecosystem services. When avoidance of impacts is not possible, measures to minimize impacts and restore biodiversity and ecosystem services should be implemented. Given the complexity in predicting project impacts on biodiversity and ecosystem services over the long term, the client should adopt a practice of adaptive management in which the implementation of mitigation and management measures are responsive to changing conditions and the results of monitoring throughout the project's lifecycle.	The Madhugiri project location site does not have any forest area within its 10 km radius. Project land is a non-forest waste land. There is no national park, wildlife sanctuary, biosphere reserve within 10 km of the study area. As per Wildlife Protection Act 1972, there is no critically endangered, endangered, threatened or rare species of wildlife in the core & buffer zone Moreover, Scheduled I species (species provided highest degree of protection by Wildlife Protection Act, 1972) as well as Red listed (Vulnerable or Threatened categorised by IUCN) can be found in the study area.	Following actions are required to be taken **During Construction Phase** • Activities generating high noise shall be restricted to day time and will be mitigated to minimize the noise level outside the site boundary. • Fencing along with proer lighting along the fencing must be constructed. • Camp and kitchen waste shall be collected in a manner that it does not attract animals. • Temporary barriers shall be installed on excavated areas.

Title of Performance Standard	Performance Standard (PS) requirements in brief	Applicability to project (Compliance)	Actions Taken/Requirements
		Adequate safeguards must be followed during construction and operation phase to prevent unwanted utilization of natural resources. **PS -6 is not applicable for the project.** Measures are already being taken like construction of fencing along the project boundary.	• The footprints of the construction activities shall be kept to minimum to reduce disturbance to flora and fauna. **During Operation Phase** • 6ft fencing should be properly maintained along with lighting along the fencing. • Solar panels shall have an anti-reflective coating to minimize the light reflecting off the panels so that there is very less impact due to glare from the panels. • Moreover, to minimize effect of "Lake effect", visual frightening techniques like "Scare crow" may be considered to frighten any bird trying to land on panels and prevent birds from landing. • The general measures for natural resource conservation and project impact mitigation will be followed. EHS practices will be ensured to minimize impacts on soil and water. Also, there has been no cutting / felling of trees. Stretches of avenue plantation of trees, with multi – tier canopy, such as Ficus beghalensis, Tamarindus indica, Azadirachta indica and Ficus religiosa will be planted along the project boundaries and the road stretch leading to project site. Such practices will improve the scope for rejuvenating the degraded vegetation and soil profile and contributing to ecological services also with a target of improving the micro – climate of the study area
PS 7: Indigenous People	Performance Standard 7 recognizes that Indigenous People, as social groups with identities that are	• To ensure that the development process fosters full respect for the human rights,	No action required

Title of Performance Standard	Performance Standard (PS) requirements in brief	Applicability to project (Compliance)	Actions Taken/Requirements
	distinct from mainstream groups in national societies, are often among the most marginalized and vulnerable segments of the population. Indigenous People are particularly vulnerable if their lands and resources are transformed, encroached upon, or significantly degraded. Their languages, cultures, religions, spiritual beliefs, and institutions may also come under threat. Therefore, Indigenous People may be more vulnerable to the adverse impacts associated with project development than non-indigenous communities	dignity, aspirations, culture, and natural resource-based livelihoods of Indigenous Peoples; • To anticipate and avoid adverse impacts of projects on communities of Indigenous Peoples, or when avoidance is not possible, to minimize and/or compensate for such impacts; • To promote sustainable development benefits and opportunities for Indigenous Peoples in culturally appropriate manner; • To establish and maintain an ongoing relationship based on Informed Consultation and Participation(ICP) with the Indigenous Peoples affected by a project throughout the project's life- cycle; • To ensure the Free, Prior, and Informed Consent (FPIC) of the Affected Communities of Indigenous Peoples when the circumstances described in this Performance Standard are present; and • To respect and preserve the culture, knowledge, and practices of Indigenous Peoples. • Project Proponent has informed the ESIA team that no ST land will be taken, neither any of their individual household or community assets are being affected for the 20 MW Solar Power Project in the proposed area. • PS 7 is not applicable for this project.	
PS 8: Cultural Heritage	Performance Standard 8 recognizes the importance of cultural heritage for current and future generations. Consistent with the Convention Concerning the Protection of the World Cultural and Natural Heritage, this Performance Standard aims to ensure	This PS is applicable when tangible forms of cultural heritage, unique natural features or tangible objects that embody cultural values and certain instances of intangible forms of culture are	The PS is not applicable as there is no impact anticipated on the cultural heritage of the proposed project site due to the project activities. No monument or structure of religious importance were observed within 5

Title of Performance Standard	Performance Standard (PS) requirements in brief	Applicability to project (Compliance)	Actions Taken/Requirements
	that clients protect cultural heritage during their project activities. In addition, the requirements of this Performance Standard on a project's use of cultural heritage are based in part on standards set by the Convention on Biological Diversity.	impacted or are to be used for commercial purposes. No notified cultural heritage site is located near the project areas. **Hence, PS8 is not applicable.**	KM. Chance finding procedure should be applied during construction phase for the proposed project. Though, no such evidential proof was found in the study area village

3.3 Categorization of Projects

3.3.1 Categorization of Projects as per IFC Guideline

As part of its review of a project's expected social and environmental impacts, IFC uses a system of social and environmental categorization. This categorization is used to reflect the size of impacts understood because of the client's social and environmental assessment and to specify IFC's institutional requirements. The categories used by the IFC are:

- **Category A Projects:** Projects with potential significant adverse social or environmental risks or/and impacts that are diverse, irreversible or unprecedented;
- **Category B Projects:** Projects with potential limited adverse social or environmental risks or/and impacts that are few, generally site-specific, largely reversible and readily addressed through mitigation measures;
- **Category C Projects:** Projects with minimal or no adverse social or environmental risks or/and impacts, including certain financial intermediary (FI) projects with minimal or no adverse risks;
- **Category FI Projects:** Business activities involving investments in financial institutions (FIs) or through delivery mechanisms involving financial intermediation.

IFC therefore categorizes the project primarily according to the significance and nature of its impacts. IFC defines the project's area of influence as the primary project site(s) and related facilities that the client (including its contractors) develops or controls associated facilities that are not funded as part of the project (funding may be provided separately by a client or a third party including the government), and whose viability and existence depend exclusively on the project and whose goods or services are essential for the successful operation of the project; areas potentially impacted by cumulative impacts from further planned development of the project; and areas potentially affected by impacts from unplanned but predictable developments caused by the project that may occur later or at a different location. The area of influence does not include potential impacts that would occur without the project or independently of the project.

The project can be categorized as **Category B** projects based on limited environmental and social impacts envisaged.

4 DESCRIPTION OF ENVIRONMENT

This chapter describes the existing environmental settings of the project site and its immediate surroundings. This includes physical environment comprising air, water and land components, biological environment and socio-economic environment. Attributes of the physical environment like air, surface water, ground water and noise quality in and around the project area were assessed primarily through monitoring and analysis of samples collected from the area. Primary monitoring was conducted by a NABL certified laboratory.

Secondary information on geology, hydrology, prevailing natural hazards like floods, earthquakes etc. have been collected from literature reviews and authenticated information made available by government departments. Primary surveys were carried out to understand and record the biological environment prevailing in the area and the same was verified by the forest officials and against published information and literature. The socioeconomic environment has been studied through consultations with various stakeholders within the site. Additionally, socioeconomic data have been obtained from the Census of India, 2011 report.

4.1 Study Area

The project site for the solar power plant is located at Malagondanahalli village under Bedattur panchayat in Madhugiri Tehsil of Tumkur district, Karnataka. To understand and assess the environmental and social risks associated with the project the study area was divided into core area (5km around the project site) and buffer area (10 km around the project site).

4.2 Baseline Conditions

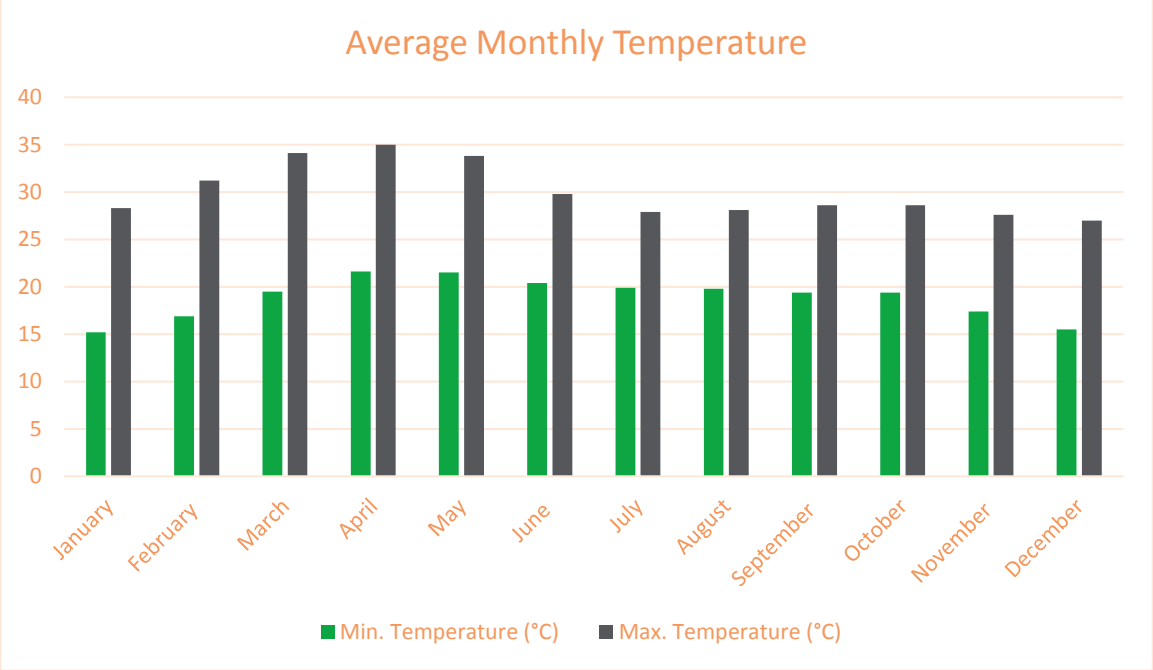
4.2.1 Climate and Meteorological Conditions

The climate of Tumkur District, Karnataka, may divide into four seasons. The cold season, December to February which is generally very dry, followed by the hot season from March to May. The period from June to September is the south west monsoon season. October and November form the post monsoon period through the North East.

The normal maximum temperature received during the month of April is 28.3 ^{0}C and minimum during the month or December 21.2 ^{0}C. The normal annual means maximum and minimum temperature of Tumkur District is 29.3 ^{0}C & 18.9 ^{0}C respectively.

During the south west monsoon season the relative humidity generally exceeds 88% (July month). In rest of the year it is drier. The driest month of the year is January.

Figure 4-1: Average Monthly Temperature Tumkur District



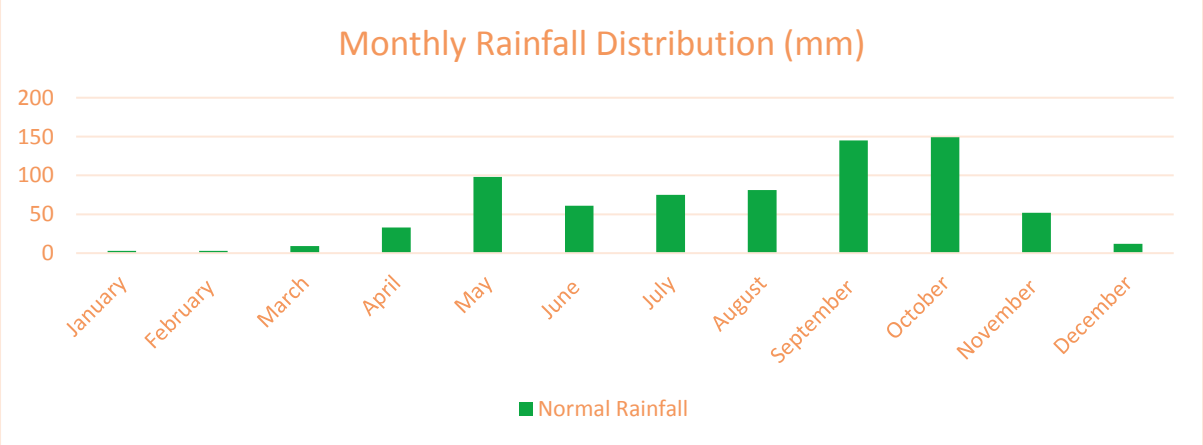
(Source: https://en.climate-data.org/location/47643/)

4.2.2 Rainfall

The normal annual rainfall of Tumkur District is 780 mm and it varies from 918mm in Tumkur to 620 mm at Pavagada. The amount of rainfall is maximum in eastern part around Tumkur and it sharply reduces to 620 mm at Pavagada towards north. It slowly reduces towards west towards Tiptur to 769 mm.

December to March receives very low rainfall. September is the wettest month with monthly rainfall more than 170mm. The rainfall occurs nearly 45 days in a year. The pre-monsoon period contributes an average rainfall of 166 mm (21%), the SW monsoon period contributes 417 mm (54%) and the NE monsoon period contributes 97mm (25%). During the year 2011, the district received an average rainfall of 673mm.However it varied spatially from 333 mm at Pavagada to 814 mm at Koratagere.

Figure 4-2: Monthly Rainfall Distribution Tumkur District



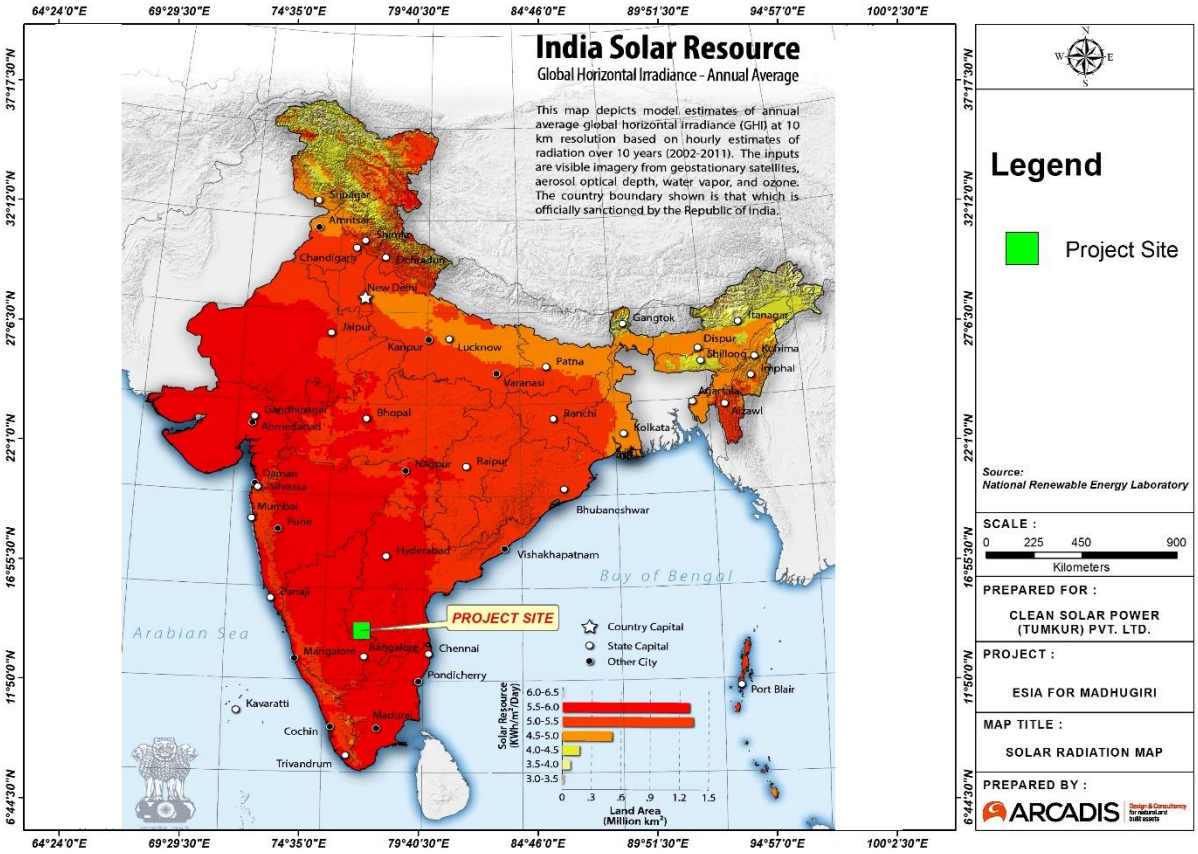
(Source: https://www.ksndmc.org/#rainfall)

4.2.3 Solar Radiation Profile

Selection of project location for solar energy project is very critical with solar intensity playing a key role. Karnataka receives considerable solar radiation intensity in India. In addition, the average rainfall is very low in the state.

Indian solar radiation map of India, which is based on the measured data of National Renewable Energy Laboratory (NREL) and satellite data, indicates that Karnataka state receives good amount of solar radiation of around 5.5 - 6 kWh/sq.m/day.

Figure 4-3: Solar Resource Potential Map



Source: http://www.nrel.gov/international/images/india_ghi_annual.jpg

4.2.4 Topography

The district is characterized by denuded uplands. Besides there are structural ridges along with Denudational hills in the North-East part. Flat valleys are observed in the southern part of the district. To the east of Tumkur and north of Devarayana Durga, the region presents beautiful scenery of hill ranges intersected by cultivated valleys. These hills pass through the taluks of Pavagada, Madhugiri, Koratagere and northern parts of Tumkur. In the eastern part, the hills pass through Madhugiri, Sira, and Gubbi taluks. The prominent hills in the eastern range of hills are Madhugiridurga (1199 m), Devarayanadurga (1187m), Nidugal (1148m), Channarayadurga (1138 m), Hutridurga (1130) Nijogal (1086m), Kamandadurga (1077 m), Koratagiri (879m), and Huliyardurga (844m) above mean sea level. The landmass in the plains ranges between 450 to 840 m above msl, while hilly areas range between 840 to 1200 m above msl. [2]

[2] *Ground Water Brochure, Tumkur District, Karnataka, Central Ground Water Board, Ministry of Water Resources, Government of India, September 2012.*

A part of the surrounding area is part of rain fed dry cultivation area and the rest was sparsely colonized by xerophytic shrubs. It was open to grazing by local domestic livestock of sheep, goats and cows. Depending the land use different areas supported different types of vegetation and flora. The areas under cultivation were colonized mainly by weeds while the wastelands were colonized mainly by non-palatable xerophytes and succulents. The prominent and abundant species include Dodonaea viscosa, Tarenna asiatica, Erythroxylon monogynum, Agave americana, Lantana camara, Chromolaena odorata, Acacia leucophloea, Prosopis juliflora and others. There are only a few trees of Neem, Tamarind and White babul.

The Topography of the Project site is an open area with moderate undulation. The average elevation of the site is 700. The site has been divided into two halves by the drainage channel passing through the site from west to east. An access road has been constructed through the natural drain with a culvert so as to let the movement of water along the channel. Pictures of the topography of the site is provided in **Figure 4-4**. The Digital elevation map along with Site Contour map is provided in **Figure 4-5** and **Figure 4-6** respectively.

Figure 4-4: Site Topography

Figure 4-5: Digital Elevation Map

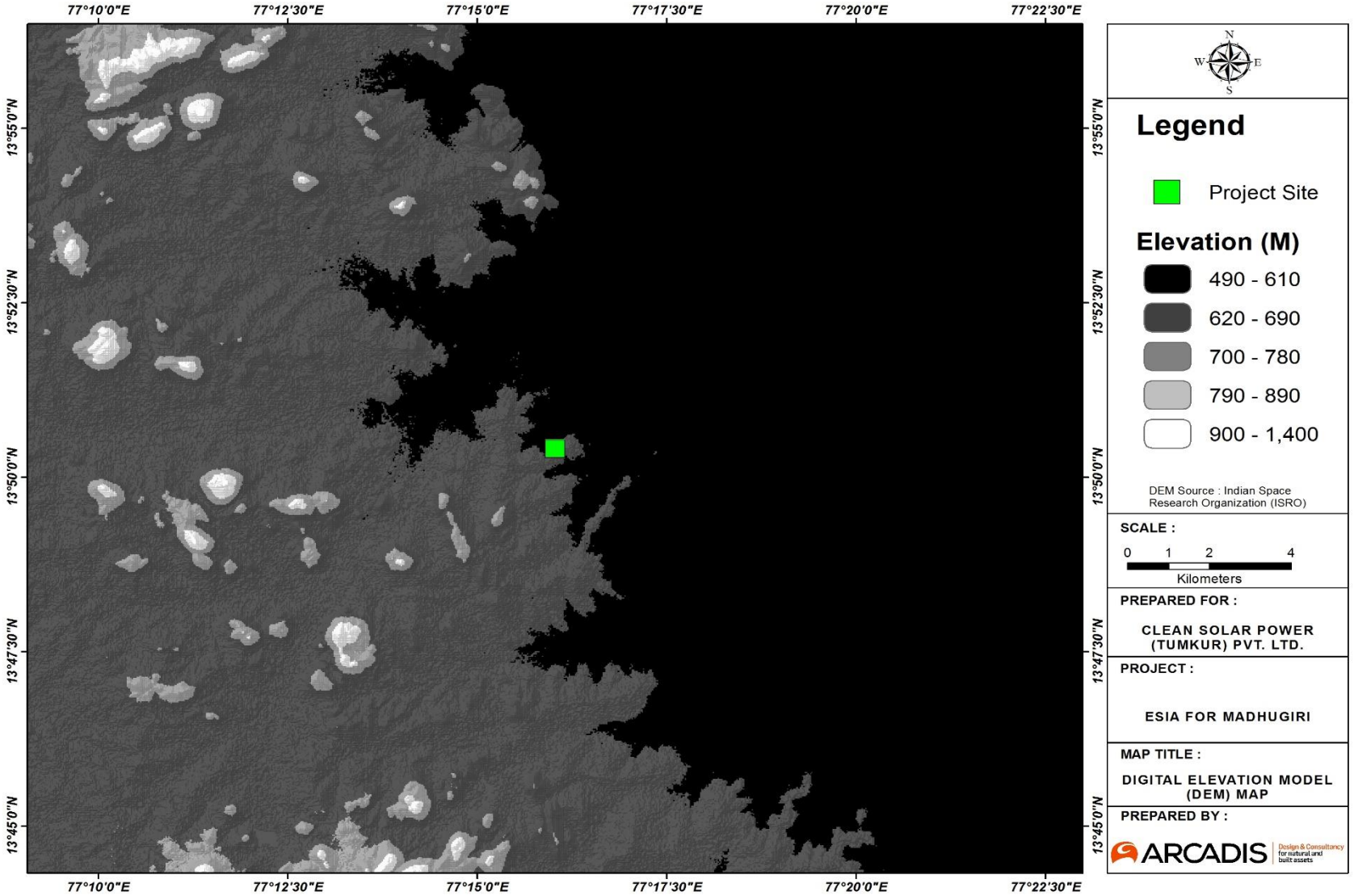
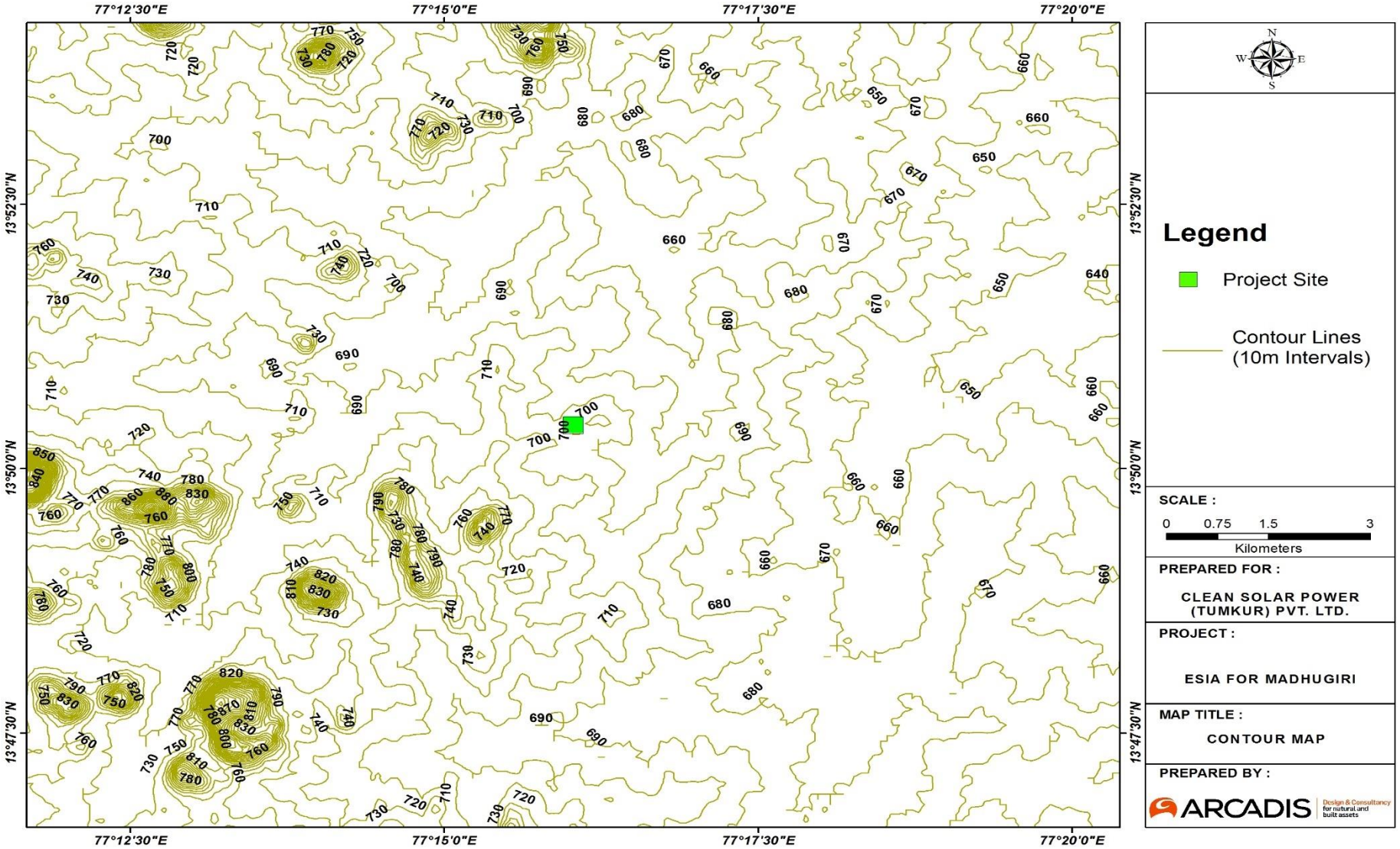


Figure 4-6: Site Contour Map



4.2.5 Soil Profile

A major part of the district is occupied by red sandy soil, red loamy soil along the eastern part. Very small part in North West part of CN Halli taluk is occupied by mixed red and black soils. Red sandy soils are suitable for the growth of ragi, jowar, millets and oil seeds under rain fed conditions. The irrigated areas of red loamy soils are favorable for paddy, sugarcane and vegetables.[3]

4.2.6 Land Use Analysis

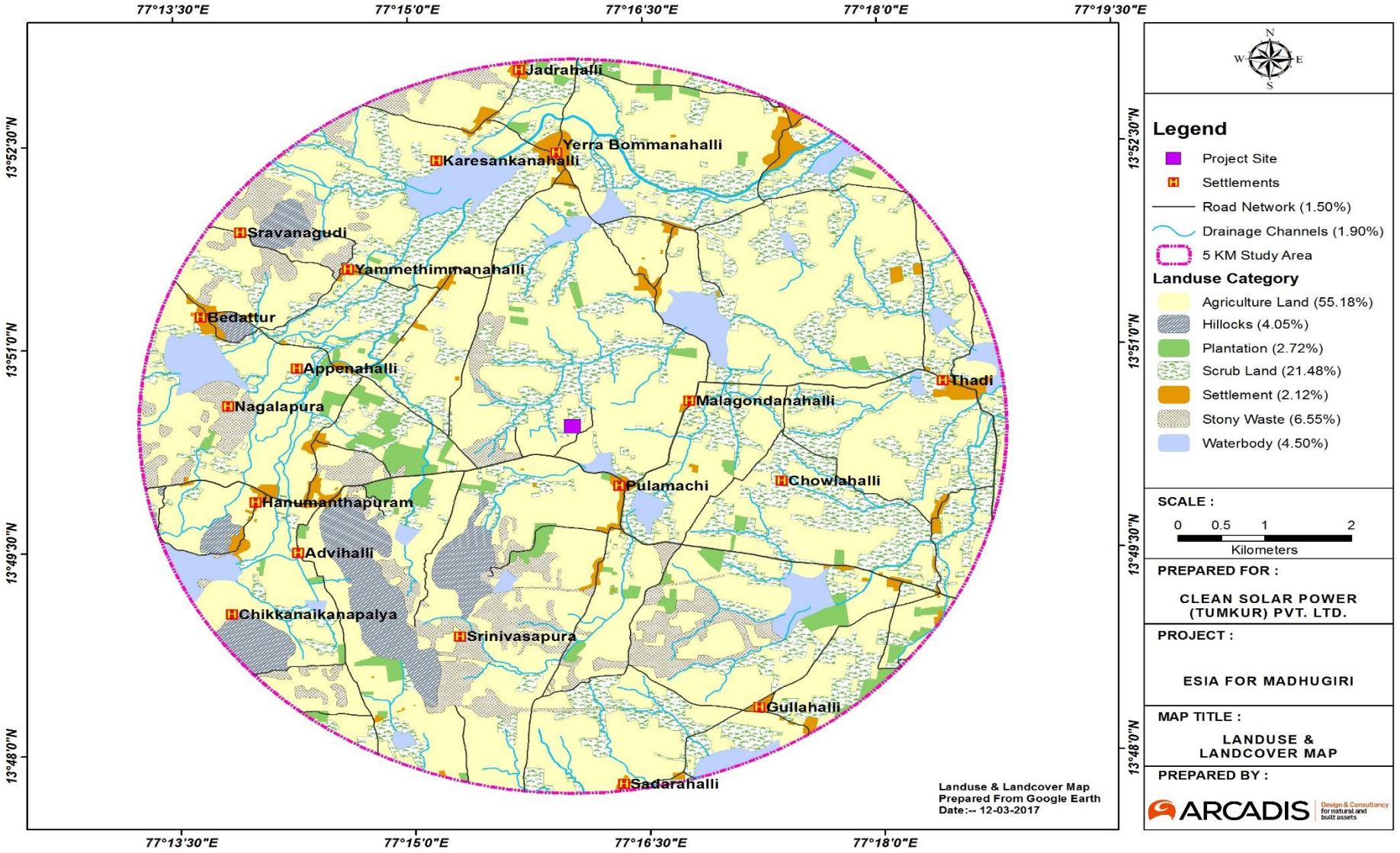
The land-use and land-cover of the study area (10 kms) has been interpreted from visual interpretation, google earth satellite imagery of the area, and subsequently by ground truth verification during field surveys.

Table 4-1: Land Use of Study Area

Category	Percentage
Agriculture land	55.18
Open Scrub	21.48
Hillocks	4.05
Stony Waste	6.55
Plantation	2.72
Waterbody	4.50
Settlement	2.12
Road Network	1.50
Drainage Channels	1.90
Total	100

[3] *Ground Water Brochure, Tumkur District, Karnataka, Central Ground Water Board, Ministry of Water Resources, Government of India, September 2012.*

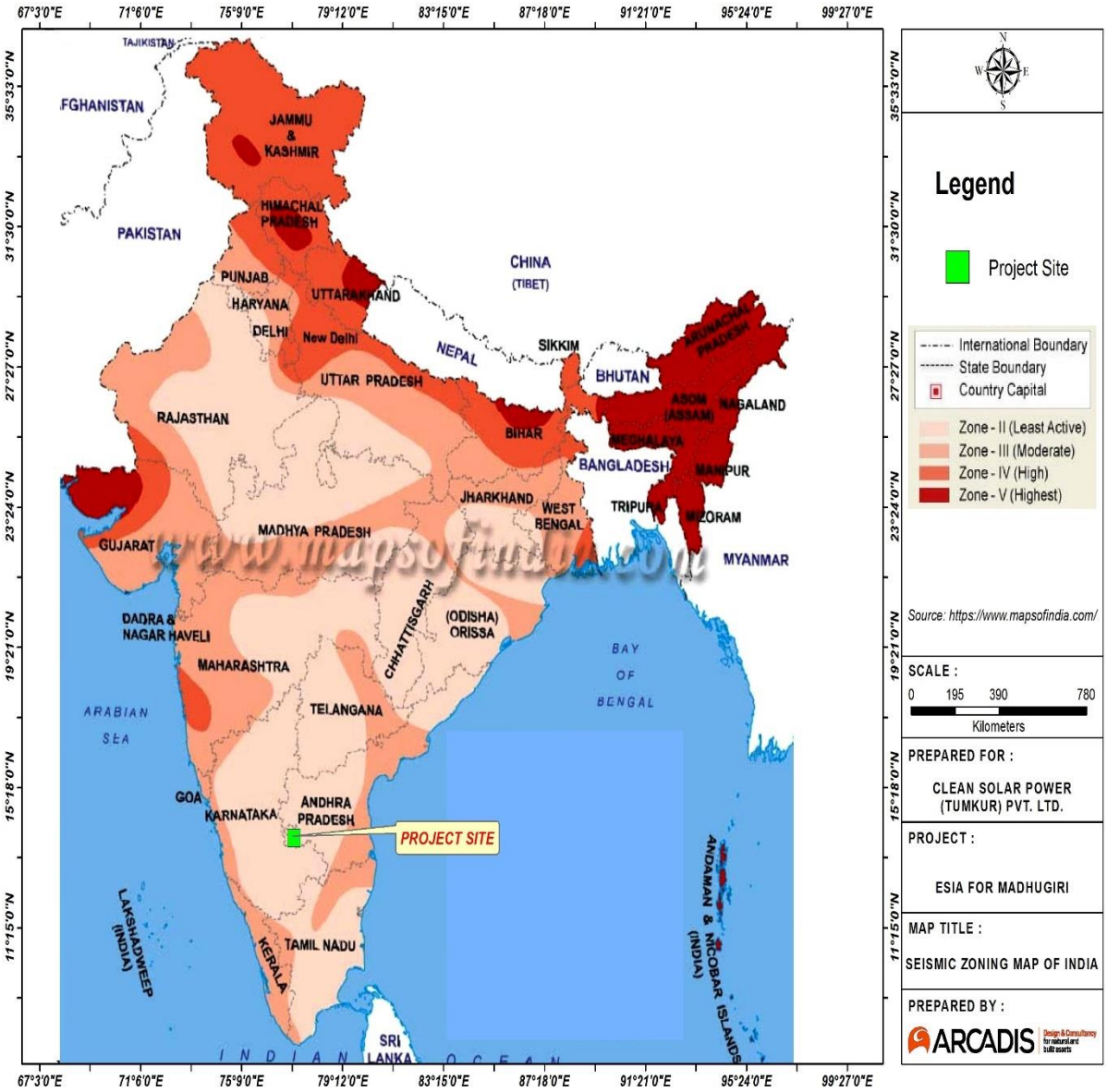
Figure 4-7: Land Use Map



4.2.7 Seismic Hazard

The project site is in **seismic zone II** as per the seismic zoning map of India (IS 1893–2002). Accordingly, implying that potential threats of damage due to earthquake are quite weak. The seismic zoning map of India has been shown in **Figure 4-8.**

Figure 4-8: Seismic Map



4.3 Environmental Monitoring

The project is in the pre-commissioning stage during ESIA study. Baseline environmental monitoring has been carried out for ambient air quality, surface water& ground water quality and noise quality monitoring conducted by NABL/MOEF Accredited Laboratory as per the applicable standard methods & analysis. The result of the environmental monitoring represents the baseline environmental condition in the region. Monitoring pictures are shown in **Figure 4-9.** Monitoring Location map is illustrated in **Figure 4-13**.

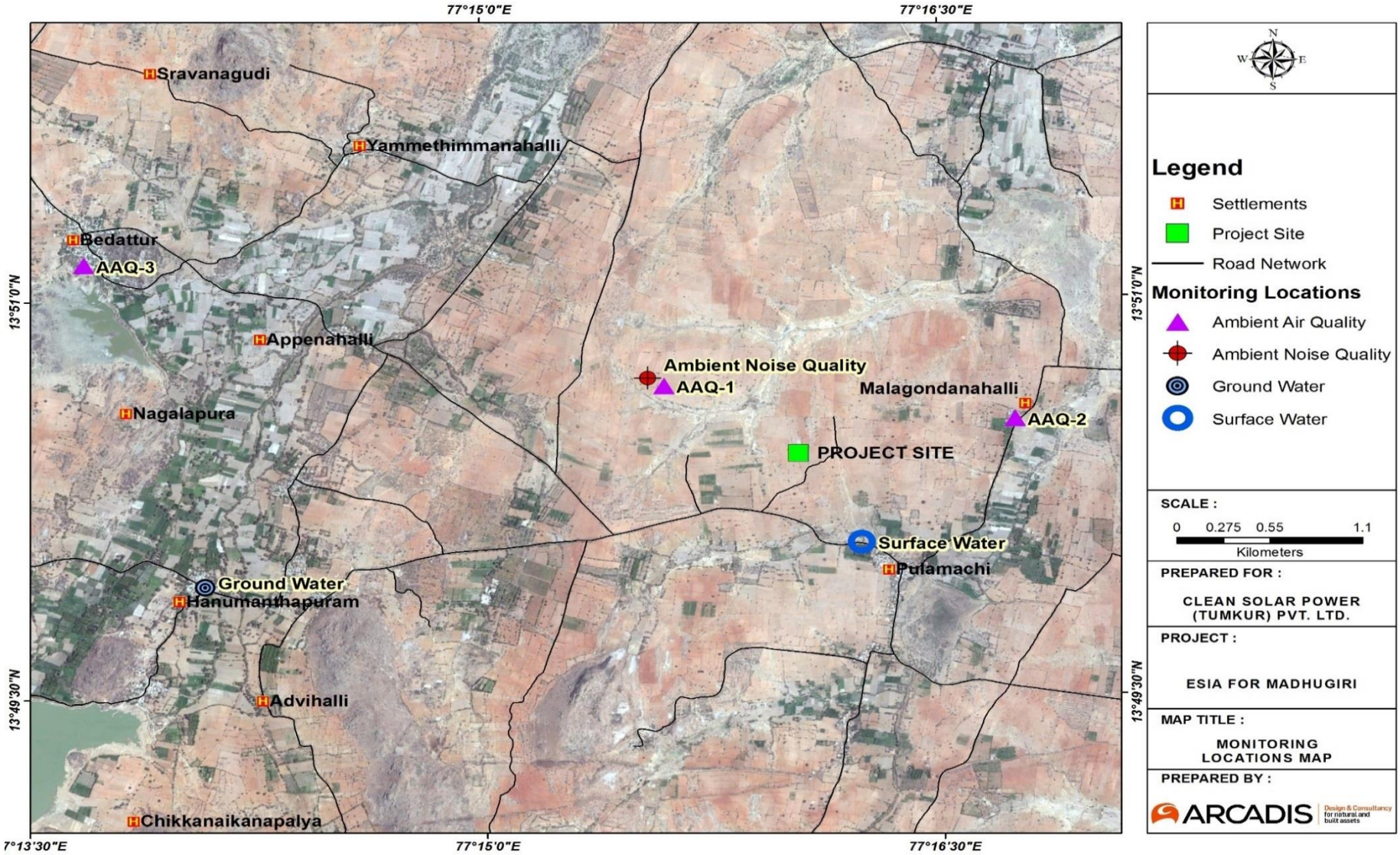
Figure 4-9: Ambient Air Quality Monitoring

Figure 4-10: Ground Water Sampling

Figure 4-11: Ambient Noise Monitoring

Figure 4-12: Surface Water Sampling

Figure 4-13: Monitoring Location Map



4.3.1 Ambient Air Quality

The existing quality of the ambient air environment serves as an index for assessing the pollution load and the assimilative capacity of any region and forms an important tool for planning project activities in the area. A detailed assessment of the existing air environment was undertaken for the purpose mentioned above. The ambient air quality monitoring was conducted at 3 representative locations.

The baseline air quality status of the study area was primarily assessed by monitoring for particulates and gaseous pollutants at these stations (**Refer Table 4-2**). The monitoring network was established based on the following key criteria.

- Regional Meteorology
- Important receptor locations (e.g. prominent villages, ecological sensitive areas etc.)
- Site reconnaissance survey and professional judgment

The ambient air quality monitoring was carried out in accordance with guidelines of Central Pollution Control Board (CPCB) June 1998 and National Ambient Air Quality Standards (NAAQS), November 2009. Air quality monitoring was carried out for 24 hours a day once a week for Particulate Matter (PM_{10} and $PM_{2.5}$), Sulphur Dioxide (SO_2) and Oxides of Nitrogen (NO_x), 8 hours a day once a week for Carbon Monoxide (CO).

Table 4-2: AAQ Levels Recorded at Three Monitoring Stations

SN	Pollutants	Result			Limit as per CPCB	Method of Test Reference
		Madhugiri Project site	Pulamachi Village	Bedattur Village		
1	Particulate matter (PM_{10}) in µg/m^3	54	41.5	39.6	100	IS 5182: Part 23-2012
2	Particulate matter ($PM_{2.5}$) in µg/m^3	26.8	19.6	18	60	USEPA CFR-40, Part-50, Appendix-L
3	Sulphur dioxide (SO_2) in µg/m^3	8	6.4	5.9	80	IS: 5182 (Part-2)-2001 (RA-2012)
4	Nitrogen dioxide (NO_2) in µg/m^3	22.4	13.8	11.5	80	IS: 5182 (Part-6)-2012
5	Carbon Monoxide (CO) in mg/m^3	<1	<1	<1	<2.0	IS: 5182 (Part-10)-1999 (RA-2014)

Interpretation of Air Quality Results

On comparison of the ambient air quality values with NAAQ standards, the recorded values are well within the prescribed standards for all parameters viz PM_{10}, $PM_{2.5}$, NO_X & SO_2. CO values were below CPCB limits at three locations.

Figure 4-14: Graph of PM_{10}

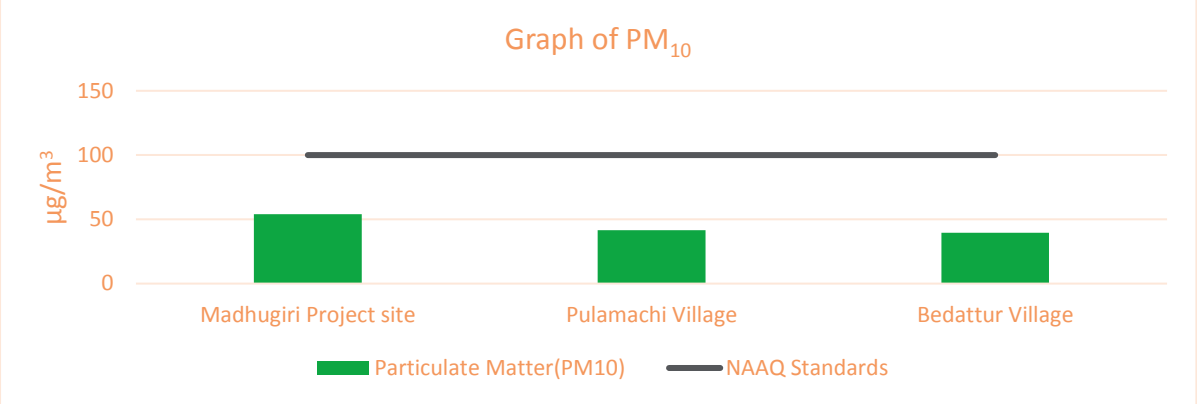


Figure 4-15: Graph of $PM_{2.5}$

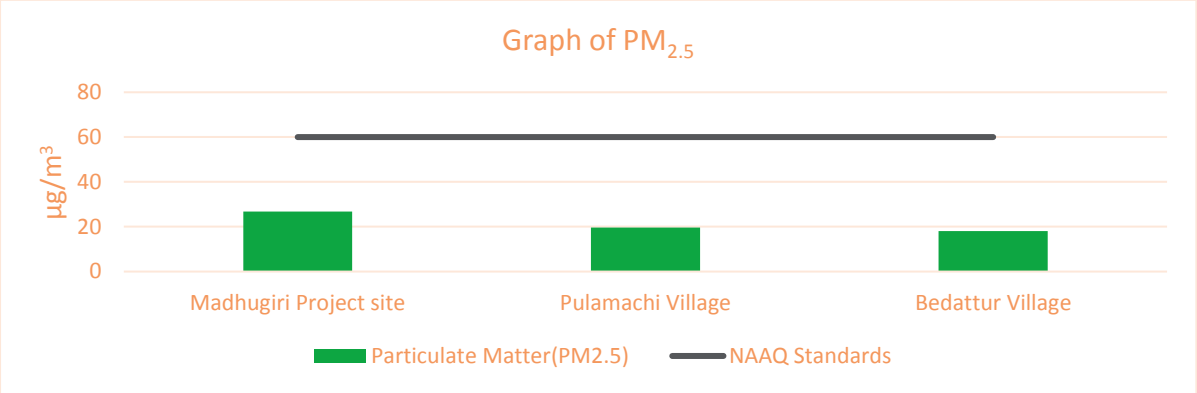


Figure 4-16: Graph of SO_2

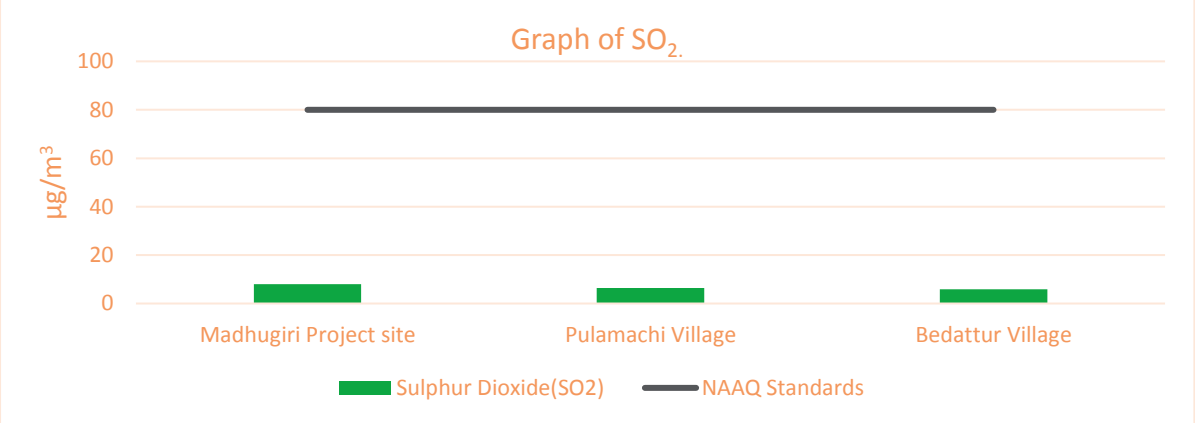
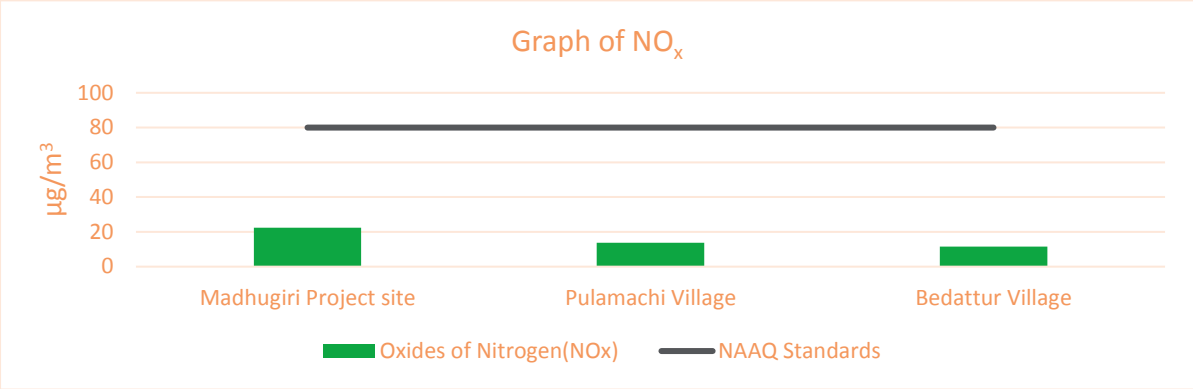


Figure 4-17: Graph of NOx



4.3.2 Ambient Noise Quality

The ambient noise monitoring was conducted at 1 location. The noise monitoring network was established based on the understanding of the proposed project activities and professional judgment. The location of the ambient noise quality stations has been represented in the **Figure 4.7** for reference.

Sound pressure level (SPL) measurements in dB(A) were recorded hourly for 24 hours at the aforesaid monitoring stations in equivalent noise levels as L_{eq} day and L_{eq} night. The results so obtained were compared with the standard specified in Noise Pollution (Regulation and Control) Rules, 2000. The summary of noise quality results is presented in **Table 4-3** below.

Table 4-3: Ambient Noise Monitoring Results (in decibels)

SN	Location	Leq dB(A) Day Time	Leq dB(A) Night Time
1	**Madhugiri Project site**	**62.9**	**32.6**

The project area being an industrial area the limits for day time noise level is 75 decibels and at night the prescribed limit is 70 decibels. Noise monitoring shows that the ambient noise level is within the permissible limit.

Table 4-4: Ambient Air Quality Standards in Respect of Noise as per MoEFCC

Area Code	Category of Area	Limit in Db (A) Leq	
		Day Time	Night Time
A	Industrial Area	75	70
B	Commercial Area	65	55
C	Residential Area	55	45
D	Silence Area	50	40
Note	Day time is reckoned in between 6 am and 10 pm		
	Night time is reckoned in between 10 pm and 6 am		
	Silence zone is defined as areas up to 100 m around such premises as hospitals, educational institutions and courts. The silence zones are to be declared by the Competent Authority		
	Mixed categories of areas should be declared as "one of the four above mentioned categories by the Competent Authority and the corresponding standard shall apply		

4.3.3 Drainage

The district is drained by both north flowing Pennar, and Lower Tungabhadra and south flowing Lower Cauvery basins. None of these rivers is perennial in nature. The major surface water divide between north and south flowing rivers passes through north of Tiptur, Gubbi and Tumkur towns. Pennar Basin is primarily comprised of three watersheds and is drained by Jayamangala and Kumudvathi rivers. Lower Tungabhadra Basin is drained by Vedavathi and Suvarnamukhi rivers and primarily comprised of four watersheds. River Shimsha drains the area falling in Lower Cauvery Basin and is primarily comprised of five watersheds. The rivers and streams originate from small watersheds and empty into a number of tanks scattered in the district. The drainage pattern in the area can be described as semi dendritic to dendritic.[4] The closest water body to the project site is Pulumacha Kere which is a natural pond used for agricultural and washing purposes of clothes and domestic animals

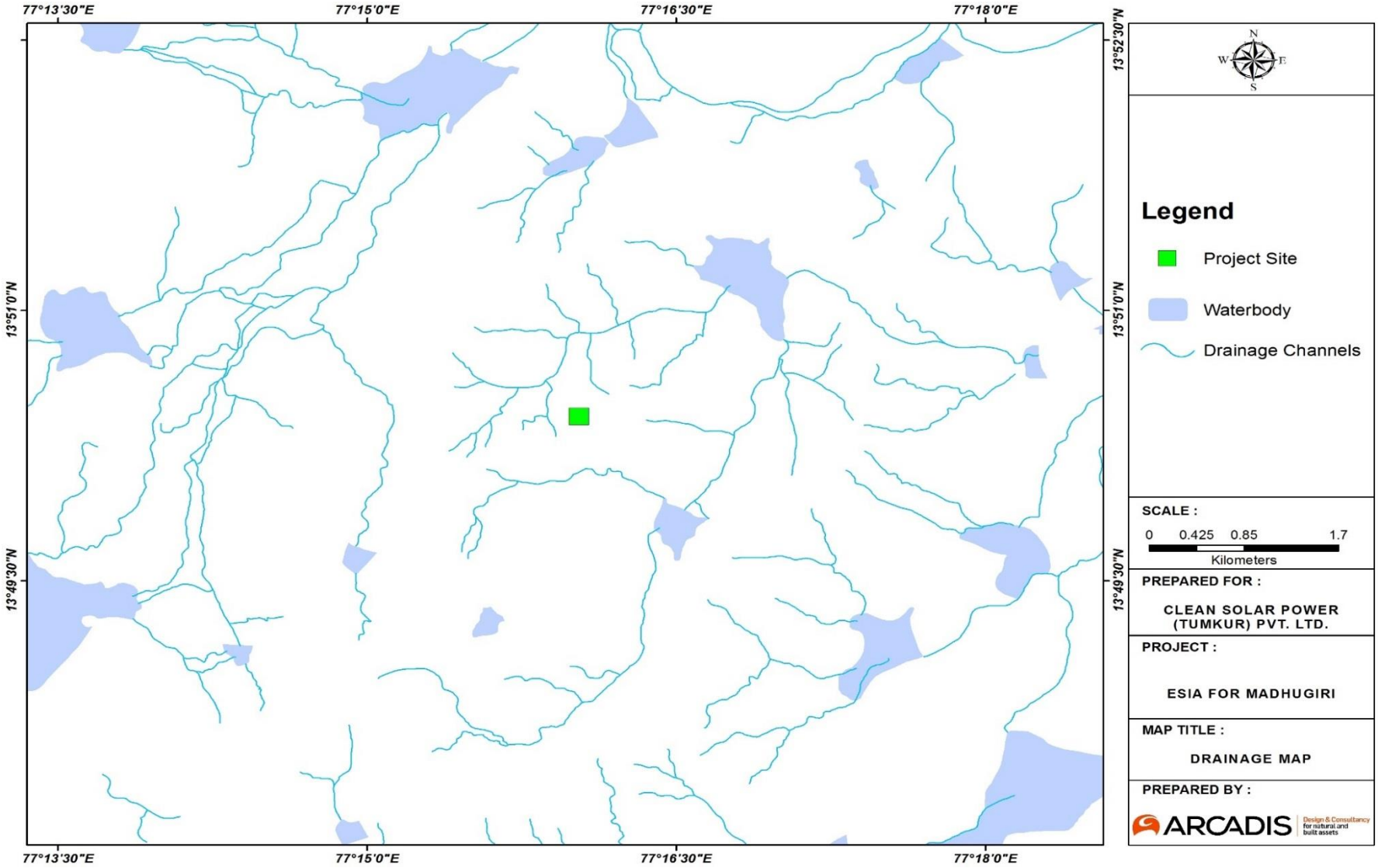
At the project area the natural drain flows through the site from west to East. Based on the discussion with the project team it was understood that no flooding was observed in and around the areas where the solar structures were mounted. An access road passes through the natural drain with provision of a Culvert through which the natural flow of water is undisturbed. The artificial drains will be based on the slopes around the project site to carry the runoffs from washing of solar panels and other activities. This is then drained into the integrated drain outside the project site.

Drainage map of the area is depicted in **Figure 4-19.**

Figure 4-18: Pictures of Drainage at the Site

[4] Ground Water Brochure, Tumkur District, Karnataka, Central Ground Water Board, Ministry of Water Resources, Government of India, September 2012.

Figure 4-19: Drainage Map



Surface Water Quality

Surface water was collected from Pulamachi Kere, within the study area. Surface water quality has been represented in the following Table below

Table 4-5: Surface Water Monitoring Results

SN	Test Parameter	Test Method	Units	Result	Tolerance Limit for inland surface water, Class C (IS: 2296-1982)
1	pH Value at 25ºC	IS 3025 (Part 11)-1983; RA:2006	-	8.92	6.5-8.5
2	Temperature	IS 3025 (Part 38)-1989; RA:2003	^{0}C	25.5	---
3	Turbidity	IS 3025 (Part 10)-1984; RA:2002	NTU	6.14	---
4	Dissolved Oxygen	APHA 22nd Edition-2012, 4500-O-C	mg/L	4.6	4 (min)
5	Biochemical oxygen demand (3 days at 27^{0}C)	APHA 22nd Edition 2012, 5210B	mg/L	<2	3
6	Chemical oxygen Demand	IS 3025 (Part 58) 2006	mg/L	6	---
7	Total Coliform Organisms,	IS 15185. 2002	MPN/100 ml	280	5000
8	Colour,	IS 3025 (Part 4)-1983; RA:2006	Hazen Units	50	300
9	Fluorides (as F)	IS 3025 (Part 60)-2008	mg/L	0.14	1.5
10	Conductivity at 25ºc	IS 3025 (Part 14)-1984; RA:2013		163	---
11	Alkalinity	IS 3025 (Part 14)-1986; RA:2003	mg/L	50	---
12	Chlorides (as Cl)	IS 3025(Part 23)-1988; RA: 2009	mg/L	15	600
13	Chromium (as Cr $^{6+}$)	IS 3025 (Part 52)-2007	mg/L	<0.001	0.05
14	Cyanides (as CN)	IS 3025 (Part 27)-1986; RA:2009	mg/L	<0.001	0.05
15	Total dissolved solids	IS 3025 (Part 16)-1984; RA:2006	mg/L	112	1500
16	Total Suspended solid	IS 3025 (Part 17)-1984; RA:2006	mg/L	12.54	---
17	Total Hardness as $CaCO_3$	IS 3025 (Part 21) 2009	mg/L	50	---
18	Sulphates (as SO_4)	IS 3025 (Part 24)- 1986; RA:2009	mg/L	7.6	400
19	Total Nitrogen	IS 3025 (Part 34)- 1988; RA:2003	mg/L	4	---
20	Calcium as Ca	IS 3025 (Part 40)- 1991; RA:2009	mg/L	12	---

SN	Test Parameter	Test Method	Units	Result	Tolerance Limit for inland surface water, Class C (IS: 2296-1982)
21	Magnesium as Mg	IS 3025 (Part 46)- 1994; RA:2003	mg/L	4.8	---
22	Sodium as Na	IS 3025 (Part 45)- 1993; RA:2009	mg/L	12.8	---
23	Potassium as K	IS 3025 (Part 45)- 1993; RA:2009	mg/L	0.6	---
24	Lead (as Pb)	IS 3025 (Part 47)- 1994; RA:2009	mg/L	<0.001	0.1
25	Copper (as Cu)	IS 3025 (Part 44)- 1993; RA:2009	mg/L	<0.001	1.5
26	Arsenic (as As)	IS 3025 (Part 40)- 1988; RA:2009	mg/L	<0.02	0.2
27	Iron (as Fe)	IS 3025 (Part 53)- 1988; RA:2009	mg/L	0.04	50
28	Total Phosphorous	IS 3025 (Part 31)- 1988; RA:2003	mg/L	<0.02	---
29	Boron	IS 3025 (Part 57) 2005	mg/L	<0.001	---
30	Phenolic Compounds as (C_6H_5OH)	IS 3025 (Part 43)-1992; RA: 2009	mg/L	<0.001	0.005
31	Zinc (as Zn)	IS 3025 (Part 49)- 1994; RA: 2009	mg/L	<0.001	15
32	Mercury as Hg	IS 3025 (Part 48)- 1994	mg/L	<0.001	---
33	Oils and grease	APHA 22nd Edition-2012, 5520B	mg/L	<1.0	0.1
34	Faecal Coliform	IS 15185. 2002	MPN/100 ml	40	---
35	Pesticides	USEPA	µg/L	<0.001	<0.001

The surface water sample was analysed for physicochemical and bacteriological parameters and results compared with CPCB Surface Water standards with designated best use being Inland surface water under class C to identify and interpret any deviation in the statutory limits set for parameters in the standard.

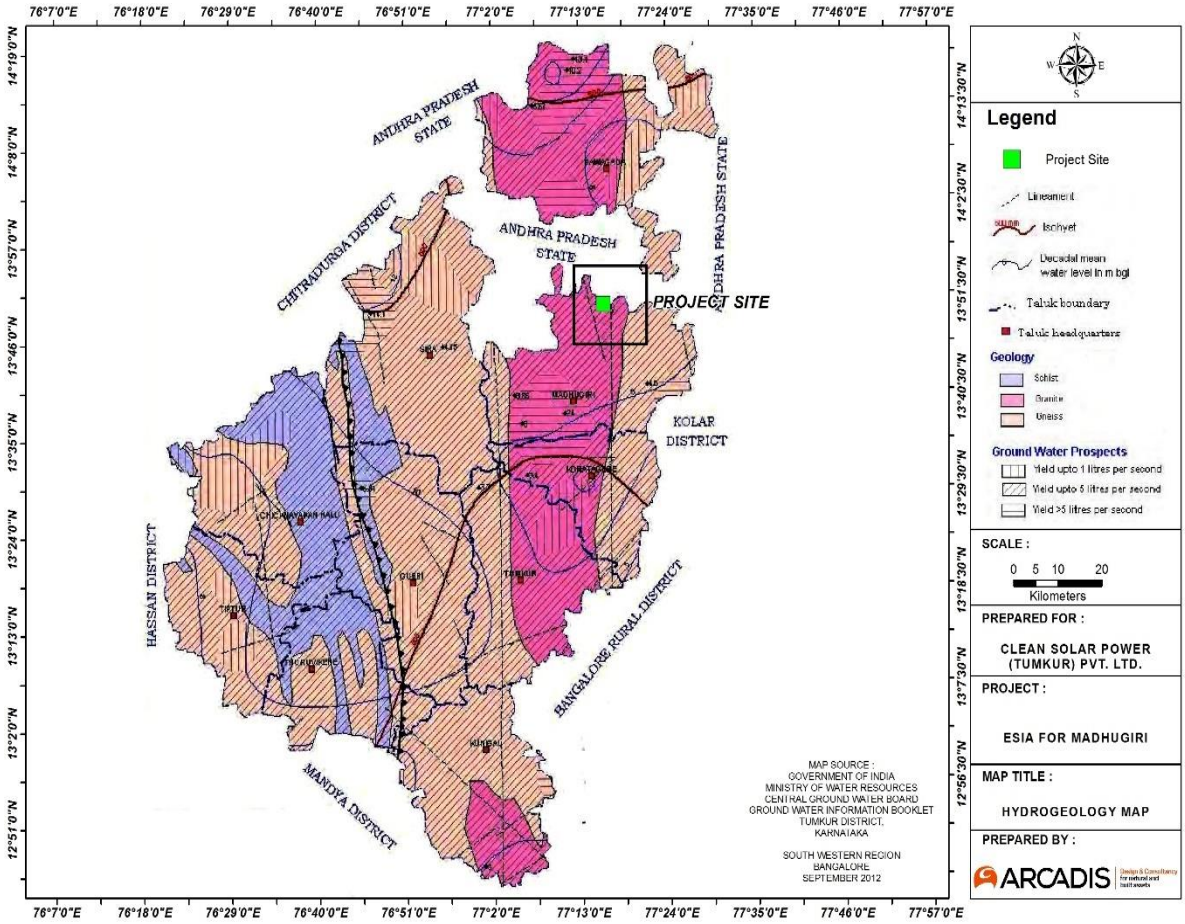
The pH lies at 8.92 indicating basic nature of water. The TDS was observed to be 112 mg/l which is below the permissible limit. The total hardness is 50 mg/l. Analysis of surface water sample confirms that surface water is free of any heavy metal contamination.

The microbiological analysis suggests the absence of the total coliform was found to be 280 MPN/100 ml which is below the permissible limit

4.3.4 Hydrogeology

Ground water occurs in weathered and jointed zones of gneisses, granites and schists and alluvium in unconfined or water table conditions where as it occurs in semi confined to confined conditions in fractured formations at deeper depths. Unconfined aquifer system is developed by dug wells, shallow bore wells and filter points. This zone extends down to 10-30 mbgl depth. The yield range of irrigation dug wells in alluvium is 50-150 m^3/day whereas the same in weathered formation is 10 to 50 m^3/day. The yield of filter points is in the range of 50-200 m^3/day. As the filter points are in alluvium of limited thickness, many of them become dry during summer. Due to over exploitation in many pockets, this zone is getting dried up gradually. Semi confined to confined aquifer is formed due to fractures in hard formations at deeper depths. This aquifer system is developed by bore wells ranging in depth up to 200m. The general yield ranges from negligible to 120 m^3/day, and specific capacity ranges from 2 to 173 lpm/mdd.

Figure 4-20: Hydrogeology Map of Tumkur District, Karnataka.



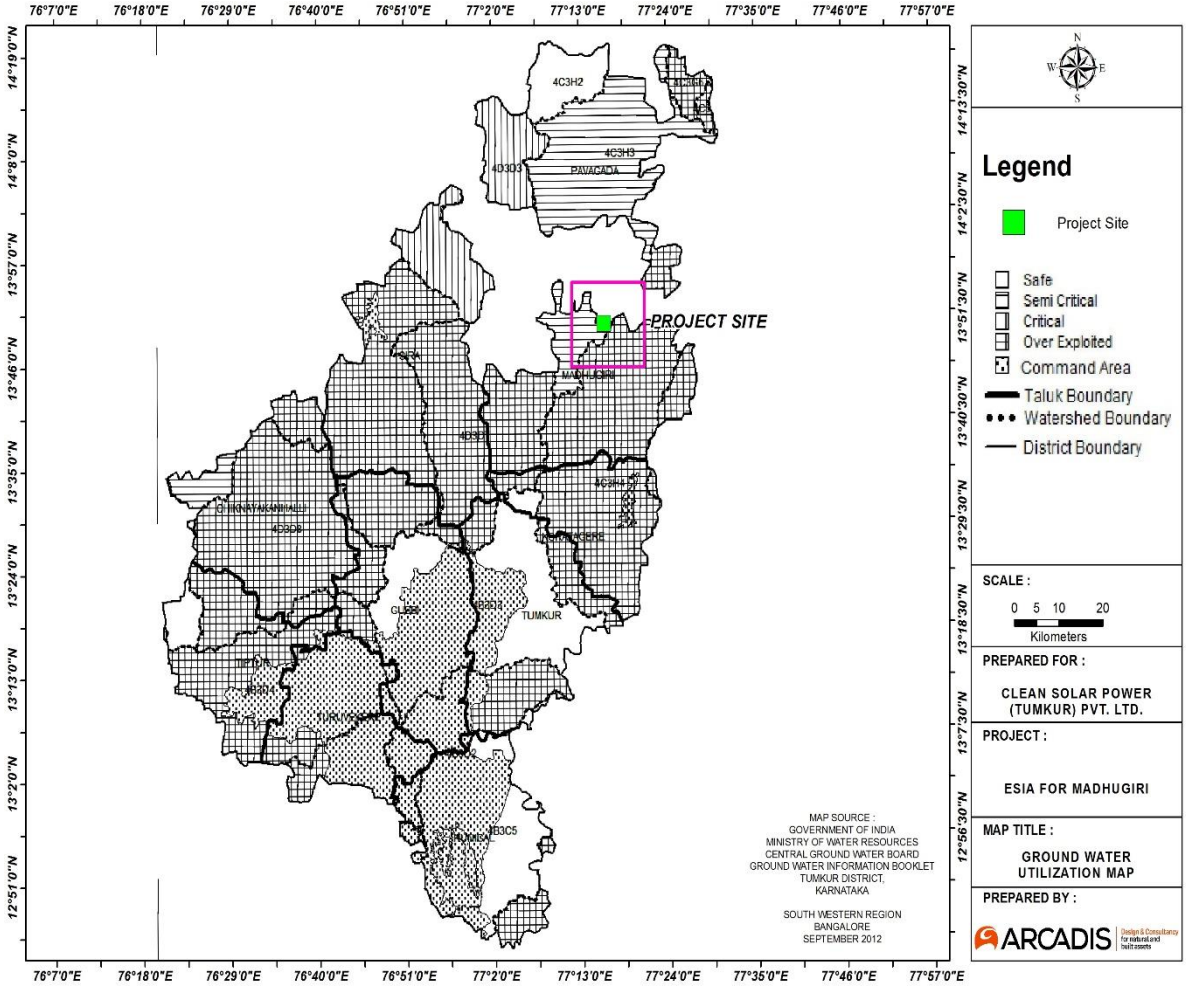
Source: Groundwater information booklet, Tumkur district, CGWB

4.3.5 Ground Water Resources [5]

- As per the CGWB categorization the proposed project sites falls under "**Semi Critical**" zone. This is depicted in **Figure 4-21.**

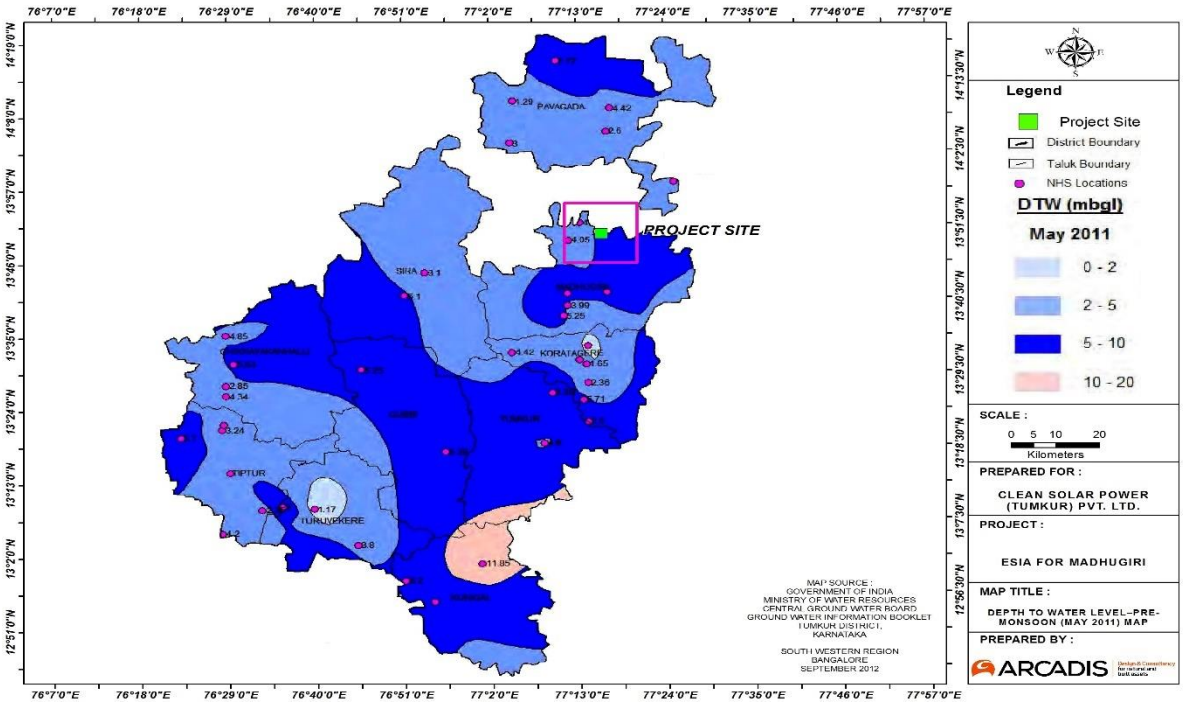
[5] *Ground Water Brochure, Tumkur District, Karnataka, Central Ground Water Board, Ministry of Water Resources, Government of India, September 2012*

Figure 4-21: Ground Water Utilization Map



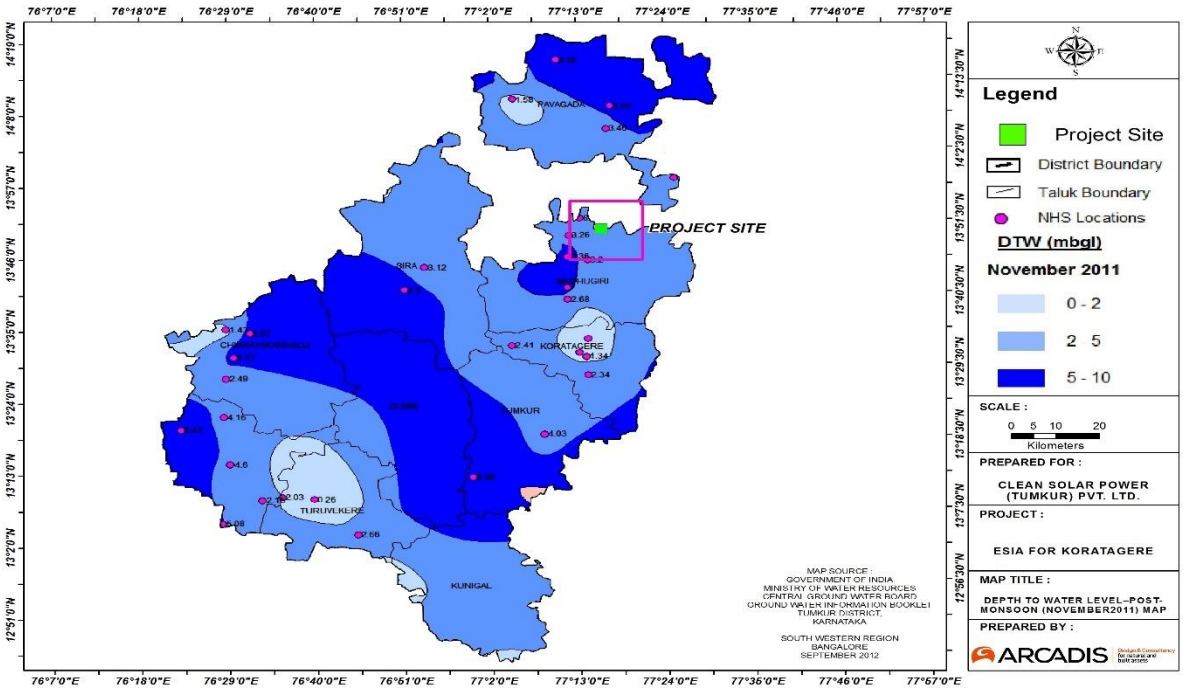
- **Pre-monsoon depth to ground water level**: It is observed that the depth to ground water level during May 2011 varies from 1.17 to 11.85 mbgl. In general, major part of the district having depth to water levels 2 to 5m and 5 to10 mbgl. Very small isolated pockets in Pavagada, Turuvekere and Koratagere taluks fall in 0-2 m category. More than 10 m bgl observed at Hebbur in Kunigal taluk. The depth to water levels varies from 4.12m to 31.70m. The deepest water levels are noticed at Dandinadibba (31.70m) and 26.44 m at Kibbanahalli locations. The shallowest water levels are noticed at Koratagere (4.12m) and Hosakere (4.45m) locations. Water level is represented on the map provided in **Figure 4-22.**

Figure 4-22: Pre-Monsoon Depth of Water Level



- **Post monsoon Depth to ground water level:** Post monsoon depth to water level in dug wells (NHS) varies from 0.26 to 10.65 m bgl. The shallowest water level noticed at Turuvekere and the deepest water level noticed at Hebbur. In general, major part of the district having depth to water levels ranges from 2 to 5 and 5 to10 mbgl. Very small isolated pockets in Pavagada, Turuvekere and Koratagere taluks fall in 0-2 mbgl category. More than 10 m bgl observed at Hebbur in Kunigal taluk. The depth to water levels in 20 Piezometers during November 2011 varies from 1.35m to 25.84m. The deepest water levels are noticed Kibbanahalli station. The shallowest water levels are noticed at Sira (1.35m) and Koratagere (2.72m) locations. Water level is represented on the map provided in **Figure 4-23.**

Figure 4-23: Post-Monsoon Depth of Water Level



Ground Water Quality

Ground water sample has been collected from Hanumanthapura village.

Following table represents the ground water analysis result.

Table 4-6: Ground Water Monitoring Results

SN	Test Parameter	Test Method	Units	Hanumanthapura village	Acceptable Limits (As Per IS: 10500:2012)
		Physical Properties			
1	Colour	IS 3025 (Part 4)-1983; RA: 2006	Hazen Units	<05	Max. 5.0
2	Odour	IS 3025 (Part 5)-1983; RA: 2002		-	Agreeable
3	pH Value at 25ºC	IS 3025 (Part 11)-1984; RA: 2006		7.7	6.5 – 8.5
4	Turbidity	IS 3025 (Part 14)-1984; RA: 2006	NTU	2.46	Max. 1.0
5	Total Dissolved Solids (as TDS)	IS 3025 (Part 16)-1984; RA: 2006	mg/l	1,004	Max. 500
6	Total Suspended Solid	IS 3025 (Part 17)-1984; RA: 2012	mg/l	2.46	---
7	Conductivity at 25ºC	IS 3025 (Part 14)-1984; RA: 2013	µMho/cm	1454	---
		Chemical properties			
8	Aluminium (as Al)	IS 3025 (Part 55)-2003; RA: 2009	mg/l	<0.001	0.03
9	Aniomic Detergents (as MBAS) in	IS 13428-2005 (Annex K)	mg/l	<0.001	0.2
10	Boron (as B)	IS 13428-2005 (Annex L)	mg/l	<0.001	1.00
11	Calcium (as ca)	IS 3025 (Part 40)-1991; RA: 2009	mg/l	104	Max. 75
12	Chloride (as Cl)	IS 3025 (Part 32)-1988; RA: 2009	mg/l	120	Max. 250
13	Phosphate as PO_4	IS 3025 (Part 31)-1988; RA: 2003	mg/l	<0.02	---
14	Copper (as Cu)	IS 3025 (Part 44)-1993; RA: 2009	mg/l	0.092	Max. 0.05
15	Sodium as Na	IS 3025 (Part 45)-1993; RA: 2009	mg/l	91.5	---
16	Potassium as K	IS 3025 (Part 45)-1993; RA: 2009	mg/l	2.4	---
17	Fluoride (as F)	IS 3025 (Part 60)-2008	mg/l	0.96	Max. 1.0
18	Free Residual Chlorine	IS 3025 (Part 26)-1986; RA: 2009	mg/l	<0.001	Min. 0.2

SN	Test Parameter	Test Method	Units	Hanumanthapura village	Acceptable Limits (As Per IS: 10500:2012)
19	Iron (as Fe)	IS 3025 (Part 53)-1988; RA: 2009	mg/l	0.17	Max. 0.3
20	Magnesium (as Mg) in	IS 3025 (Part 46)-1994; RA: 2009	mg/l	62.4	30-100
21	Manganese (as Mn) in	IS 3025 (Part 59)- 2006	mg/l	<0.001	Max. 0.1
22	Nitrate (as NO_3)	IS 3025 (Part 34)-1988; RA: 2009	mg/l	5	Max. 45
23	Phenolic Compounds (as C_6H_5OH)	IS 3025 (Part 43)-1992; RA: 2009		<0.001	Max. 0.001
24	Sulphate (as SO_4)	IS 3025 (Part 24)-1986; RA: 2009	mg/l	47	Max. 200
25	Alkalinity (as $CaCO_3$)	IS 3025 (Part 23)-1986; RA: 2009	mg/l	500	---
26	Total Hardness (as $CaCo_3$)	IS 3025 (Part 21)-1983; RA: 2003	mg/l	520	Max. 200
27	Cadmium (Cd)	IS 3025 (Part 41)-1992; RA: 2003	mg/l	<0.001	Max. 0.003
28	Cyanide (as Cn)	IS 3025 (Part 27)-1986; RA: 2009	mg/l	<0.001	0.005
29	Lead (as Pb)	IS 3025 (Part 47)-1994; RA: 2009	mg/l	<0.02	0.05
30	Mercury (as Hg)	IS 3025 (Part 48)-1994; RA: 2009	mg/l	<0.0002	0.00
31	Arsenic (as As)	APHA 22nd Edtn – 2012, 3114 C	mg/l	<0.01	0.01
32	Zinc (as Zn)	IS 3025 (Part 49)-1994; RA: 2009	mg/l	0.028	5-15
33	Total Chromium (as Cr)	IS 3025 (Part 52)- 2007	mg/l	0.008	Max 0.05
34	Mineral Oil	APHA 22nd Edtn – 2012	mg/l	<0.001	0.01
35	Pesticides	USEPA	µg/L	<0.001	<0.001

The sample was analysed for physicochemical parameters and results compared with IS: 10500 drinking water standards to identify and interpret any deviation in the statutory limits set for parameters in the standard. Ground water in the district, in general is suitable for both domestic and irrigation purpose. The pH is at 7.7 indicating a slight basic nature of water.

TDS values was observed to be 1004 mg/l which is higher than the IS: 10500:2012 acceptable limits this could be due to the presence of minerals, nutrients, and trace elements which is conclusive by the Total Hardness being high as well (520 mg/l).

All other parameters are within permissible limits. Analysis of ground water sample confirms that ground water is free of any heavy metal contamination

4.4 Ecological Environment

Ecology & biodiversity study was carried out during Mid-Week of December 2017, with the aim to assess the existing ecological resources of the project site and the study area. Primary baseline survey was conducted to assess the nature of the existing habitat, local flora and fauna, ecological sensitivity if any, locations of wetlands/ water bodies, and land use pattern. Apart from that, published/ unpublished secondary information was also collected from journals and local residents of the area.

These information's will further enable to gauge potential ecological impacts that can be generated from the project activities. Understanding of the significant risks and impacts is important to implement mitigation measures or suggest changes if the associated risks are huge. Such mitigation measures will help reduce the impacts and also develop ecological monitoring parameters.

Main objectives for Ecological surveys:

Flora

- Identification of floral species, endangered as well as endemic species (if any), important habitats, forests area within the study area;
- Surveys to identify local, widespread floral species, any endangered or endemic species and protected species in the study area;
- Identification of aquatic flora near the water bodies found in the study area;
- Identification of any notified area under international conventions, national or local legislation for their ecological, landscape, cultural or other related values within the study site.

Fauna

- Identification of fauna (terrestrial, aerial and aquatic) by direct sighting and through secondary means like, nests, roosts, pug marks, droppings, etc.
- Identification and classification of species recognised as critically endangered, endangered, threatened etc. as per IUCN Red list and scheduled species as per WPA (1972).
- Identification of areas important for breeding, foraging, nesting, resting or over wintering areas include migratory corridors/ avian migratory routes.
- Identification and assessment of aquatic fauna near the study area.

4.4.1 Methodologies for Ecological Surveys

Desktop Review

A desktop review (published document) was conducted to determine the land use and land cover, vegetation type (Champion and Seth, 1962), floral and faunal assemblage in the study area.

In order to provide representative ecological status for the project a study area is defined for ecological study. As solar power plants have no moving part or emission, most of the project related impact (if any) will be confined to the project site only and access roads. Therefore, project development area and 100m around the project site was considered as the "high risk zone" or "core study area", and 5-km radius surrounding the project site is considered as the "buffer zone" or the zone of influence of the project.

Baseline Survey

Baseline survey was carried out to determine the existing ecological conditions and was designed to fill any data gaps, and to facilitate an adequate assessment of the project's impacts upon ecology and the

development of appropriate mitigation measures. Survey was conducted in mid-week of December 2017 for habitat survey, flora & faunal assemblage, in the study area. Baseline survey has two parts-

(i) Secondary data collection and (ii) Primary data collection

Secondary Data Collection

Secondary baseline data regarding sensitive ecological habitat (National Park, Sanctuary, Ecological Sensitive Area, Migratory Corridor, habitat of endangered, vulnerable and range restricted species etc.), flora & fauna in the study area, and other published and unpublished documents. Stakeholder consultations (Forest Department, Local People etc.) were also carried out to understand the major flora & fauna in the study area, pressure on forest resources, presence of any Schedule I species.

Primary Survey

Habitat Survey

Different habitats identified by desktop review and reconnaissance visit were visited. Data regarding the type and quality of habitat with reference to flora and fauna that it supports and might support is collected.

Flora Survey

The primary floral survey was conducted to record site specific floral species and its diversity. At the time of the survey, xerophyte scrub like vegetation was recorded from the proposed project site. Further data were gathered from secondary sources like governmental department records, forest officials and local residents. None of the species recorded falls in the IUCN red list category.

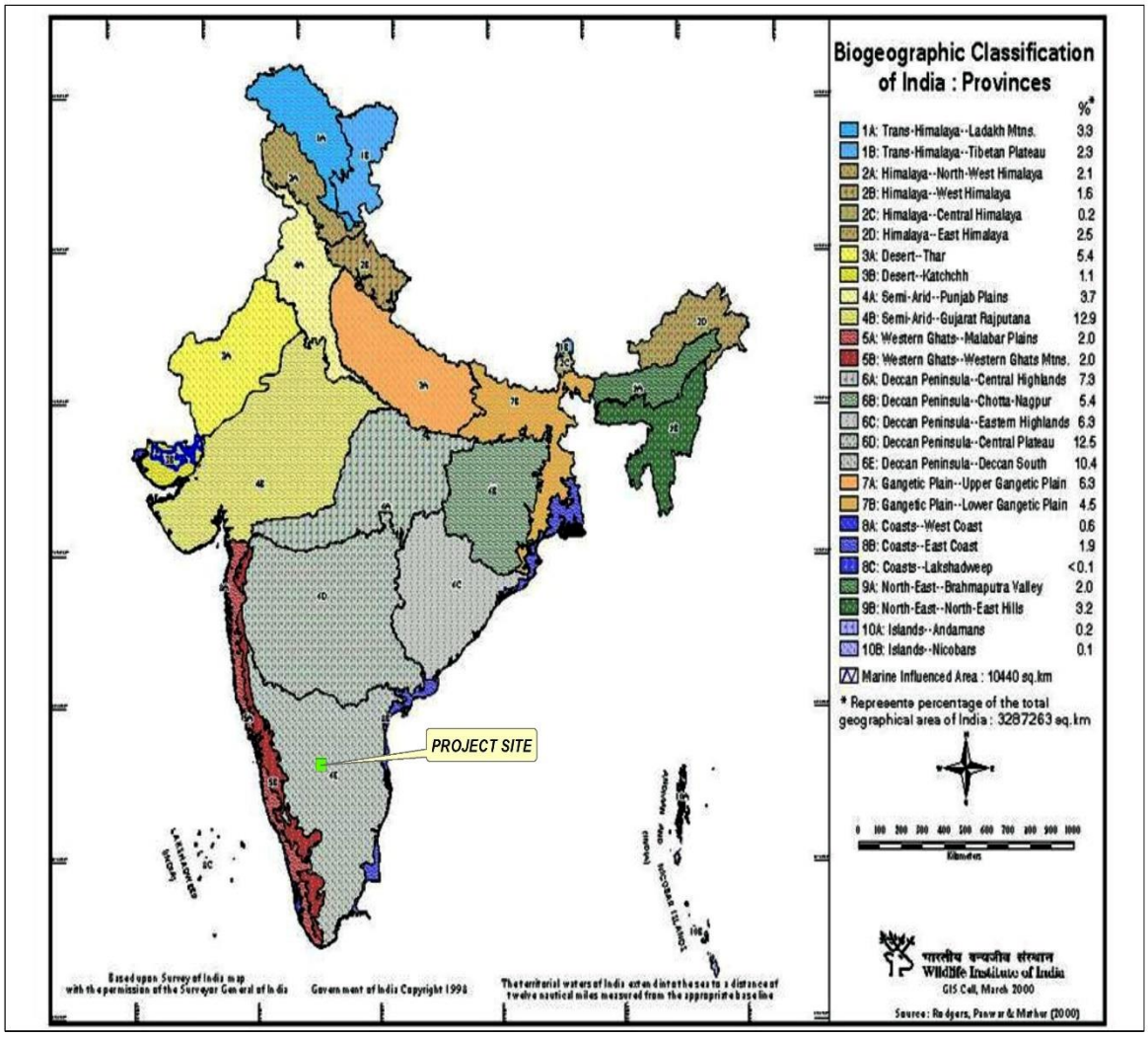
Faunal Survey

To assess the presence of fauna in the project site, a walk-through survey area was carried out. The project site and the nearby areas were visited to find out the presence of faunal species in the area either by direct sighting or through secondary clues like scat, scale etc. The faunal survey focused mainly on three group's viz. mammals, avifauna and hereto fauna of the study area. Data related to the other faunal species were also noted, based on the direct sightings and from authentic secondary sources like standard field guides.

4.4.2 Habitat Survey

According to the Biogeographic provinces of India published by Wildlife Institute of India (Rodgers, Panwar and Mathur, 2002), the project site falls under the Biogeographic Province – 6E-Deccan South. The map is provided in **Figure 4-24**

Figure 4-24: Biogeographical Classification of India



The site survey also included understanding of important habitats in the area. A "Habitat" according to IFC is defined as a terrestrial, freshwater or marine geographical unit or airway that supports assemblage of living organisms and their interactions with the non-living environment. As per IFC, habitats are divided into - Natural, Modified or Critical 6 the purpose of implementation of IFC Performance Standard-6 (Biodiversity Conservation and Sustainable Management of Living Natural Resources). Critical habitats are subsets of Natural habitats. Ecological sensitivity map of the project site is provided in **Figure 4-25**

[6] *Natural Habitats- These are the areas composed of viable assemblages of plant and/or animal species of largely native origin, and/or where human activity has not essentially modified an area's primary ecological functions and species composition.*

Modified Habitats- These are the areas that may contain large proportion of plant and/or animal species of non-native origin and/or where human activity has substantially modified an area's primary ecological functions and speciescomposition. It may include areas managed for agriculture, forest plantations, reclaimed coastal zones and reclaimed wetlands.

Critical Habitats- These are the areas with high biodiversity value, including (i) habitat of significant importance to critically endangered and/or endangered species; (ii) habitat of significant importance to endemic and/or restricted range species; (iii) habitat supporting globally significant concentrations of migratory species and/or congregatory species; (iv) highly threatened and/or unique ecosystems; and/or (v) areas associated with key evolutionary processes. Critical habitat can be subset of Natural or Modified Habitat.

Types of Habitat in the Study area

Agricultural Field & Orchards

During survey, the cropping pattern in the surrounding area reveals that the common crops in the study area are saccharum officinarum, oryza sativa, Triticum diococcum, Pennisitum glacaum, zia mays which are mainly depend on rainwater and tube well, borewell in non-monsoon season. In addition to these crop lands, various weeds are entered like Cynodon dictylon, Euphorbia hirta, Cyperus rotundus, Digitarea species and Alycicarpus are also contributing to primary production. Apart from that commercial crops like groundnut, sunflower and several vegetables like, red chillies, brinjal, bhendi, leafy vegetable crops are also grow in this region Madhugere.

As mentioned above, along with agricultural fields, mango orchards were observed in the study area. This type of habitat mosaic of agricultural fields and orchards with shady mango trees and grassland in between is good habitat for birds. Presence of orchards may attract fruit eating bats.

Rocky Barren and Scrub Land

Project site can be classified as rocky barren scrub land with shrubby vegetation to be majorly seen. Surface is mostly covered by hard rocks with hardly any large vegetation or scrub. Nooks and crevices or rocks are covered by dry grass and lithophytic plants like *Selaginella bryopteris.* There is hardly any fertile topsoil and bare rock surface is devoid of any nutrients or moisture, so these plants grow in fissures in rocks where soil or organic matter has accumulated. These plants are adapted to survive in drought like conditions. For most of the year these plants maintain a dry dehydrated morphological state to survive dry season. Only after rainfall or during monsoon these plants rehydrates and becomes green.

Natural Vegetation

There is no national park, wildlife sanctuary, biosphere reserve within 10 km of the study area. As per Wildlife Protection Act 1972, there is no critically endangered, endangered, threatened or rare species of wildlife in the core & buffer zone. With reference to the vegetation of the district, it has different types of forest vegetation's such as ever green forests, shoal forests, dry deciduous forests, and scrub jungles. Dry deciduous & shrub type of forests is observed the study area. Natural factors include factors such as the altitude, the soil conditions, the quantity and regularity of the rainfall. As per primary survey details, fair agro- vegetation cover in seen outside the study area. Growth of grasses in the study area is more in rainy season. Apart from rainy season, study area looks dry as most of the trees shed their leaves and it starts from December to May. No Forest/Reserved Forests blocks are found in the study area. Eucalyptus plantation is being observed along agriculture bunds and both sides of the road. However, there are no reserve forests, protected forests or revenue forest within the core zone. Project land is a non-forest wasteland. The areas under cultivation were colonized mainly by weeds while the wastelands were colonized mainly by non-palatable xerophytes and succulents. The prominent and abundant species include Dodonaea viscosa, Tarenna asiatica, Erythroxylon monogynum, Agave americana, Lantana camara, Chromolaena odorata, Acacia leucophloea, Prosopis juliflora and others. There are only a few trees of Neem, Tamarind and White babul. The vegetation types located within 5 km radius of the project road are Thorn Scrub, Dry Deciduous, outside forest land natural vegetation is mostly replaced by scrubby vegetation and agricultural fields only in few fertile lands.

4.4.3 Flora and Faunal Profile of the Study Area

(A) Floral Profile

5A/C_{ib} Southern tropical dry deciduous dry teak forest

Top Storey: Feronia Limonia, Lannea grandis, Diospyros malanoxylon, Madhuca indica, Terminalia arjuna

Middle Storey: Butea monosperma, Acacia Leucophloea, Aegle marmelos, Lagestroemia parviflora, Anogeissus latifolia, Cassia fistula, Emblica officinalis, Acacia catechu.

Lower Storey: Carissa Opaca, Nyctanthus arbortristis, Woodfordia floribunda, Helicteres isora, Lantana camara.

Grass Species: Heteropogan contortus, Imperata cylindrical, Saccharum spontaneum, Cynadon dactylon,

Other Species: Zizyphus oenoplia, Butea superba, Bauhinia vahalii, Vigra trilobata,

5B/C_{ic} Northern tropical dry deciduous dry peninsular sal forest

Top Storey: Terminalia tomentosa, Diospyros melanoxylon, Boswellia serrata, Lannea grandis, Anogeissus latifolia, Terminalia arjuna, Terminalia belerica, Eleodendron glaucum, Schlichera oleosa, Pterocarpus marsupium, Dalbergia paniculata, Madhuca indica.

Middle Storey: *Buchanania lanzan, Emblica offcinalis, Zizyphus xylopyra, Casearia tomentosa, Ougenia oojeinensis, Cassia fistula, Flacourtia indica, Careya arborea, Acacia catechu, Eugenia heyneana, Soymida febrifuga, Saccopetalum tomentosum, Mallotus philippinensis, Dalbergia lanceolaria, Cochlospermum religiosum, Holarrhena antidysenterica, Wrightia tinctoria, Bauhinia retusa, Grewia tiliaefolia, Kydia calycina, Dendrocalamus strictus*

Lower Storey: Nyctanthus arbortristis, Woodfordia floribunda, Indigofera pulchera, Gardemi turgida, Flemingia spp., Phoenix acaulis. Carissa opaca, Asparagus racemosus, Randia dumetorum, Grewia hirsuta

Major Grass Species: Heteropogan contortus, Eragrostis tenella, Themedi triandra

Other Species: Vallans haynei, Celastrus paniculata, Zizyphus oenoplia, Abrus precatorius, Ventilago calyculata, Smilex zeylanica.

5B/C_{2c} Northern tropical dry mixed deciduous forest

Top Storey: Anogeissus latifolia, Diospyros melanoxylon, Boswellia serrate, Lannea grandis, Anogeissus latifolia, Terminalia arjuna, Terminalia belerica, Eleodendron glaucum, Schleichera oleosa, Pterocarpus marsupium, Dalbergia paniculata, Madhuca indica)

Middle Storey: *Buchanania lanzan, Emblica officinalis, Zizyphus xylopyra, Casearia tomentosa, Ougenia oojeinensis, Cassia fistula, Flacourtia indica, Careya arborea, Acacia catechu, Eugenia heyneana, Soymida febrifuga, Saccopetalum tomentosum, Mallotus philippinensis, Dalbergia lanceolaria, Cochlospermum religiosum, Holarrhena antidysenterica, Wrightia tinctoria, Bauhinin retusa, Grewia tilaefolia, Kydia Calycina, Dendrocalamus strictus.*

Lower Storey: Woodfordia floribunda, Nyctanthus arbortristis, Carissa opaca, Ziyphus jujube, Helicteres isora.

Major Grass Species: Heteropogan contortus, Apluda varia, Dicanthium annulatum

Other Species: Bauhinia vahlii, Zyzyphus oenoplea, Abrus precatorius, Smilex macrophylla, Vallaris heynei, Dioscoria diemona, Butea parviflora

5B/E_1 Kardhai Forest:

Top Storey: Lannea grandis, Mitragyna parviflora, Diospyros melanoxylon, Lagerstroemia parviflora, Anogeissus latifolia, Aegle marmelos, Acacia catechu, Bauhinia retusa, Zizyphus xylopyra, Flacourtia indica.

Lower storey: Carissa opaca, Helicteres isora, Capparis spinarum, Ziyphus jujube, Grewia hirsute,

Major Grass Species: Eragrostis Tenella, Heteropogan contortus.

Other Species: Zizyphus oenoplea, Ichnfrocarpus frutescens, Gymnema sylvestris, Coccaluns villosus.

5B/E$_2$ Boswellia Forests:

Top storey & Middle Storey: Lannea grandis, Anogeissus latifolia, Diospyros melanoxyoln, Erythrina suberosa, Cochlospermum religiosum, Dalbergia peniculata, Buchanania lanzan, Lagerstroemia parviflora, Aegle marmelos, Ficus tomentosa, Zizyphus xylopyra, Gardinia latifolia, Acacia catechu.

Lower storey: Nytanthes arbortristis, Helicteres isora, Gardonia turgida, Bauhinia retusa, Woodfordia fruticosa.

Major Grass Species: Eragrostis Tenella, Heteropogan contortus

Other Species: Zizyphus oenoplea, Butea superba, Ventilago calyculata, Pueraria tuberosa.

Detailed list of flora of the study area is provided in **Appendix J.**

(B) Faunal Profile

There is no national park, wildlife sanctuary, biosphere reserve within 10 km of the study area. As per Wildlife Protection Act 1972, there is no critically endangered, endangered, threatened or rare species of wildlife in the core & buffer zone.

Red listed species found mostly in the forest areas of the study area is provided in **Table 4-7.**

Table 4-7: Mammals Found in the Forest within the Study Area

Sl. No	Common Name	Scientific Name	Schedule WPA 1972	IUCN Status	Occurrence in the Study Area
1	Elephant	*Elephas maximus*	I	Least Concern	rare
2	Tiger	*Panthera tigris*	I	Least Concern	rare
3	Leopard	*Panthera pardus*	II	near threatened	rare
4	Common Fox	*Vulpes bengalensis*	II	Least Concern	rare
5	Wild Boar	*Sus scrofa*	III	Least Concern	rare
6	Blacknaped Hare / Indian Hare	*Lepus nigricollis*	III	Least Concern	rare
7	Stripped Hyaena	*Hyaena hyaena*	II	Least Concern	rare
8	Bonnet Macaque	*Macaca radiata*	II	Least Concern	rare
9	Indian Flying Fox	*Pteropus giganteus*	III	Least Concern	rare
10	Jackal	*Canis aurens*			
11	Sambar	*Cervus unicolour*	I	Least Concern	rare
12	Common mangoose	*Herpestes edwardsi*	II	Least Concern	rare
13	Gaur	*Bos gaurus*	II	Least Concern	rare
14	Porcupine	*Hystrix indica*		Least Concern	rare
15	Wolf	*Canis lupus*		Least Concern	rare
16	Pangolin	*Manis crassicaudata*		Least Concern	rare

Avifauna

Bird species such as egrets, black drongo, red vented bulbul, green bee eater, barn swallow, ashy crowned sparrow, common myna, paddy field pipit, laughing dove were found in large numbers from the survey.

The species of birds recorded in the project area during site visit is listed in the **Table 4-8.**

Table 4-8: List of Avifauna Sighted in the Project Area

Sr. No	Scientific name	Common name	Family	WPA Schedule
1	*Accipiter badius*	Shikra	Accipitridae	IV
2	*Acridotheres tristis*	Common Myna	Sturnidae	IV
3	*Acrocephalus agricola*	Paddyfield Warbler	Sylviidae	IV
4	*Acrocephalus stentoreus*	Clamorous Reed Warbler	Sylviidae	IV
5	*Actitis hypoleucos*	Common Sandpiper	Scolopacidae	IV
6	*Aegithina tiphia*	Common Iora	Aegithinidae	IV
7	*Alauda gulgula*	Oriental Skylark	Alaudidae	IV
8	*Alcedo atthis*	Common Kingfisher	Alcedinidae	IV
9	*Anas acuta*	Northern Pintail	Anatidae	IV
10	*Anas clypeata*	Northern Shoveler	Anatidae	IV
11	*Anas penelope*	Eurasian Wigeon	Anatidae	IV
12	*Anas poecilorhyncha*	Spot-billed Duck	Anatidae	IV
13	*Anas querquedula*	Garganey	Anatidae	IV
14	*Anas strepera*	Gadwall	Anatidae	IV
15	*Anser indicus*	Bar-headed Goose	Anatidae	IV
16	Anthus hodgsoni	Olive-backed Pipit	Motacillidae	IV

Detailed list of fauna of the study area is provided in **Appendix K.**

Pictures of Birds in Study Area

Jungle Babbler species (Turdoides striata)

Pied bush chat (Saxicola caprata)

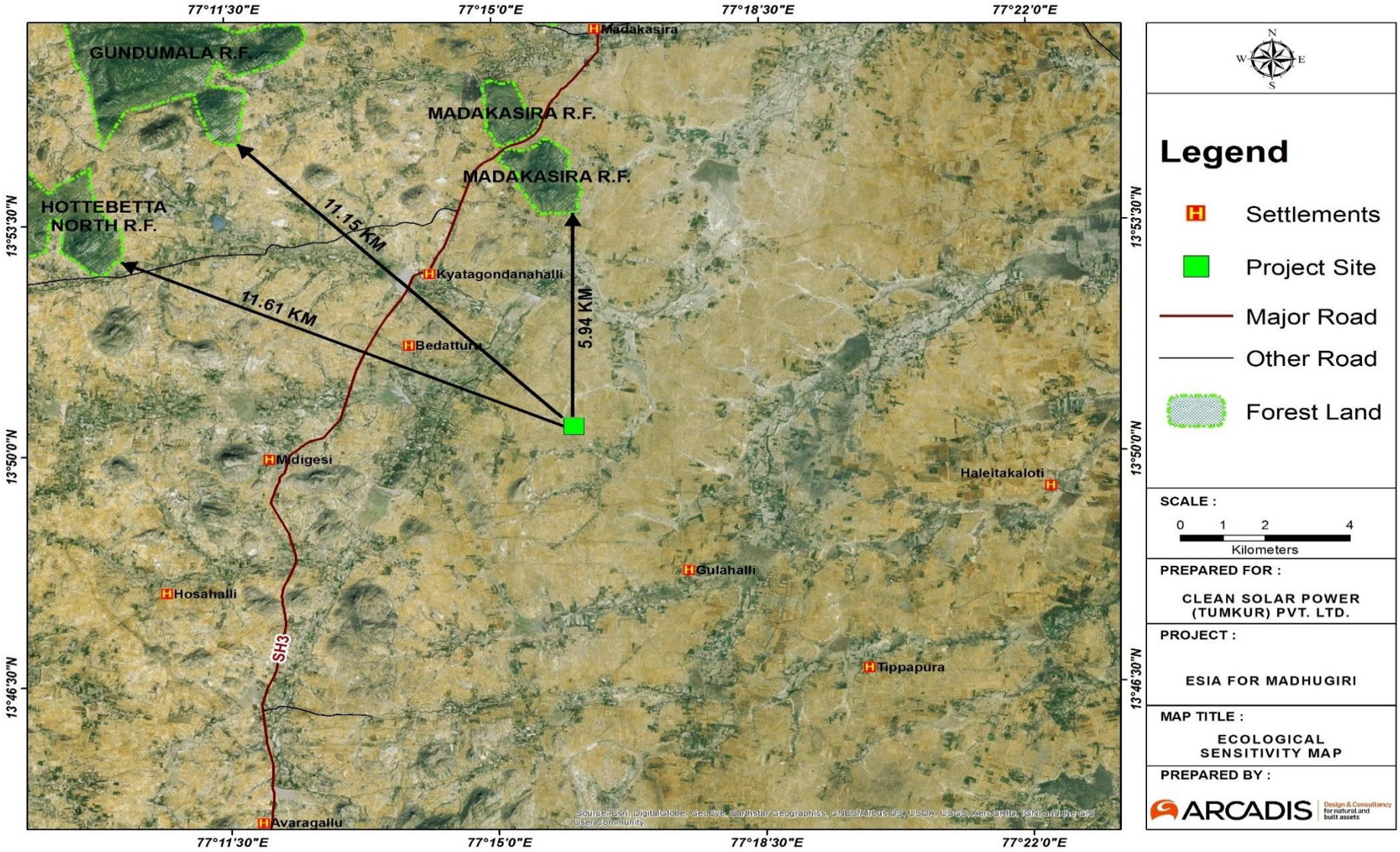
Brahminy Kite (Haliastur indus)

Green Bee-eater (Merops orientalis)

Black Drongo (Dicrurus macrocercus)

Laughing Dove (Spilopelia senegalensis)

Figure 4-25: Ecology Map of the Project Surrounding



4.5 Socio Economic Profile of the Study Area

This section describes the socioeconomic condition in the study area and relates the village level socioeconomic conditions with taluk and district level. The objective of analysis of information at village, taluk and district level is to identify the existing facilities and gaps at village level which can be considered as need of the study area.

The site for the present solar power project is located in Malagondanahalli village of Madhugiri taluk, at approximately 27 km south of Madhugiri town, in Tumkur district, Karnataka. The project site is well connected by State Highway (SH) No. 3 with the taluk headquarters- Madhugiri town. The district headquarters Tumkur (also called Tumakaru) is located around 72 Kms to the south of the site location. Site visit was undertaken along with primary and secondary data collection from various sources. Interviews were also undertaken with representatives of project proponent (HFE), EPC contractor (Jackson), land aggregators, land sellers, local villagers and government officials in different departments. Information and required documents related to project site, land details etc. were collected from the project proponent and personnel of EPC contactors present at site.

The assessment of socio-economic environment was carried out based on the primary survey with the help of framed questionnaire to conduct community consultation (as presented in **Appendix D**) Secondary data includes Census 2011, information available on the official website of Tumkur district,[7] statistical data website of Karnataka[8] statistical abstract Directorate of Economics and Statistics, Government of Karnataka, District Census Handbook, and other available data on official Government websites.

4.5.1 Demographic Profile of District and Study Area Villages

According to the 2011 census of India, the total population of Karnataka was 61,095,297 of which 30,966,657 (50.7%) were male and 30,128,640 (49.3%) were female. The sex ratio for the state is 973 females per 1000 male. This represents a 15.60% increase over the population in 2001. The population density was 319 per sq. km. The literacy rate was 75.36% with 82.47% of males and 68.08% of females being literate.

Tumakuru district is located in the eastern belt in the southern half of the State. Spanning an area of 10598 sq.km. Tumakuru district is surrounded on the north by Anantapur district of Andhra Pradesh; on the east by the districts of Kolar and Bangalore; on the south by Mandya district and on the west & north-west by the districts of Hassan and Chitradurga. In the mid-west, Chikmagalur district too touches the district and shares a common border.

Demographic profile of the project affected areas and comparative co-relation between the state, district and the area are drawn on the basis of primary consultation and Census, 2011.

[7] *http://tumakuru.nic.in/*

[8] *http://des.kar.nic.in/*

Project Impacted / Study Area Village

The proposed project is located at Malagondanahalli village under Bedathur Gram Panchayat in Madhugiri Taluk of Tumkur district, Karnataka. Hence, Malagondanahalli village has been considered as the study area for socio- economic profiling located within the project area. During site visit it was observed, that other villages also have common amenity facility with other villages, e.g. Pulamachi, Appenahalli etc., of Bedathur Gram Panchayat. During site visit it was found that people from other villages, e.g. Hanumanthapura also have lands in this village. Land owner for majority of the lands resides at Hanumanthapura. The details of the study area for which socio-economic profiling has been carried is depicted in **Table 4-9.**

Table 4-9: Project Location

State	District	Mandal/ Taluk	Gram Panchayat	Village
Karnataka	Tumkur	Madhugiri	Bedathur	Malagondanahalli

Source: Hero Future Energies Pvt. Ltd. (HFE)

Demographic Profile

The demographic profile in terms of total population, number of households, household size and sex-ratio of the selected villages surveyed in the study area are discussed in the section below.

Population & Gender ratio[9]

Tumkur District: As per Census, 2011 the district has population of 26, 78,890 which accounts for 4.38% of the total population of the state. Among the total population of the district 13, 50,594 are male and 13, 28,386 females. The sex ratio of Tumkur district is 963.

Madhugiri Taluka: As per census 2011, the total population of Madhugiri Taluk is 2, 67,866 of which male and female are 13, 50, 594 and 13, 28,386 respectively. The sex ratio of Madhugiri Taluk is 984, higher than state (973), district (963), and the national ratio (940).

***Study area village (Malagondanahalli)*)**: As per Census 2011 the total population of the study area village (namely Malagondanahalli) is 128 only, out of which male and female part is 61 are 67 respectively. The gender ratio in the village is 1098, which is higher from national, state, district and taluk ratio. The details are presented in

[9]*Census 2011*

Appendix F**.**

Household Size: Considering the Census 2011 data of the villages, field visit observations and consultations with the community reveals that average household size of the study area villages is around 5.

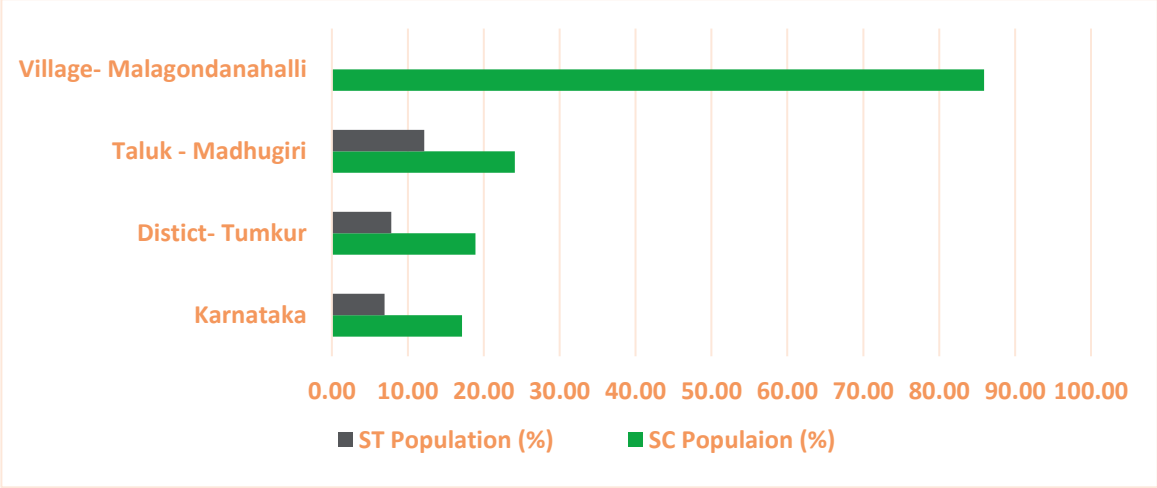
4.5.2 Schedule Caste (SC) & Scheduled Tribe (ST)

Tumkur District, Madhugiri Taluk:

As per Census, 2011 the Schedule Caste (SC) and Scheduled Tribe (ST) population of Tumkur district is 506,901 and 209,559 respectively. The SC & ST Population in Madhugiri Taluk is 64,608 and 32,648 respectively, i.e. 24.12% and 12.19% of the total population.

Study Areas Villages: As per census 2011, around 85.94% of the population in Malagondanahalli village are Scheduled Caste (SC). There is no Scheduled Tribe (ST) in the village. Details are given in **Appendix G** and shown in **Figure 4-26.**

Figure 4-26: SC & ST Population in Study Area



Source: Census, 2011

4.5.3 Literacy

Karnataka

As per Census, 2011 the literate population of Karnataka is 40,647,322. Out of which, male and female part are 22, 508, 471 and 18, 138, 851 respectively. Around 75.36% of the total population above the age of 6 years in Karnataka are literate.

Tumkur District:

As per Census, 2011 the literate population of Tumkur district is 1,68,024. Out of which, male and female part are 95,763 and 72,261 respectively. Around 75.14% of the total population above the age of 6 years in Tumkur district are literate.

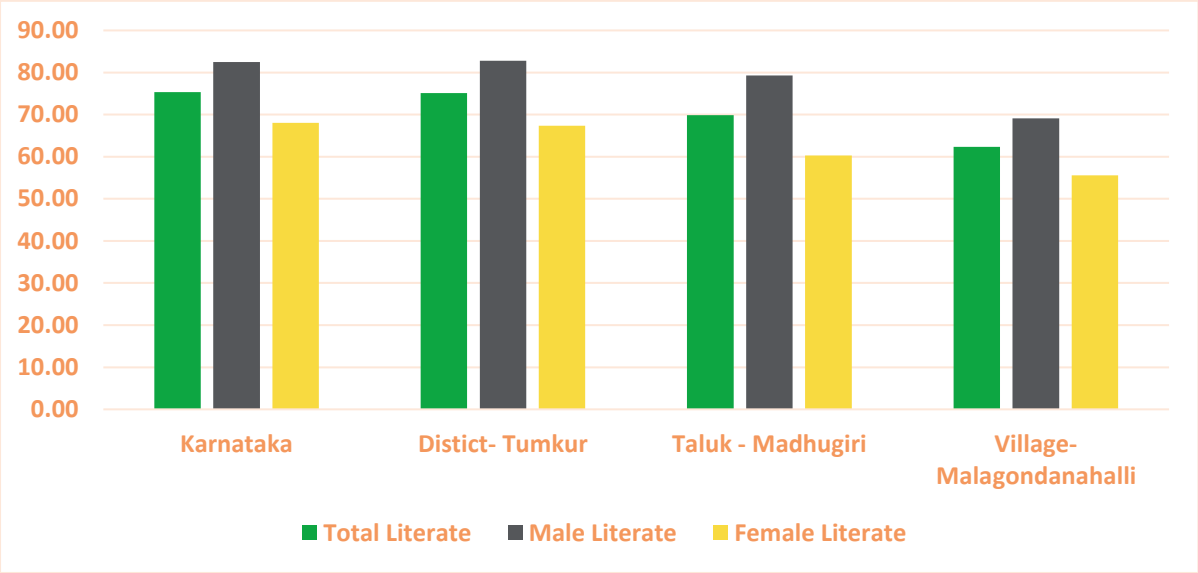
Madhugiri Tehsil:

As per Census 2011, Madhugiri Taluk has 1,68,024 literate population. Out of which, male and female part are 95,763 and 72,261 respectively. Around 69.85% of total population (above the age of 6 years) are literate in the taluk.

Study area village - As per Census 2011, 62.39% population of Malagondanahalli village (above the age of 6 years) are literate. About 69.09% and 55.06% of the male and female (above the age of 6

years) population of village respectively are literate. Details of literacy scenario in the study area is provided in **Appendix H** shown in **Figure 4-27.**

Figure 4-27: Literacy Scenario in Study Area



Source: Census, 2011

4.5.4 Workers and Occupation

As published in the 'Economic Survey of Karnataka - 2015-16' of Department of Planning, Programme Monitoring & Statistics, Government of Karnataka, Labour Force Participation Rate (LFPR) of age 15 Years and above for Karnataka State is 57.8%, whereas this is 55.6% for India. The state average male and female worker population ratios (78.2% and 34.5%) are also higher than all India average.[10]

Tumkur District:

As per Census 2011, total working population of Tumkur district is 13,54,646. Out of total working population of the district, 72.61% people are dependent on agriculture either directly or with allied activities. Rest of the working population in Tumkur district are involved in household works and different other activities.

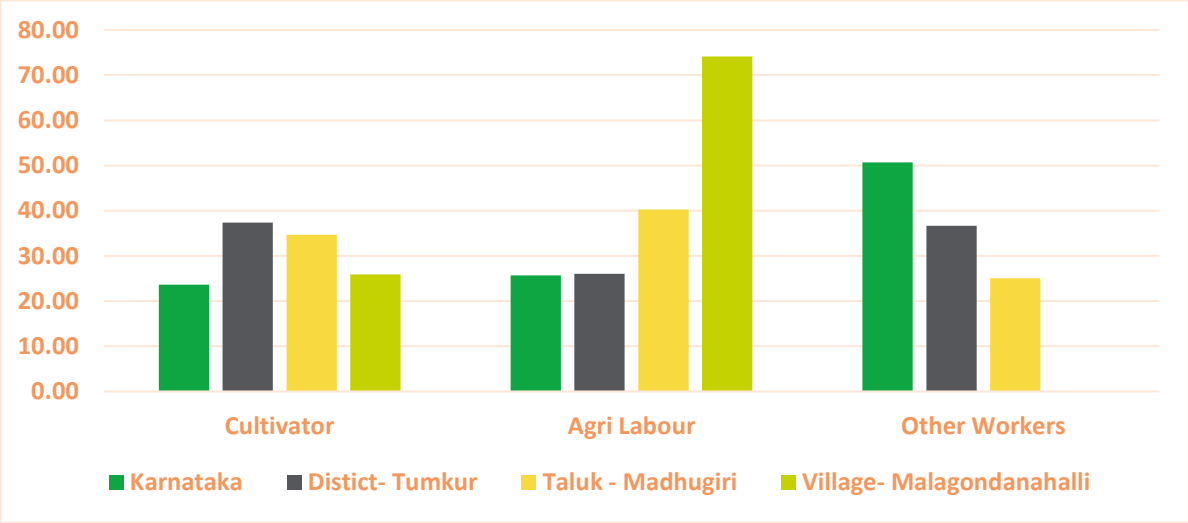
Madhugiri Tehsil:

As per Census 2011, the average LFPR of Madhugiri Taluk is about 56.11%. The percentage of cultivators and agriculture labors stands at 34.71% and 40.27% respectively. Household workers in the taluk is 3.15% of the total workforce. Other work force participation rates stand at 21.87%.

Study area village - As per Census 2011, the average LFPR of Malagondanahalli village is about 66.41%. The percentage of cultivators and agriculture labors stands at 25.88% and 74.12% respectively. Comparative analysis of workforce participation in the study area is given in **Appendix I** and **Figure 4-28**

[10] *Source: http://des.kar.nic.in/docs/Economic%20Survey%202015-16_English%20Final.pdf*

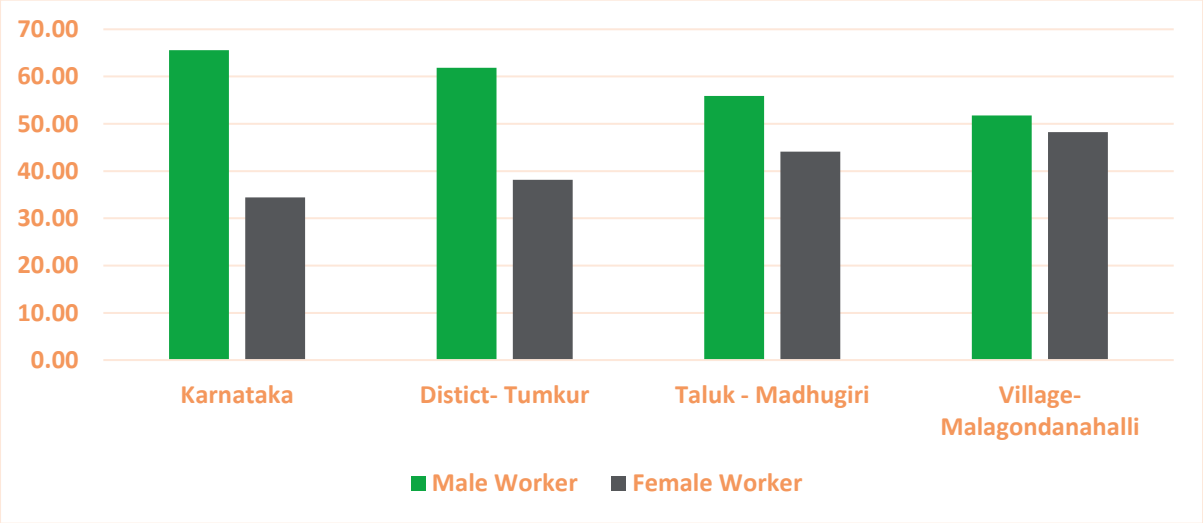
Figure 4-28: Sector wise Work Force Participation Rate



Source: Census, 2011

Female Workforce participation: As stated in 'Economic Survey of Karnataka - 2015-16', by Ministry of Labor and Employment, Department of Planning, Programme Monitoring & Statistics, Government of Karnataka the female workforce participation rate in Karnataka is 34.5%%. Census 2011 reports that the female work participation rate in Tumkur District is 38.17%. For Madhugiri taluk the same is 44.12%. In study area village- Malagondanahalli, the average female work force participation rate is 48.24%. Details of Female WFPR is given in **Appendix I** and shown in **Figure 4-29.**

Figure 4-29: Gender wise Work Force Participation in Study Area



Source: Census, 2011

4.5.5 Wages

According to Karnataka Minimum Wage Rule for 2016-17, the minimum wage for contract laborer's in agricultural sector is Rs. 303.98/ day for various relevant activities. It is inclusive of variable dearness allowance of Rs. 200.00/ day and variable dearness allowance (VDA) of 103.98/ day. [11] The wages and

[11] *Source: http://labour.kar.nic.in/labour/2016-17%20Minimum%20wages%20rates.pdf*

VDA are of varied range depending on the level of skill (termed as unskilled, semi-skilled and skilled) in different other sectors.

4.5.6 Livelihood Source

As per Census 2011, about 37.35% and 26.01% of the working population is directly dependent on agriculture, as cultivators and agriculture-based laborer's respectively in Tumkur district. In Madhugiri taluk about 34.71% and 40.27% of the total population are cultivators and agricultural laborer's respectively. Thus, agriculture continued to play an important role in the economic growth of the region of the upcoming solar power project.

As mentioned in website portal[12] of Karnataka State Department of Agriculture (KSDA), Govt. of Karnataka, the state grows a range of crops including Rice, Jowar, Ragi, Maize, Bajra, Wheat, different kind of lentils, different kind of food grains including Soya Beans, Ground Nuts, Sunflower etc. As per the website portal around 102.26 L hectare land area are cultivated.

Cropping Pattern

The principal crops grown in the state during Kharif and Rabi Season is depicted in the figure season are Paddy, Bajra and Tur etc. and in **Figure 4-30.**

Figure 4-30: Principal Crops and Cropping Pattern in Karnataka

Calendar of Agricultural operations indicating the period of sowing and harvesting in respect of Principal crops in Karnataka state.				
Sl. No.	Name of the crops	Period of		Other seasons in which grown
		Sowing	Harvesting	
	KHARIF			
1	Rice-Autumn	May - September	October - January	]Summer
2	Rice-Winter	August - November	January - April	]
3	Jowar	May - July	September - December	Rabi, Summer
4	Bajra	June - August	September - November	Summer
5	Maize	May - August	September - December	Rabi, Summer
6	Ragi	May - August	September - December	Summer
7	Small Millets	June - August	September - December	Summer
8	Tur	June - July	December - February	
9	Other Pulses (Kharif)	May - August	October - December	Rabi
10	Tobacco	April - September	September - January	
11	Groundnut	June - August	September - December	Summer
12	Castor Seed	April - August	September - February	Summer
13	Sesamum	April - June	August - September	
14	Cotton	May - July	December - April	Rabi
15	Niger seed	June - July	September - October	
16	Sunflower	June - August	September - December	
	RABI			
1	Jowar	September - October	January - March	Kharif Summer
2	Maize	October - December	January - March	Kharif Summer
3	Wheat	October - December	January - March	
4	Gram	October - December	January - March	
5	Other Pulses (Rabi)	September - February	November - April	Kharif
6	Cotton	August - September	February - April	Kharif
7	Safflower	October - November	January - March	
8	Linseed	October - November	January - March	
9	Rape & Mustard	October - November	January - March	
10	Sunflower	October - November	January - March	

Groundnut, Maize, Tomato, Onion etc. food crops along with cotton is cultivated in the project area villages. Though not cultivated, scattered Neem trees surrounding the cropping fields at few places are seen. As informed by the farmers and the community members a crop wise productivity in the study area and market price is given in **Table 4-10.**

[12] *Source: http://raitamitra.kar.nic.in/KAN/Document/agriprop.pdf*

Table 4-10: Production & Productivity and Price of Major Crops

Sl. No.	Crop	Harvest Period	Productivity (q/acre)	Price/ Quintal (in INR)
1	Ground Nut	October - January	12	Rs. 4000.00-4080.00
1	Paddy	July to December	25-32	Rs. 1700.00- 1900.00
2	Maize	July to December	4-5	Rs. 1200.00- 1300.00
3	Tomatoes	July to October	40-50	Rs. 800.00- 1000.00

Source: Primary Consultation in the Study Area Villages

4.5.7 Livestock

Karnataka has rich livestock resources especially goat and sheep population. Rural population in the state is predominantly agricultural with majority of the workforce being engaged directly in the agriculture sector. Animal husbandry and dairy are important sources of supplementary income to farmers in the state.

As per 19th Livestock Census, Karnataka has a population of 27701896 livestock and 53442030 poultry. An account of the domesticated animal population of the state as given in 19th Livestock Census and in website portal[13] of Department of Animal Husbandry & Veterinary Services, Govt. of Karnataka is given in **Figure 4-31**.

Figure 4-31: Principal Crops and Cropping Pattern in Karnataka

Sl. No.	District	Cattle	Buffaloes	Sheep	Goats	Pigs	Horses & Ponies	Mules	Donkeys	Camels	Dogs	Rabbits	Elephants	Total Livestock	Stray Cattle	Stray Dogs	Total Poultry
1	Bagalkot	279415	234802	733600	324741	33467	428	1	1169	5	37774	908	0	1646310	2462	12766	1372196
2	Bangalore	136582	8453	77302	44725	18114	1262	8	65	1	127120	3506	0	417138	1326	103690	2421151
3	Bangalore Rural	158820	24381	124870	80740	6052	44	1	34	0	26177	3967	0	425086	760	34125	8165758
4	Belgaum	592833	829370	788929	491545	25676	4898	0	463	1	75232	161	1	2809109	4623	29920	2738292
5	Bellary	344077	142255	756270	187270	14971	99	15	231	0	26030	494	2	1471714	3691	40682	2723680
6	Bidar	234519	130781	88402	145942	18712	104	0	2621	97	9295	15	0	630488	1551	17638	402661
7	Bijapur	253025	156860	309278	367563	22672	1851	0	133	0	45305	24	0	1156711	2290	15607	300018
8	Chamarajanagar	262520	20887	128483	102854	1049	38	0	105	1	12321	254	8	528520	1201	16157	377463
9	Chikkaballapura	246339	47140	432691	137050	4738	23	0	117	3	26894	518	0	895513	758	53931	1660703
10	Chikmagalur	337576	70870	91312	46068	2158	73	0	226	0	42577	1059	0	591919	3332	25225	1178382
11	Chitradurga	275889	152852	940038	231279	3160	896	0	4212	21	37256	1491	2	1647096	1508	24832	2411780
12	Dakshina Kannada	253715	3700	265	24628	6463	9	0	2	0	146510	1166	9	436467	1172	10750	1721908
13	Davanagere	332075	175896	343178	103187	3828	31	2	134	2	23486	386	0	982205	2351	29771	3193472
14	Dharwad	193781	79513	73982	62140	3162	96	0	2	0	20378	351	0	433405	2504	12648	904421
15	Gadag	142655	60989	259047	106353	6569	216	11	95	0	16711	341	0	592987	2399	8594	156270
16	Gulbarga	473117	91254	100061	372951	23915	178	1	321	4	31792	35	0	1093629	3711	21634	362754
17	Hassan	606460	141264	160685	99405	2155	403	0	409	0	42657	924	0	1054362	1747	50691	2578599
18	Haveri	284609	98468	254708	127757	6453	834	0	97	0	26866	298	0	800090	2781	17748	885232
19	Kodagu	88428	14476	1401	7785	16948	25	3	2	4	47131	723	112	177038	456	3721	207886
20	Kolar	229036	45876	445100	86263	4257	11	0	113	1	36016	312	0	846985	1276	42989	4275529
21	Koppal	260408	77860	547061	156509	12657	100	0	12	1	24406	40	4	1079058	2056	13200	3534459
22	Mandya	366740	145516	341774	261300	6802	259	308	154	0	25961	341	0	1149155	892	44127	1293779
23	Mysore	549552	45419	218381	168299	5476	204	0	71	5	33191	1157	10	1021765	2870	68893	3065218
24	Raichur	359124	136854	647549	281710	14072	21	2	84	0	31458	45	0	1470919	5587	24411	372688
25	Ramanagara	259897	30619	152938	120238	2050	47	0	165	2	12694	1262	33	579945	749	19082	1284545
26	Shimoga	568476	149515	36791	58034	4007	27	2	144	0	70201	685	18	887900	2974	23587	1739272
27	Tumkur	527067	181118	1061330	326890	7122	436	326	5074	0	49673	1065	1	2160102	1890	71733	2107798
28	Udupi	252067	8846	70	6600	3098	3	0	0	0	92845	1396	8	364933	1255	8180	1193772
29	Uttara Kannada	336955	87816	4783	8961	1491	16	82	8	0	57544	508	0	498164	3589	19103	537037
30	Yadgir	310727	76855	463482	257360	23504	344	0	49	3	19621	126	0	1152071	997	10646	275307
Total		9516484	3470505	9583761	4796147	304798	12976	762	16312	151	1275122	23558	208	29000784	64758	876081	53442030

Source: http://www.ahvs.kar.nic.in/pdfs/stats/19LC-Nutshell.pdf

[13] *Source: http://www.ahvs.kar.nic.in/en-reportsstat.html*

4.5.8 Local Employment and Migration

During consultation with the community in the study area it was observed that, cultivation, daily wage labor in agriculture and other sectors (as porter) are important sources for livelihood in the study area villages. Also, the same has been reported in Census 2011. A notable part of the population migrates to big cities like Mumbai or Bengaluru to work as daily wagers, laborer's etc. Major livelihood in this area is agriculture.

4.5.9 Gender Empowerment Status

The female work participation in Karnataka is notably lower than that of male. The women workers in the state are still not better placed, specifically by financial status because the workforce is concentrated in activities which are unorganized, informal, seasonal, insecure, menial and poorly paid, especially in the unorganized sectors like agriculture, masonry etc.

In Tumkur district, female workforce participation rate is around 38.17%. On an average, in the study area villages the female work participation is around 48.24%. Female laborers are engaged in sowing, weeding, plant protection, grading, kitchen gardening, cleaning of grains, harvesting, feeding the cattle, irrigating fields, taking care of livestock, growing vegetables. There are no SHGs active in the study area.

Following the Census, 2011, the average literacy rate of female both at district and taluk level is found much lower than the male. On an average around 55.56% of the female population, above the age of 6 years of the study area are literate. Whereas the around 69.09% of the male, above the age of 6 years are literate. This denotes a notable distinction between male and female literacy rate. The details are given in **Appendix H.**

As observed during field visit the social status of the women needs improvement. During consultation with the women participant it was observed that early marriage and child marriage, minimal participation of women in household or economic decision making and lesser economic freedom is common in the area. The women are entirely responsible for household chores and additionally engaged as agriculture labor, harvesting, feeding the cattle, and taking care of livestock.

4.5.10 BPL Families and Vulnerability

As per consultation with the community members as well as Panchayat Members during visit of Arcadis ESIA Team a few BPL family reported to be present at the study area village- Malagondanahalli in Madhugiri taluk.

Vulnerable group is *"Groups that experience a higher risk of poverty and social exclusion than the general population. Ethnic minorities, migrants, disabled people, the homeless, those struggling with substance abuse, isolated elderly people and children all often face difficulties that can lead to further social exclusion, such as low levels of education and unemployment or under employment."*

During community consultation, it was observed that some vulnerable group like landless family, physically handicapped and lone widow are present in the study area village- Malagondanahalli, given in **Table 4-11.**

Table 4-11: Vulnerable Groups in Study Area- Malagondanahalli

Village Name	Vulnerable group			
	Women headed Family	Lone Widow	Physically Handicapped	Landless HH
Malagondanahalli	10	1	1	3

Source: Primary Consultation in Study Area Villages

The project proponent may be required to focus on providing employment opportunity to the vulnerable members and implementation of program under CSR activity for them. During dialogue with HFE representative, it was informed that land has not been procured from any vulnerable household or family.

4.5.11 Land Holding

Karnataka, with an area of 191,976 sq. km. is the seventh largest state by area in India after Rajasthan. Average land holding size in Karnataka is shown in the following **Table 4-12.**

Table 4-12: Distribution of Average Size per Holding - All Social Groups

State	Average size per holding in Hactre					
	Marginal	Small	Semi Medium	Medium	Large	All size groups
Karnataka	0.45	1.43	2.71	5.78	14.90	1.63

Source: Agricultural Census, 2011

During discussions with the local community in the study area, it was understood that the average land holding size varies between 1-7 acre per household.

4.5.12 Irrigation

As per CGWB report 2013 of Tumur district, the average annual rainfall during 2012 was 780 mm. The annual number of the rainy days is around 45 days. As per CGWB Report 2013, the ground water level range in Tumkur District is 0.26-25.84 mbgl at post monsoon and 1.17-31.70 mbgl at pre-monsoon period. Thus, it is evident that the agriculture in this region is majorly dependent on rain.

4.5.13 Amenities and Infrastructure

Village and district level integrated education, health amenities data available as per census 2011, as well as from other resources and study area villages visit are described in the section below.

Medical Facilities:

Project area villages: In the study area villages, the health amenities are inadequate. As informed during consultation people generally avail local unregistered medical practitioners or go to nearby health centers outside the village. It was informed by the community members that ambulance facilities are available on call to emergencies nos. 104 and 108. Fluoride contamination in water is reported during consultation with community and Panchayat members. Fluoride related health problems, e.g. joint pains, teeth problems etc. were also reported. It was informed by local community members and panchayat members that joint pain and other general diseases are common ailment problems in the area.

As observed during consultation Malagondanahalli village has no health sub center (HSC). Auxiliary Nurse & Midwife (ANM) and Doctor visit the center once in a month. For better treatment, they have to travel up to the taluk town Madhugiri. The taluk hospital is located around 25 Km. at Madhugiri. Villagers also go to local quacks in the time of need.

Primary Health Centre is available at Bedathur, around 1 Km, the panchayat village. The nearest Health Sub Centre is at Madikashi village around 4 Km from the project area village.

Schemes Sponsored by Health Department

Several schemes are adopted by both the central and state governments to reach out to the remote most rural population of the state. The same is followed by the medical administration of Tumkur district as well. A few of such programs are, (1.) Universal Immunization Program: (Immunization / Vaccination

/ IPPI / Vit-A, Prophylaxis) (2.) Family Welfare program: (Eligible couple survey, Family Planning operations, temporary methods incentives to beneficiaries etc.) (3.) Madilu Programme & Prasooti Araike: Rs 1000/- is being paid as incentive to BPL pregnant women who deliver at Govt health facilities. (4.) District Mental Health programme- Mano Chaitanya. (5) National Blind Control Programme ;(6.) NVBDCP: Prevention and control of vector borne diseases like malaria, dengue, chicken guinea, filariasis, Japanese encephalitis etc.

Education:

As per the district website portal of Tumkur[14] the district has 3840 govt. primary schools and 756 govt. high schools and number of degree colleges along with different specialized colleges.

As revealed during visit and consultation that at the study area village- Malagondanahalli has no schools. The nearest primary school is located at Pulomachi located adjacent to the village. The nearest middle high school is located at Hanumanthapura, around 3 Km form the study area village. For higher studies people go to Madhugiri, Madakasira or Bedattur around 1 Km away from the village.

Drinking Water Facility:

As per Tumkur district website portal, piped water supply system is available in Madhugiri taluk. As per District Census Hand Book, 2011 of Tumkur District, about 14.46% of the population in Madhugiri taluk uses piped tap water from treated resource, 44.57% from untreated source and only 4.14% uses hand pump.

RO Water Filter at Pulomachi Village

During consultation with the community, water is extracted from ground through bore wells for drinking water consumption in the study area. Hand pumps are also seen to be used in the village. RO water system and overhead tank of 50000 Liters capacity is seen at the close proximity in Pulaomachi village. As told by the community and panchayat members these are not adequate to cater the need in the area. As expressed during interaction with the villagers that the quality of water may impacting the health of the local people. The project proponent may consider this area of need in their CSR activity.

Sanitation: According to District Census Handbook, 2011 of Tumkur district, Madhugiri taluk around only 12.52% of individual households in rural area are having latrine within their premises. Out of this around only 2.97% have sanitary latrines with septic tank facility and about 79.77% resort to defecate in open.

During community consultation, it was observed that proper sanitation facilities within households is ranging from 80% in the study area villages. It was informed during the field visit, sanitary toilets construction at individual households has been started under Swachh Bharat Mission scheme.

Cooking Source: A little section of the population in the surveyed villages use fire wood, cow dung, and crop residue as fuel for cooking. Majority of the study area populace use LPG as cooking medium.

Communication and Transportation facilities: Private and Govt. Buses are the major mode of transportation in the study area. Self-owned motor cycles and bicycles are frequently used private transport for the villagers. During site visit, it was observed that there is good road connectivity. Access roads within the study area village- are bituminous, concretized as well as kuchcha. Telephone

[14] *Source: http://tumkurzillapanchayat.gov.in/education.html*

connectivity is also available. Hence, it can be summarized that communication facilities are satisfactory from the site area.

The nearest town from the study area village- Madhugiri, which is connected through NH 3. Madhugiri is approximately 25 km away from the study area. There is no railway station near the study area village. The locals have access to the bus services at Medigeshii, which connects to big cities like Bengaluru, Tumkurand Anantapur at Andhra Pradesh etc. There is no railway network in the study area. Nearest railway station is in Hindupur in Andhra Pradesh more than 100 Km by roadways from the project site. It can hence be concluded that even in the presence of good approach roads, the communication facilities are not satisfactory in this region.

Local transportation at study area

Power supply: Households of the study area village- Malagondanahalli observed to have electricity connections in the proposed project area. It was told by the local people that electricity is available almost 24 hours. Tariffs are being charged for these connections.

4.5.14 Common Property Resources (CPR)

During consultation with Panchayat members and villagers, it was noted that the Malagondanahalli village have some Common Property Resources (CPR) like temples, cremation ground etc. as presented in **Table 4-13**. In terms of CPR, the likely impact from the project development was also observed and discussed with the villagers.

Table 4-13: Common Property Resources[15]

Study Area Village	Common Property Resources (CPR)		
	Temple	RO Water Treatment Plant	Cremation Ground
Malagondanahalli village	1	1 (shared with Pulomachi village)	1

Source: Primary Consultation at Study Area Villages

4.5.15 Archaeology and Cultural Heritage Sites

As observed during field visit there is no structure of archaeological and cultural heritage on the proposed project site. No monument or structure of religious importance were observed within 5 Km radius of the study area village.

4.5.16 Stakeholder Consultation

Consultation with land owners and community members were held separately at each study area villages. Consultation was carried out with representative of Project Proponent, Land Owners, Village

[15] *Source: Primary Consultation at study area village*

Panchayat Members and other community members from village. People consulted are appended here below in **Table 4-14**.

Table 4-14: Consultation with Different Stakeholders

Stakeholder type	Name & Designation	Department/Address	Date
Project Proponent	Rajaram Shetty, Manager, Lands Vinod Gunnam, HSE Engineer	Hero Future Energies	12/12/17
Land Aggregator	Pirushottam Reddy, Land Agregator for Hero Future Energies	Malagondanahalli village	12/12/17
EPC Contractor	Santosh Singh, Senior Engoneer Rajkumar Chowdhury, Engineer Laksman Patel, Engineer	Jakson	12/12/17
Security Agency of EPC Contrcator	Chandra Mohan, Security Supervisor Mali Gowda, Security Personnel	Harsha Security Services	12/12/17
Land Owner	Venkat Raman Reddy	Malagondanahalli village (resides at Hanumanthapura, adjacent to site)	12/12/17
Panchayat President	Thimma Reddy	Bedattur Panchayat (Panchayat for Malagondanahalli village)	12/12/17
Community	Ramanna Hanumanth Reddy Pavana Chandramma	Malagondanahalli Village	12/12/2017
Labourers	Hanumant Ram Nanhal Rahul Purushottom	Meera Enterprise (sub-contractor for boundary wall) at Project Site	12/12/2017

Consultation was held with the local people and panchayat members of the study area. Details given in **Appendix E**). Discussion was based on a set questionnaire including project specific negative and positive impacts, socio-economic resource, and demographic profile of the villages. Expectations of local's w.r.t the project development was also discussed.

a. Consultation with Project Proponent (Hero Future Energies Pvt. Ltd.)

Representatives of the project proponent has informed the visiting ESIA team that the private land is procured on wiling-buyer- seller basis and good faith negotiation, in the project area exclusively for the purpose of 20 MW solar power project owned by HFE. The land that has been procured is clearly demarcated. The land parcel marked exclusively for the 20 MW solar project is approximately around 113 acres as per HFE.

b. Consultation with Land Owner

Private land has been procured on wiling-buyer- seller basis and good faith negotiation. Consultation was done with one land seller for understanding the likely livelihood impact. It was understood that major part of the procured land belongs to him. During consultation with the land sellers it was revealed,

the sellers feel that land was taken from him for a greater cause and people's benefit. He aspires that the solar project will contribute to the development in the area.

c. Consultation with Panchayat President and Community Members

As informed during consultation agriculture is the major livelihood resource the project area village-Malagondanahalli. Majority of the population is involved in agriculture, a major part of which are agriculture laborer's. Mostly rain-fed agriculture pattern is practiced in project area. There is no health facility in the study area villages, locals rely on quacks. Drinking water facility needs to be developed exclusively for the village. At present it is shared with Appenhalli and Pulomachi villages adjacently located. Majority of households of the study area have their own sanitation facilities in form of sanitary latrines in the study area villages. Health facility is not present in the project area village.

Details of Stakeholders consultation has been provided in **Appendix E.**

Key Findings of Consultation

Some notable key findings of different level stakeholder consultation are appended below:

- Agriculture is the major livelihood resource in the area. Quiet a notable amount of population is involved in agriculture, a major part of which are agriculture labourers.
- The main crops are paddy, Tur dal, maize, Cotton and vegetable.
- Rain-fed agriculture pattern are practiced in project area.
- The main source for irrigation is bore wells.
- Female literacy rate is much lower than male literacy rate.
- There is no health facility in the study area villages, locals rely on quacks.
- Common health problems like fever, joints pain and tuberculosis are present in the village.
- Drinking water and sitting arrangements are main areas of concern that needs improvement in most of the schools of the study area`
- No monument or structure of religious importance were observed within 5 Km radius of the study area village.
- Majority of households of the study area have their own sanitation facilities.
- RO water system and OHT (overhead tanks) were observed to be present in the adjacent villages and not within village area.

Consultation with Manager, Lands, HFE

Consultation with Laborer's in the site area

Consultation with Security Personnel at Site

Consultation with community & Panchayat President

5 ANALYSIS OF ALTERNATIVES

The section gives analysis of alternatives with respect to the project. The following scenarios have been considered:

- Current or No Project Scenario
- Alternate methods of power generation
- Alternate location for the project

5.1 Current or No Project Scenario

India is blessed with abundant sunshine and solar power is expected to play a critical role in meeting the energy needs of the country in the long run.

Karnataka is rich in solar resources and solar energy will complement the conventional sources of energy in a large way. The State of Karnataka is blessed with about 240 to 300 sunny days with good solar radiation of 5.4 to 6.2 kWh/m2/day. The solar energy potential in Karnataka is estimated in excess of 24,700 MW. However, the actual potential for solar energy is significantly higher than the estimated capacity, considering the recent technological advances and increasing efficiencies brought in solar energy segments

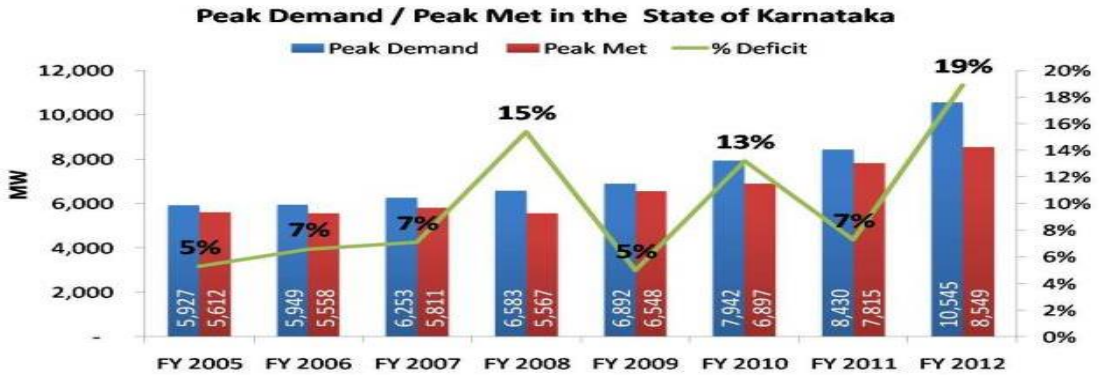
The Govt. of Karnataka, in its Solar Policy 2014- 2021, has set a target of installing 2,000 MW solar power by 2021, including grid connected rooftop projects of 400 MW. Though the solar policy of the state aims to achieve 3% contribution from solar sources out of the total energy consumption in the state by year 2021, the Karnataka Electricity Regulatory Commission (KERC) has kept the solar renewable purchase obligation on the distribution licensee's constant at 0.25% since March 2011. However, KERC offers a very liberal and predictable concessional open access regime for solar energy which includes exemption from wheeling charges, banking charges and cross subsidy surcharge for the first 10 years of operation of solar projects which are not under REC mechanism[16].

Karnataka has been facing both peak and energy deficits over the last few years. Peak demand deficit in the state has increased from 5% in FY 2005-06 to 19% in 2011-12. Between 2005-06 and 2011-12, peak electricity demand grew at a compound annual growth rate (CAGR) of 9%, while peak demand met at CAGR of 6%. The peak demand- peak met deficit grew at CAGR of 20% over the last 8 years.[17] please refer **Figure 5-1**

[16] *Karnataka Solar Policy 2014-2021*

[17] *http://greencleanguide.com/electricity-scenario-of-the-state-of-karnataka/*

Figure 5-1: Power Supply Status in Karnataka



The proposed project being a non-conventional source of power generation intends to contribute towards meeting the peak demand. Solar power-based projects with a cumulative capacity of around 2200 MW[18] have been commissioned in the state.

Based on the solar GIS data, which is the most reliable and accurate source of solar resource information, the average annual Global Horizontal Radiation Irradiance (GHI) near the site is 1900 kWh/m^2 to 2100 kWh/m^2. Hence, to meet the target of renewable energy generation in Karnataka, it is a perfect setting for solar power projects. The proposed project presents an opportunity to utilize the potential for solar power generation. A "No Project Scenario" is not favorable, as it will render one of the potential sites for development of solar energy projects. The project being a solar power project will not lead in any CO_2 and SO_2 emissions during the operation phase. It does not deplete the natural resources.

5.2 Energy Security

In 2007 the Ministry of Environment Forests and Climate Change (MoEFCC), Ministry of Power (MoP) and the Bureau of Energy Efficiency (BEE) issued a paper entitled 'India: Addressing Energy Security and Climate Change'. In India, the need for expanding the role of domestic Renewable Energy (RE) sources is a logical next step. Wind power is already in a position to provide a significant portion of India's planned capacity addition up to 2030, with simple regulatory and grid modernization initiatives. Unlike oil, coal or LNG, wind & solar power is not subject to fluctuating fuel prices which drain India's limited foreign reserves, and in addition, wind & solar power helps in reducing the carbon footprint of the economy. In the **Figure 5-2**, India's projected power requirement until 2030 has been indicated.

This project is a step towards achieving energy security in India.

[18] *http://kredlinfo.in/Solarlistrpt.aspx*

Figure 5-2: India's Projected Power Requirement

5.3 Alternate Methods of Power Generation

Solar power is a free and inexhaustible ("renewable") source of energy. Unlike fossil fuels such as coal and oil, which exist in a finite supply and which must be extracted from the earth at great environmental cost, solar power plant harnesses a boundless supply of potential energy in the form of solar light. The environmental impact of solar power when compared to the environmental impacts of fossil fuels, is relatively minor. Solar power has the lowest global warming potential per unit of electricity generated. Further there is no Green House Gas (GHG) emission from a solar power plant as compared to power from fossil source.

There are various non-renewable and renewable energy sources which can be utilized for power generation. Each option has its own advantages and disadvantages. Based on the site conditions, availability of resources, environmental & social concerns and project cost suitable option for power generation need to be selected. Comparison of advantages and disadvantages of various non-renewable and renewable energy is represented in table given below.

Table 5-1: Advantages and Disadvantages of Renewable and Non-Renewable Energy

Source of Energy	Advantages	Disadvantages
Coal	• Relatively cheap form of energy availability in large scale worldwide • Easily transported to power stations • Reliable for energy with steady output • Coal is available in India	• Non-renewable energy source • Large water requirement • High emission of air pollutants and generation of fly ash • Source of greenhouse gases • Mining of coal causes impacts on land and surrounding environment.
Oil & Gas	• Oil and gas can be easily transported by pipes or ships. • Natural gas is the "cleanest" of the fossil fuels	• Non-renewable energy source • Working environment risks to staff and environment • Burning of oil and gas can cause pollution & health impacts • Releases GHG and hence causes global warming and climate change

Source of Energy	Advantages	Disadvantages
		• India imports majority of Oil and Gas requirement and hence high dependency of raw material outside the country
Nuclear	• Nuclear fuel does not create greenhouse gases when making energy. • Only a very small amount of nuclear fuel is needed to make a lot of energy. • Does not produce significant atmospheric pollutants.	• Expensive, especially in capital costs, maintenance costs • The waste produced from nuclear energy is radioactive and Safe long-term disposal of nuclear waste can be difficult.
Solar	• Energy from the sun is exhaustive & free. • Solar energy does not create greenhouse gases.	• Only specified places are right for solar power. • Solar energy cannot be produced at night
Wind	• Wind power does not create greenhouse gases. • The energy used to build one of the large turbines is repaid in 3-6 months. They last for 25 years.	• Need a lot of turbines to make electricity. • Location specific resource • Wind turbines can only be used where it is windy. On days where there is little wind, less energy will be generated.
Hydroelectric	• Hydroelectricity creates no greenhouse gases. • Energy from water is free and will not run out. • Hydroelectric energy is more reliable than wind or solar power.	• Hydroelectric power needs enough water to turn the turbines. • Dams are expensive to build. • Building large dams can cause damage to water courses which affects people and wildlife and it can be difficult to find the right site. • Small dams for local buildings on weirs do not have these problems.
Biomass	• Biomass fuel is cheap and could use rubbish that we might otherwise throw away. • Biomass fuels will not run out. • Biomass crops that are grown absorb the same amount of pollution whilst they are growing as they release when they are burned, so do not create extra greenhouse gases in the atmosphere.	• Growing biomass crops needs a lot of space and could replace growing valuable food crops. • Biomass fuels that are not grown (such as waste products) create greenhouse gases when burned.

The conventional sources of power generation have high environmental cost when compared to non-conventional sources like solar, wind, hydro, etc. Its construction periods are longer with higher environmental risks from emissions. On the contrary power source from solar energy is most eco-friendly mode available. It does not have any kind of emissions during operation. While wind power requires high wind zones to be set up and micro siting along with detailed meteorological analysis is required, site selection for solar power is relatively easier. Solar Power Energy is a clean power project with no emissions and feasible for the project area keeping in mind the good solar potential of Karnataka throughout the year.

5.4 Alternate Location for the Project

Solar energy projects are site specific and its feasibility depends on a number of factors which can be broadly categorized as solar resource assessment, land availability, cost of land and impact on community.

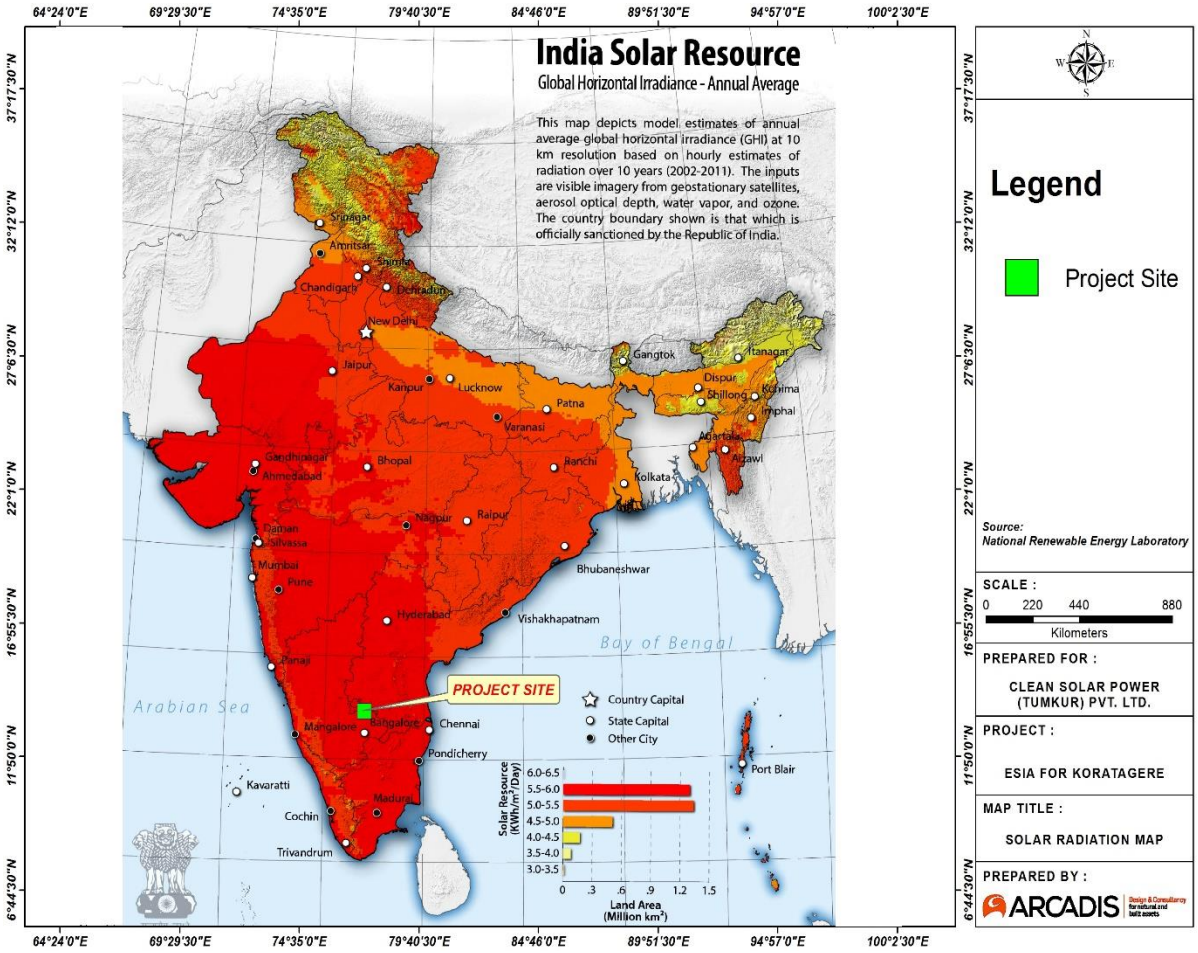
5.4.1 Identification of Sites for Solar Plant

Global horizontal irradiance map of India is shown in **Figure 5-3**. The western and southern region of India has good solar potential with solar resource within the range of 5.5-6.0 kWh/m^2/Day. Karnataka falling in the central region also have good solar resource potential and can be harnessed.

The key factors considered for the final selection of solar plant site included the following:

- **Solar radiation at the site:** Solar radiation map of India indicates that Karnataka receives a global horizontal irradiation (GHI) in the range of 5.5 to 6 kWh/ m^2/ day.
- **Land Use:** Land is mostly barren devoid of agricultural activity making it suitable for solar power project instead of agricultural land.
- **Substation proximity:** Power from the solar photovoltaic plant of 20 MW capacity will be evacuated to 66 kV substation (Pooling Substation of 20 MW), located adjacent to the site. The Pooling substation will be connected to a 66/11 kV grid substation (GSS). GSS is around approx.4 Km (Areal distance) from the site at Medigeshi Sub Station.
- **Accessibility**: The site is located about 30km South West from Tumkur town and is accessible through State highway 33.
- **Topography:** The project site is spread across an open area with mild slope in multiple directions. Erection of solar panels will be undertaken through varying the height of the poles required for mounting solar panels. Hence, the installation will be easy for technical modifications required to adjust for undulations at the ground.
- Near and far shading effects due to objects like transmission lines, trees, hills, wind farms, etc. There are no shading elements such as mountains or dense trees available on the site.
- The site is devoid of any habitation.
- Any other alternative site may not enjoy above mentioned benefits

Figure 5-3: Solar Resource Potential Map



Source: http://www.nrel.gov/international/images/india_ghi_annual.jpg

5.4.2 Alternate Routes for Transmission Lines

The planned grid connection point is located in the in 66/11 kV substation. Produced power will be evacuated through 66kV power evacuation line to the pooling substation located within the project boundary. After stepping up voltage power will be transmitted to 66/11 kV grid substation, 4 km (Areal distance) from grid substation towards south west at Medigeshi.

Maximum output power in connection point will be 20 MW. Bangalore Electricity Supply Company Ltd. will be in charge of the substation. Project Company will be responsible for laying the 33 kV cables from the project plot to the pooling substation.

Reportedly, the route for the transmission line was selected keeping in mind the following factors:

- Transmission line route will be planned to avoid any habitations along the route
- Areas requiring extensive clearing of vegetation will be avoided
- Selection of the transmission route avoids any environmental sensitive site like schools, health centres, etc.
- Right of way/access roads will be shared with the common user of the substation.

The shortest possible route after considering the above factors will be selected for the transmission lines. Consideration of all the above factors will reduce the environmental and social footprint of the transmission line.

5.5 Conclusion

Various factors are considered such as solar resource potential at the project site, favorable environmental and social settings, lowest GHG emissions in the project life cycle, availability of land and other resources. Considering these factors, it can be concluded that the site is the good location for development of solar power project. This is due to availability and suitability of solar power potential, land and other allied infrastructure availability and various government supporting policies.

6 ENVIRONMENTAL & SOCIAL IMPACT ASSESSMENT

6.1 Approach & Methodology

There may be few potential environmental & social impacts due to the project activity during construction & operation phases. During the construction phase, the impacts may be regarded as temporary or short-term ranging from 6-12 months; while few long-term impacts may also be visualized during the operation stage. Primary impacts are assessed for a radius of 3 km around the project site and secondary impacts are assessed within the study area (5 km radius from project site). Further the impacts have been assessed over the study area of 5 km radius of the project site. The project has overall positive impacts by providing a competitive, cost-effective, pollution free reliable mode of solar power. It will certainly meet the ever-increasing demand of power that will bridge the gap between demand and supply of power.

The methodology adopted to assess the significance of impact associated with project activities during construction and operational has taken following criteria into consideration. Details of screening criteria are given in **Table 6-1.**

Table 6-1: Screening Criteria for Environmental and Social Impact Assessment

Impact	Distribution of impact	Duration of Impact	Intensity
Low/ Short	Influence of impact within the project site boundary and RoW of Transmission line (Site)	Limited for duration of less than 6 months (Short)	Limited local scale impact resulting in temporary disturbance/ loss of environment/ social components (low)
Moderate/ Medium	Spread of impact within 3 km from the of the project site boundary (Buffer)	Impact may extend up to 2 years (Medium)	Local scale impact resulting in short term change and/ or damage to the environment components. (Moderate)
High/ Long	Influence of impact beyond 3 km from the project site boundary (Widespread)	Impact extends beyond 2 years (Long)	Regional impact resulting in long term changes and/ or damage to the environment components. (High)

6.1.1 Significance Evaluation Matrix

Significance evaluation matrix as shown in **Table 6-2** has been used to evaluate the significance of identified potential environmental impacts. This matrix includes criteria as discussed above to analyze the significance of impact. Color codes have been given to signify the impact intensity.

Significance of environmental impact has been analyzed and presented in further section of this chapter. The environmental impacts associated with the project activities have been identified and analyzed to evaluate their significance. Because of clean category projects, environmental impacts are very few with minor significance and can be controlled through mitigation measures.

Table 6-2: Impact Significance Matrix

Distribution	Duration	Intensity	Significance
Within Site	Short	Low	LOW
Within Site	Short	Moderate	
Within Site	Medium	Low	
Within Site	Medium	Moderate	
Within site	Long	Low	
Buffer area	Short	Low	
Widespread	Long	Low	
Within Site	Short	High	MODERATE
Within Site	Medium	High	
Within Site	Long	Moderate	
Within Site	Long	Low	
Buffer area	Short	Moderate	
Buffer area	Medium	Low	
Buffer area	Medium	Moderate	
Buffer area	Long	Low	
Buffer area	Long	Moderate	
Widespread	Short	Low	
Widespread	Short	Moderate	
Widespread	Medium	Low	
Widespread	Medium	Moderate	
Widespread	Long	Moderate	
Within Site	Long	High	HIGH
Buffer area	Short	High	
Buffer area	Long	High	
Widespread	Short	High	
Widespread	Medium	High	
Widespread	Long	Moderate	
Widespread	Short	Low	
Widespread	Short	High	
			NO IMPACT
			POSITIVE IMPACT

Table 6-3: Impact Aspect Matrix for Construction and Operation Phase

	PHYSICAL ENVIRONMENT									BIOLOGICAL ENVIRONMENT						SOCIO-ECONOMIC ENVIRONMENT					
	Aesthetics and Visual impacts	Air Quality	Noise Quality	Top soil removal / Soil Quality	Land Use	Local Drainage and Physiography	Surface water quality	Ground Water Resources	Ground water quality	Terrestrial habitat	Ecological Sensitive Areas	Aquatic Habitat and resources	Migratory Birds	Agriculture	Domesticated Animals	Loss of land and livelihood source	Common Property Usage Conflict	Local Job and Economic Opportunity	Cultural and Behavioral Conflict	Community Health and Safety	Occupational Health and Safety
A. Construction Phase																					
Land lease/purchase process										L				L		M	L	P			
Sourcing and transportation of construction material etc.	L	M	L	L						L							L		L	L	M
Storage and handling of raw material and debris	L	L	L	L	L		L		L											L	M
Establishment of labor camp and labor working condition.	L	L	L	M	M		L	L	L	M							L	P	M		L
Operation of DG sets		M	L	L						L											L
Access road construction		M	L	L	L		M	L		L							M	P	L	L	L
Site Clearance	L	M	L	M	M	L	M			L						L		P		L	M
Foundation excavation		M	M	M	M		M	L										P		L	M
Transformer yard construction		L	L	L	L													P		L	M
Substation construction		L	L	L	L													P		L	M
Laying of transmission lines	L	L	L	L	L											L	L	P	L	L	M
B. Operation Phase																					
Vehicular movement carrying Officials on site during routine inspection, maintenance and operation of solar power plant		L	L																		
Periodic maintenance of all solar modules (washing modules)							L	L													L
Maintenance of ancillary facilities such as store, yard, site office		L																			
Inspection of transmission lines																					L
Security of solar power plant in operation																		P			L
Operation of solar power plant																				L	L

6.2 Impacts on Physical Environment

6.2.1 Air Quality

During construction phase, various project components such as site preparation, transmission cable laying, switchgear, approach roads, internal road network and porta cabin construction will require land clearing, levelling, excavation, grading activities, vehicle movement and DG set operation. This results in an increased level of dust and particulate matter emissions, which in turn will directly and temporarily impact ambient air quality. If improperly managed, there is a risk of nuisance and health effects to construction workers onsite and to a lesser extent to nearby receptors from wind-blown dust (on the village access roads) due to transportation of raw materials. However, most of these project activities are expected to be restricted within the project boundary. Further, the movement of vehicles carrying raw materials on unpaved area within the project site and on access road causes fugitive dust emission and may extend to surrounding of project site like nearest settlements. Hence, the distribution of impact can be considered medium, duration of impact is short an intensity of the impact as medium. Since the impact is widespread, but for short duration and of low intensity, the impact can be termed of a **Moderate** significance. But, the impact is reversible, and temporary in nature, if the following mitigation measures are adopted.

Mitigation Measures:

- Vehicles speed to be restricted to 20-30 km/hr on unpaved road.
- Raw material should be covered with tarpaulin sheet during transportation and in storage area
- Water sprinkling on unpaved area but ensure use of tanker water purchased from suitable authorised vendor only.
- Fine materials should be transported in covered vehicle.
- All the project vehicles shall have valid Pollution Under Control (PUC) certificate. Ensure regularly maintenance of project vehicles during construction and operational phase
- Turn off the machineries when not in use

Operational Phase:

During operational phase, there would be minimal vehicular movement about 10-15 nos. project vehicles for O&M purpose. Since major source of emission into the ambient air will be absent during the operational phase therefore impact can be termed as insignificant.

Mitigation Measure:

Restrict movement of vehicles on unpaved surface within the site.

6.2.2 Soil Quality

These impacts are associated with the project activities such as piling of module mounting structure and storage of diesel, spent oil or transformer oil.

Construction Phase:

The project is under construction on open land. Loose top soil is generated due to excavation on project site due to site levelling for erection of module structures and access roads. The impact anticipated here is loss of top soil because of inappropriate storage. However, these activities and associated impacts are limited to be within the project boundary and during construction phase only. Considering the activities limited within the site, short duration of construction phase and low intensity, significance of impact is evaluated as **low.** Soil contamination may result due to accidental spillage and inappropriate

storage of diesel or used oil during construction phase. Improper handling of broken solar modules may also lead to soil contamination. However, distribution of impact within the project boundary and short duration of construction phase with **low** intensity makes impact of **low** significance and can be controlled with the recommended mitigation measures:

Mitigation Measures:

- Provide appropriate storage of top soil in an isolated and covered area to prevent its loss in high solar and runoff.
- Allow only covered transportation of top soil within the project site.
- Use top soil at the time of plantation and it can be given to nearby agricultural field after taking consent with the landowners/farmers.
- Plantation activities will be undertaken by HFE and its contractors.
- Store hazardous material like diesel and used oil in isolated room and on impervious surface to prevent seepage into project site soil
- Filling and transfer of oil to and from the container shall be on impervious surface.
- Broken solar panels should be stored on paved surface and be handed back to manufacturers/ authorised recycler.

Operational Phase:

During operational phase, project activities such as excavation and usage of chemicals such as diesel and spent oil will be absent except chances of accidental release of used oil from transformer, therefore impact associated with these activities such as top soil loss and soil contamination are minimal. Impact can be considered as insignificant. Improper handling of broken/ damaged solar modules may also lead to soil contamination.

Mitigation Measure:

- Broken solar panels should be stored in paved surface and be handed back to manufacturers/ authorised recycler.

6.2.3 Noise Quality

The environmental impact anticipated in the project is the increment in ambient noise level due to various project activities.

Construction Phase

The major noise generating sources in the project are operation of vehicular traffic, and construction equipment like dozer, scrapers, concrete mixers, generators, pumps, compressors, rock drills, pneumatic tools, and vibrators. The project site is located amongst barren fields with no continuous noise generating sources in the vicinity of the project site. Assuming, the operation of these equipment's is expected to generate noise in a range of 75 – 90 dB (A). However, distribution of impact is within the project boundary and short duration of construction phase with low intensity makes impact of **low** significance and can be controlled with the recommended mitigation measures:

Mitigation Measures

- Use DG set with acoustic enclosure
- Restrict major noise generating activities during night time 10:00 pm to 6:00 am
- Provide personal protective equipment (e.g. ear muffs) to all workers wherever noise is generated due to machinery operation.

- Regular maintenance of project vehicles.

Operational Phase:

Any significant noise generating activity during operation of solar power plant is absent therefore impact in terms of increment in ambient noise level is not anticipated during the operational phase of the project. However, distribution of impact is within the project boundary and short duration of construction phase with low intensity makes impact of **low** significance and can be controlled with the recommended mitigation measures:

6.2.4 Alteration of Natural Drainage Pattern

Topography of the project site can be characterized as mix (flat and undulations with multiple slopes) therefore levelling or filling is expected to alter the natural drainage pattern. A natural drain runs across the Project site from west to East. An access road passes through the natural drain with provision of a Culvert through which the natural flow of water is undisturbed. The artificial drains will be based on the slopes around the project site to carry the runoffs from washing of solar panels and other activities.

Construction Phase:

During construction phase, site levelling activities, construction of underground reservoir will be carried out which in turn may result in change of contour level and natural drainage system. Therefore, change in contour level may affect the flow of surface runoff from project site. After the levelling and paving, increment in surface runoff is expected which should be diverted to the natural drainage/canal exists in nearby area. If it is not carried out, then surface runoff from the site may affect nearby agricultural field which may cause social agitation.

Considering the extent of impact outside of project boundary and moderate intensity, impact is considered as major significance and following mitigation measures are suggested to implement:

Mitigation Measures:

- Project planning should consider temporary flooding or waterlogging of natural drainage due to heavy rainfall.
- Natural drainage should not be altered, and natural drainage should be kept unhindered all through the lifecycle of the project.
- Site levelling should be done with minimum alteration in contour level
- Design storm water drainage management system to discharge the surface runoff in the nearby natural drainage
- Natural drainage system must be kept undisturbed
- Flow of storm water will be maintained in such a way that there is no hindrance due to project activity to same.
- The exit of runoff from the project site in the adjacent surrounding land area should be restricted.

Operational Phase

In operational phase, project activities causing the alteration of natural drainage pattern will not exist, therefore associated impact is not anticipated. However, care should be taken to keep natural drainage channel uninterrupted.

6.2.5 Water Resources and its Quality

Water is required for various project activities, fulfilment of this water requirement through ground water may have impact on water availability. But, as reported, water will be available through local vendors from the borewells. The water will also be sourced from the borewell present at the site

Phase	Activity	Max. Consumption	Source
Construction	Civil works water requirement	11.6 KLD	Through water tanker (Authorize vendor) and Bore well.
	Domestic use – considering 150 labours	13.95 KLD	water tanker (Authorize vendor) RO water through authorize vendor for drinking purpose
Operation	Washing of solar panels (1.938 m2 each panel)	Reportedly 0.5 to 1 litre per module per month Considering 1 lit each for 69840 nos of modules, the water requirement comes around 69.84 KL per month.	Water tanker (Authorize vendor)
	Domestic use	2 KLD (approximate)	RO water through authorized vendor for drinking

Construction Phase

In the construction phase, water was required for construction activities and for domestic use. Further, construction activities were limited only to 6-7 months' duration therefore a long-term water requirement is not expected.

Domestic water requirement will be only for drinking, which will be met by packaged drinking water. Portable cabins are set up for site officials, equipped with urinals and toilets during the construction phase. Proper septic tanks will be constructed for discharge of waste water. During the construction works, there is a possibility of contaminated runoff from the site as the activities involve the installation of solar modules, underground cables, soil compaction, increased run off and sedimentation of surface waters. Any spillage of chemicals or disposal of waste in or near surface seasonal streams can cause water pollution issues in nearby areas.

Thus, taking into consideration of distribution of negative impact being widespread as the ground water resources are being used of the nearby village, as well as the runoff drainage may find its way into a nearby water body, duration medium and intensity as moderate, the impact on water resources will be considered as **Moderate** with the recommended mitigation measures

Mitigation Measures:

- The water for construction should only be sourced from authorized sources through tankers.
- The drainage will be designed in such way that natural storm water flow is maintained.
- It shall also be ensured that levelling of project site will not cause accumulation of surface runoff in adjacent surrounding areas.
- Conserve water at all project locations and ancillary facilities and if possible recycle and reuse water utilising every opportunity.
- No chemicals / oils to be stored near any water body.
- All chemicals / oils to be stored on impervious surface with provisions of spill containment kits.
- No waste will be disposed in any water body.

- No water will be sourced directly for project use or by workers.
- Workers will be trained for the same.
- The rainwater harvesting plan to support ground water percolation.
- Machinery and vehicles shall be thoroughly checked for the presence of leaks if any;
- To prevent contamination of water, for sewage management, toilets with septic tanks to be provided.
- Toilets and septic tanks should be located more than 500 m away from surface or ground water source.
- Periodic monitoring shall be carried out to ensure that the waste water is not finding its way into natural water channels.

Operational Phase

In operational phase, the water requirement would include cleaning of PV cells, domestic consumption of water for site personnel and security guards. The cleaning of PV cells would generate waste water which may find its way into the natural drainage hence contaminating the surface water body as well as the check dam where the channel drains in the adjacent village. taking into consideration of distribution of negative impact being in the buffer zone duration long and intensity as Low. impact on water resources will be considered as **Moderate** with appropriate mitigation measures.

Mitigation Measures:

- Water requirement should be estimated, and sustainable water sourcing must be planned
- Water must be sourced sustainably and responsibly
- Ensure optimal usage of water viz., storage and reuse of wash water after module washing and plantation of low water requirement species.
- Construction of rain water harvesting pit to recharge the ground water table.
- Measures should be taken to direct the entire waste water from cleaning of solar panels into the storm water drains.

6.2.6 Solid/ Hazardous Waste Disposal

Construction Phase:

Solid waste during the construction phase consists primarily of scrapped building materials, excess concrete and cement, excavated material, rejected components and materials, packing materials (pallets, crates, plastics etc.) and human waste. The broken solar panels will be properly packed and will be sent back to manufacturer/ approved vendors.

Labor camps have been set up where in cooking takes place. Hence solid waste as well as biodegradable waste is envisaged.

However, taking in consideration the impact within site, short duration and moderate intensity, the impact is considered as **low.**

Mitigation Measures

- The excavated material generated will be reused for site filling and levelling to the maximum extent possible.
- Ensure contractual obligation that necessitates broken solar panels will be accepted by manufacturer

- Use of proper segregation system so that food waste and recyclables viz. paper, plastic, glass, scrap metal waste etc. are segregated and stored in designated waste bins/ containers. The recyclables should be periodically sold to local recyclers while food waste will be disposed through waste handling agency.
- Waste oil from transformer will be collected and stored in paved and enclosed area and subsequently sold to SPCB authorised recyclers.

Operation Phase:

There will not be any substantial generation of solid waste, other than insignificant domestic waste, and broken solar panels. The broken solar panels will be sent back to the manufacturer. Considering the limited distribution of impact (within the site), long duration of activities and low intensity, significance of impact is assessed as low.

Mitigation Measures

- Use of proper segregation system so that food waste and recyclables viz. paper, plastic, glass, scrap metal waste etc. are segregated and stored in designated waste bins/ containers. The recyclables should be periodically sold to local recyclers while food waste will be disposed through govt. approved waste handling agency.
- Ensure broken solar panels are properly packed and sent back to manufacturer.

6.2.7 Impact on Land and Landuse

Construction Phase

During construction phase, impact on land use is anticipated due to various activities such as site levelling, filling and development of solar power plant. Land use classification will change into industrial land use after the development of solar power plant.

Construction activities that cause land disturbance include installation of solar module foundations, road preparation, excavation, etc. Excavation will be carried out to the minimum. The soil will be mainly excavated for laying foundation of module structures, site leveling and road work

Impact on natural drainage system may be anticipated. Further, impact will be of long term and permanent in nature, but impact will not be of adverse nature.

Mitigation Measures

- Changes in contour level should be avoided to the extent possible
- Maintain natural drainage system

Operation Phase

No impact on land use is envisaged during the operation phase.

6.2.8 Impact on Local Ecology

Construction Phase

The associated ecological impacts of the construction phase are due to following activities:

- Clearing and levelling of land
- Fencing of land
- Laying of solar module foundation and erection
- Laying of transmission towers and transmission lines

- Creating access roads

The impacts envisaged on ecology during construction phase are enlisted below:

- Loss of vegetation and habitat due to site clearance, road construction, building and PV array support construction etc.
- Erosion and clearing of topsoil (loss of habitat and habitat fragmentation).
- Disturbance/ displacement of animal's due to noise and movement of construction equipment and personnel.

Destruction and Loss of Vegetation

Project construction involves land clearance, leveling, etc. causing the loss of vegetation. The clearance of vegetation will be restricted to the project site. Clearing of vegetation is also required for access route and transmission lines. Natural vegetation in the study area is under pressure from poor rainfall resulting in annual natural forest fire as well as modified by fire started by grazers. As a result, only scanty and scrubby vegetation can be found in the project site, no large trees are present, and the level of impact generated from removal of this seasonal understory (ground cover) can be termed as negligible as the species are very common and have least conservation value.

Disturbance to Fauna

IFC Performance Standard 6 recognizes that protecting and conserving biodiversity - the variety of life in all its forms, including genetic, species and ecosystem diversity - and its ability to change and evolve. This Performance Standard reflects the objectives of the Convention on Biological Diversity to conserve biological diversity and promote use of renewable natural resources in a sustainable manner. Performance Standard 6 is designed to protect and conserve biodiversity.

Construction and associated activity like movement of vehicle will be temporary in nature. Most of the small mammalian species, birds and reptiles those were either sighted directly during primary survey or through secondary sources are very common and found all over the region. Temporarily, they may abandon the project activity area during the construction period and migrate to nearby areas. Thus, the impact on fauna of the area is considered to be minor.

Other mammalian species like sloth bear are distributed in specific habitats within the study area which are relatively free from anthropogenic activities. Proposed project site is not their suitable habitat or any suitable den site or cavern was recorded from the project site. During construction period due to added noise and vehicular movement these animals may temporarily move away from adjacent suitable habitats like forested hillocks but may recolonize once the construction phase is over.

As a preventive measure HFE has constructed 6ft high fencing with lighting along the fence as a preemptive measure to prevent man animal conflict.

Moreover, project area is not a designated or qualifying site of national and international importance for biodiversity the impact on disturbance to fauna of the area is of minor significance.

Significance of Impacts

Due to influx of labor and project personal during the construction phase, there is a probability of "man animal conflict". But the impact would be temporary and expected to be limited to the construction phase only.

The impact on fauna and flora will have low intensity with a local spread for a short duration which will result in an overall low impact without mitigation. However, with proper implementation of suggested mitigation the impact can be reduced to insignificant.

Mitigation Measures

The following measures should be considered in the project design to mitigate the impact during construction phase due to the project:

- Labour camp should be located as far as possible from the Reserved Forest areas.
- All project activities shall be undertaken with appropriate noise mitigation measures to avoid disturbance to faunal population in the region.
- Activities generating high noise shall be restricted to day time and will be mitigated to minimize the noise level outside the site boundary.
- Movement of construction and transport vehicles shall be restricted to dedicated paths to minimize any harm to small mammals within the site.
- Nigh time movement of project related vehicles must be restricted along the highway passing through the adjacent forests.
- Transportation of construction material shall be restricted to day time hours to minimize noise and disturbance to fauna in the area.
- General awareness regarding wildlife shall be enhanced through trainings, posters, etc. among the staff and labourers.
- Strict prohibition shall be implemented on trapping, hunting or injuring wildlife within subcontractors and shall bring a penalty clause under contractual agreements.
- Camp and kitchen waste shall be collected and disposed in a manner that it does not attract scavenging wild animals.
- Temporary barriers shall be installed on excavated areas.
- The footprints of the construction activities shall be kept to minimum to reduce disturbance to flora and fauna.
- Forest department must be informed in case of any wildlife sighting or any incident involving wildlife.

Operation Phase

Impacts during operation phase are likely to be restricted to the maintenance activities within the project site like ground cover clearing under PV arrays and from internal road network within site. Apart from a relatively small direct loss of habitat, the shading of the soil by the solar panels is likely to impact reptile composition in these areas, as the shading is likely to alter soil temperatures which has direct implications for cold-blooded animals. Most reptiles are also sensitive to the amount of plant cover which is also likely to be affected by the arrays.

However, there is potential for avian distraction due to glare/ reflection from solar panels. PV solar energy facilities appear to be an “evolutionary trap” for birds who perceive them to be bodies of water on which they attempt to land. Insects, the prey of insectivorous birds, are also apparently attracted by this so-called “Lake Effect.” It might cause fatality or injury as birds contact the solar panels or surrounding ground as they attempt to land mistaking it for water (Upton, 2014). But the “lake effect” phenomena and its impact on avian fauna is very poorly understood, and detailed study is required to establish threat from such phenomenon.

Significance of Impacts

Considering the impact to have a distribution within site and low intensity, the impact significance is considered as low.

Mitigation Measures

- Vegetation clearing through brush cutting for maintenance activities shall be done manually wherever possible.
- Any cleared areas which vegetation cover do not have shall be re-vegetated with locally occurring species and monitored to ensure recovery is taking place.
- Vegetation that needs to be reduced in height shall be mowed or brush-cut to an acceptable height, and not to ground level except where necessary.
- General awareness regarding wildlife shall be enhanced through trainings, posters, etc. among the staff and labourers.
- Solar panels shall have an anti-reflective coating to minimize the light reflecting off the panels so that there is very less impact due to glare from the panels.
- Moreover, to minimize effect of “Lake effect”, visual frightening techniques like “Scare crow” may be considered to frighten any bird trying to land on panels and prevent birds from landing.
- Fencing and lighting along the project boundary must be properly maintained all through the project lifecycle.
- Regular contact with forest department must be maintained to get updated information regarding wildlife movement.

6.3 Socioeconomic Impact

Socio-economic impact assessment is designed to assist communities in making decisions that promote long-term sustainability, including economic prosperity, a healthy community, and social wellbeing. To assess and understand the social impacts associated with the project, social indicators have been identified and analyzed.

6.3.1 Loss of Land/ Livelihood Conflict

Construction Phase

As observed the project area is predominantly barren and rocky. The project site is an open vast area with mild undulations. Land in the project influenced area was predominantly unused. Agriculture in the area is majorly dependent on rain and large portion of the land remains dry most part of the year. Overall irrigation scenario is not in the optimal state in the area. There was no habitation or cultivation field present in the project site.

Hence, taking the distribution of impact as within site for short duration and medium intensity, the impact significance can be termed as **‘Moderate’**.

Mitigation Measures:

- Providing preference for livelihood opportunities to the families who lose their land due to the project activity.
- Stakeholder engagement plan and community development plan should be implemented for project if possible.
- It should be ensured that maximum employment is given to the locals w.r.t their capacity and skills.
- Grievance Redressal Mechanism is being followed onsite. Complaints from the locals is being registered, investigated and resolved.

Operation Phase:

There would be no impact on land during operation phase. There would be a requirement of security guards for plant site, hence local employment opportunity would be generated, and this would be a positive impact of the project as it would enhance the economic opportunities to the locals.

Mitigation Measures:

- Based on need assessment, CSR initiatives should be implemented in the project affected villages.
- Community development plan should be implemented.
- It should be ensured that employment is given to the locals w.r.t their capacity and skills, wherever possible.
- Grievance Redressal Mechanism (GRM) should be followed onsite. Complaints from the locals should be timely registered, investigated and resolved.

6.3.2 Engagement of Local and Migrant Labour

Construction Phase:

The social impact associated with the engagement of local and migrant labor in the project is conflict between labor and contractor or developer which in turn may result in suspension of project and reputational risk on project developer. Considering the project in construction phase indicators have been discussed to provide sense of what should not be done with respect to labor engagement. The issues discussed here in the form of indicators IFC PS 2 and Indian Labor Act. The distribution of impact is buffer area, duration is short, and intensity is moderate, the impact significance can be termed as **"Moderate".**

Considering the sensitiveness associated with the engagement of child, forced labor, HFE should laid down policies through which it should demonstrate compliance to all the above factors. Its contractors should be made aware of all its policies for labor requirements and incorporated in their contracts prior to the starting of the project.

Mitigation Measures:

- Employment will be provided to local people wherever possible, especially as unskilled construction workers and security guards
- The project proponent should include clause or provisions related with non-engagement of forced and child labour, gender equity, non-discrimination on employment and opportunity and freedom to express their view in contractor's agreement and HR policy
- Project proponent through its contractors should ensure that labour is being adequately paid by contractors. Also ensure that wages are being paid as per the requirement of minimum wages act
- Project proponent will conduct internal audits as when required to monitor the performance of contractor.
- Project proponent through the contractor will inform the labour about emergency preparedness plan and communication system to be followed during emergency.
- Project proponent through contractor should ensure that labour receive training on health and safety issues involved in the project.

Operation Phase

Locals will be hired as security guards for the project site. This will enhance the local employment and would be a **Positive Impact.**

6.3.3 Labour Camp (Onsite and offsite)

Construction Phase:

There may have some chances that conflict between the migrated labors and the local community arise. Considering the possibilities of such conflicts and the existing situation the distribution of impact is buffer area, duration is short, and intensity is moderate, the impact significance can be termed as **"Moderate"**

Mitigation Measures:

The project proponent has setup onsite labor camp for migrated labors employed through contractors to restrict the interaction between them with local community as to avoid any conflict.

6.3.4 Social Issues Regarding ROW

Construction Phase:

It was observed during site visit the land for 20 MW solar power project is located in isolation and far distant from any human habitation and/ or cultivation field. Hence, there is no chance regarding issues arise on Right of Way for transmission line etc. and thereby obstruction of places of importance at entre of the project site. Considering the existing present condition and the records, information that has been received during site visit from the Project Proponent the impact significance can be termed as **"Low".**

Mitigation Measures:

- The layout for access roads and transmission lines should consider minimum land requirement and should minimise use of agricultural land and avoid human habitation;
- Site Management should ensure that all agreements will be executed properly and documented
- Any waste generated during the construction phase should not be accumulated near the religious structure as this might affect the sentiment of the locals

6.3.5 Community Engagement

Construction Phase:

There are chances that the local community's interest may impact with any sort of undue activities. Considering the future possibilities of such impacts the impact significance can be termed as **"Moderate".**

Mitigation Measure:

- The Projects construction phase efforts will be made to engage with the community through the Panchayati Raj Institution representatives and key identified leaders of the community at site area village in Madhugiri Taluk of Tumkur district.

6.3.6 Occupational Health & Safety Impact

Construction Phase:

There are chances that the local community's interest may impact with any sort of undue activities. Considering the future possibilities of such impacts the impact significance can be termed as **"Moderate".**

Mitigation Measure:

- The Projects construction phase efforts will be made to engage with the community through the Panchayati Raj Institution representatives and key identified leaders of the community at site area village in Madhugiri Tehsil of Tumkur district.

Occupational Health & Safety Hazards for workers

Occupational Health and safety hazard associated with project activities (during construction) in Solar Power Plants are identified as follows:

- ***Electrocution and Firing due to short-circuit:*** It should be ensured that proper training be given to workers before they initiation of any project activity as well as the workers wear their appropriate Personal Protective Equipment (PPE) viz. helmets, safety jackets, safety shoes, goggles, gloves etc. as per their nature of work involved.
- Possible injuries associated with working with transmission line laying
- Accidents during cutting, chipping and piling
- ***Physical injuries:*** These can occur when workers involved in loading/unloading activities don't adhere to proper ergonomics discipline. Injuries like muscle strain, ligament tear, slip disc can occur which may prove to be fatal.
- ***Trip and fall hazards:*** The injuries are like those discussed under working at height. They occur when workers trip over/fall when debris etc. lies in the walkway/ passages.
- ***Diseases due to unhygienic condition:*** It should be ensured that proper and adequate number of toilets should be constructed for the labourers so that hygienic conditions prevail in the site area.
- ***Violation of privacy and dignity of women involved:*** There can be a violation of the privacy and dignity of the women involved in the work force as there is no enclosed or exclusive provision for women. HFE, following their own Environment, Health and Safety ("EHS") Management Policy and abide by the IFC Standards, will ensure that the dignity and privacy of women is maintained through separate and protected provision for sanitation facilities during operation phase of these project as well as in other future projects.

Also, there can be dissatisfaction among the labourers due to many conflicts/issues unresolved, hence there should be a complaint register onsite. HFE or their contractor have ensured to have regular medical check-up of their hired laborer's. HFE has a tie up Sri Raghavendra Hospital for any health care related concerned and emergencies. Hence, taking the distribution of impact as within site, duration as short and intensity as moderate, the impact significance can be taken as **"Moderate".**

Mitigation Measures:

- All material will be arranged in a systematic manner with proper labelling and without protrusion or extension onto the access corridor.
- Loading and unloading operation of equipment should be done under the supervision of a trained professional.
- All work at height to be undertaken during daytime with sufficient sunlight
- Ensure effective work permit system for critical activities
- Proper PPEs should be provided to workers handling welding, electricity and related components. Workers handling electricity and related components shall be provided with shock resistant gloves, shoes and other protective gears.
- There should periodical training to educate the workers for proper use of PPE's.

- There should be proper monitoring system to ensure that each and every individual labourer are using the PPEs properly.
- Fire extinguishing equipment should be provided in adequate number on site to handle any possible fire outbreaks
- An accident reporting, and monitoring record should be maintained
- Display of phone numbers of the city/local fire services, etc. at site should be done
- The labour engaged for working at height should be trained for temporary fall protection devices
- There should be arrangement for hygienic and scientific sanitation facilities for all the labourers working in the site.
- There need to have enclosed and exclusive provision for women to protect the privacy and dignity of the women involved in the work force.
- Provision of the Contract Labour Rules, 1971 require the operator of a construction site to provide adequate sanitation facilities to worker within the site premises (Latrine: One per 25 male/female; Urinal One per Male/female).
- HFE should ensure that labour receive training on health and safety issues involved in the project.
- HFE should inform the labour about Emergency Preparedness Plan (EMP) and communication system to be followed during emergency situation.
- HFE should involve their Welfare Coordinator.

Operation Phase: Occupational Health & Safety Hazards for Workers

Occupational Health and safety hazard associated with project activities (during operation) in Solar Power Plants are identified as follows:

- ***Electrocution/ Electrical Shocks:*** These may occur when the skin meets live power lines etc. The severity of the burn depends on voltage, current, time of contact etc.
- Firing due to short-circuit
- Diseases due to unhygienic condition
- The impact significance can be taken as Moderate.

Mitigation

- Provide and ensure wearing of personal protective equipment's viz., gloves, helmets, ear plug, safety belt etc.
- Ensure effective work permit system for critical activities such as electrical work and working at height
- Prepare emergency communication system and emergency preparedness plan
- Ensure proper sanitation facilities.

6.3.7 Labour Accommodation (Onsite and offsite)

Construction Phase

As per International Labor Organization (ILO) *"Housing provided to workers as part of the employment contract should meet certain minimum specifications in respect of the nature and standard of the accommodation and facilities to be made available. The guidelines and recommendation facilities like*

drinking water, separate kitchen, fans, beds, toilets and power supply has been provided to the workers/ labors in the labor camp set up in the project site." [19]

Considering the future construction on anvil HFE should distinctly and exclusively consider and apply as far as possible the recommendations of ILO and other relevant Apex Bodies the following factors should be followed in the Solar Power Project site located at the designated project area.

- ***Housing space:*** Adequate housing space for labours will be provided. As per International Labour Organisation (ILO) standards, the floor area of workers' sleeping rooms should not be less than 7.5 square metres in rooms accommodating two persons, if a room accommodates more than four persons, the floor area should be at least 3.6 square metres per person.
- Adequate supply of safe potable water;
- Sanitation facilities for contract labourers: Proper functional toilets will be provided in the labour camp. The disposal of waste water is managed by the septic tanks and soak pits constructed in the camp.
- Proper and adequate drainage system to drain out the waste water to avoid any kind of contamination or spread of disease thereby;
- Adequate arrangements for comfortable and secure living within the sleeping room
- Arrangements for secured locker etc. for safe keeping of the labours' individual and personal belongings. which can be locked by the occupant to ensure privacy;
- Common Hygienic dining rooms, canteens or mess rooms, located away from the sleeping areas;
- There must have arrangements for safeguard of health issues and immediate arrangements for addressing accidental incidents.

Mitigation Measures:

- HFE will formulate their own Environmental Social Management System (ESMS). Following that an Emergency Preparedness Plan to deal with health and safety issues during project life cycle of a Solar Power Plant will be built.
- HFE will ensure that they will abide by the policy of safe guarding all issues regarding the health and safety of the workers who will be working under the Projects.
- ***Emergency Preparedness and Plan for On-Site Emergencies:*** the plan will define nature of emergencies that can be encountered during operation of a solar plant. Requirements of an Emergency Control Centre (ECC), firefighting facilities and medical facilities will also be detailed out. Roles and Responsibilities of personnel at site, communication channel to be followed, and procedures for different emergencies will also be detailed. HFE should ensure that all its hired contractors should abide by the requirements of plan formulated like undertaking mock drills, identification of first aiders and fire fighters, display of emergency numbers onsite etc.

6.3.8 Impact on Cultural/ Archaeological Site

The site does not contain any archaeological monuments or sites as per the Archaeological Survey of India. No historical and cultural monuments will be affected by the 20 MW Soler Project.

No such evidential proof was found even during field visit in the site area village of Malagondanahalli Taluk of Tumkur District. Though, to ensure whether alike remnants of old civilization are present and/

[19] *Source: Labour Accommodation Standards, ILO*

or in case of accidental discovery of artefacts during construction activities, chance find procedure is required to be planned and implemented.

No impact is envisaged both during construction and operation phase.

6.3.9 Access to Common Property Resources

Another issue which may cause social impact on indigenous people in terms of conflict between project developer and local community is restriction on community to access the common property resources, any physical structure with historical, religious and aesthetic significance was also not found close to the project area villages. Considering the absence of resources with cultural significance, disturbance to physical cultural resources and impact associated with it, is not anticipated for both the construction and operation phase.

As informed by the HFE representative, the access roads will be strengthened and further maintained till the project cycle within the villages.

No impact is envisaged both during construction and operation phase.

6.4 Climate Change Effect on Solar Power Plant

Energy from solar power plant is directly related to fluctuating weather conditions. The vulnerability of solar power components due to climate change has been studied in various researches and publication. In Solar power plant, photovoltaic panels with an operating life time of 25 years are vulnerable to hail, solar and extreme temperature (Patt et al. 2010). Solar cell output usually rated at 25^0C and it decreases for each temperature rise of 1^0C after that hence increase in temperature will decrease the performance of solar cell. As the solar radiation, assessment has been conducted for the project and module has been designed in line with the assessment finding therefore solar power performance is not anticipated to reduce unexpectedly over the period of 25 years (project life cycle).

Cloud cover is another factor which influence the performance of solar panel's output and this performance can decrease by 40-80% within a few seconds. However, it increases dramatically as the sky clear (Kleissl 2010).

Higher solar radiation can also increase dust particles deposit over the panels which decrease solar photovoltaic cell output (Goosens and Van Kerschaever 1999), but higher solar radiation can also cool the modules, increasing efficiency and output.

Another component of solar power plant is inverter. Studies, consistently show that the inverter, which converts direct current power output into alternating current (DC to AC), is the most unreliable component of a photovoltaic system, accounting for up to 69% of unscheduled maintenance costs (Patt et al. 2010). However, they are not usually directly exposed to the weather and are not especially vulnerable to climate change.

6.5 Cumulative Impacts

HFE have purchased 113 acres of land. As land acquisition is involved in the solar power project, there are possibilities of impacts on the private land owners. All the settlements are located at a distance from the solar plant, hence no issues regarding the same is noticed there. Also, no obstruction to common property resources are anticipated. One of the cumulative effects is solar reflections known as Glint and Glare. With a continuous increase in both numbers and sizes of such PV developments cumulative concerns are likely to increase in the near future.

Land and access to pasture land may also be impacted considering the large trench of land being acquired for 20 MW solar power project. Safety concerns also needs to be addressed cumulatively, whereas simultaneous construction may result in deterioration of environment and safety concern.

For total 20 MW, solar power project water will be required for construction phase as well as water will be used for cleaning of PV cells and other regular activity. Water for the entire project will be provided by local vendors. During operational phase, impact will be restricted mostly within the site, long duration with moderate intensity, significance of impact is assessed as **low**.

As a whole, 20 MW Madhugiri Solar project is going to occupy approximately 113 acres land. Site development activity is expected to produce some temporary pressure on the local biodiversity, mostly due to noise and dust generation. There is also some scope of “man animal” conflict, but with proper prevention and sensitization process this risk can be reduced significantly.

There would be no significant light sources on the project sites; lighting would be provided at substations and other structures only and would be shielded to prevent spillover. Glare impacts are minimized by the inherent design qualities of the PV panels, which reduces reflectivity and the potential for visual discomfort or impairment. Additional PV panels in the area would not result in a greater intensity of glare due to the panel design and the law of reflectivity, which would not direct any reflected light along the ground surface. Accordingly, no significant cumulative impact would result from the cumulative scenario to which the Project’s incremental impact could contribute to lighting or glare. As a result, impacts from operation of the proposed project would have a less than significant impact on aesthetics.

The project would change the overall character of the region and would contribute to the conversion of rural agricultural lands to landscapes with industrial character. However, no existing highly scenic views or aesthetically unique or distinctive landscape would be forfeited by the introduction of these types of projects. The project represents conversion from a natural environment of agricultural fields to build environment with an industrial character, masked with tan colored fencing. The area is unpopulated, and no residents would be subject to alteration of views in association with the proposed solar projects. Therefore, there would be a weak direct cumulative impact to visual resources.

At the end of the proposed project’s useful life of approximately 25 years, it would be decommissioned and dismantled. Cumulative impacts associated with decommissioning of the proposed project would include the removal of all project components, including Gen-tie Line structures and wiring, as well as all towers, wiring, PV panels, and inverter structures. After removal of project components, the project sites would return to agricultural uses, in accordance with the Agricultural Reclamation Plan. Visual recovery from land disturbance of closure and decommissioning would likely occur within a few years to allow for regrowth of vegetation. Therefore, decommissioning would temporarily impact the proposed project’s contribution to local and regional cumulative impacts on visual resources. Temporary direct and indirect cumulative visual impacts would occur until re-growth of vegetation in the area is established. However, as discussed above, the project sites are void of highly scenic views or aesthetically unique or distinctive landscape, and impacts to aesthetics would remain be less than significant. When considered in combination with the impacts of other projects in the cumulative scenario, the Project’s incremental contribution to aesthetics would not be cumulatively considerable.

7 ENVIRONMENTAL & SOCIAL MANAGEMENT PLAN

The Environment and Social Management Plan specifies measures for addressing the limited negative risks and impacts and for enhancing the beneficial impacts. In addition, organizational capacity and training requirements, required to check and ensure effectiveness of the plan throughout the lifecycle of the project, have also been discussed.

HFE is committed to implement an effective Environmental and Social Management System (hereinafter referred as ESMS) to continuously manage and communicate the potential social and environmental impacts and risks imposed on the project employees (direct and indirect) and the local communities residing in the immediate vicinity of the project area. The outcomes of the Environmental and Social Impact Assessment of the project have been used to formulate an Environment and Social Management & Monitoring Plan for the project, presented in **Table 7-1**.The Plan specifies measures for addressing the limited negative risks and impacts and for enhancing the beneficial impacts. In addition, organizational capacity and training requirements, required to check and ensure effectiveness of the plan throughout the lifecycle of the project, have also been discussed.

7.1 Organizational Structure and Responsibilities

Organizational structure at project level represent the communication and working relationship at project level. At project level, implementation of management plans and corrective actions are the responsibilities of EHS specialist. In construction and operational phase, site EHS specialist will supervise the third party EHS engineer performance to implement the management action plans in coordination with site manager. On the performance and completion status, site EHS reports to Head EHS.

Social, Health, Environment and Safety Management System (SHES) Committee:

SHES committee is formed at corporate level to review the performance of project on environmental, health, safety and social aspects. Regular updating of SHES is the responsibility of SHES committee in addition to support the top management system to achieve the goal as committed in the Policy. SHES committee is formed of one member from HR, Finance, Project and Quality Health, Safety and Environment (QHSE) departments. The QHSE Head is the SHES coordinator for implementing this SHES and will need to interface with several other departments to ensure smooth and efficient functioning of the SHES. HFE employees are responsible for compliance with EHS regulations and requirements in their work areas.

Key responsibilities are as follows:

- Work in conformance to organizational policies for environmental and social performance
- Understand the SHES
- Complete training on environment, health, safety and social aspect according to work area
- Reporting Environment, Health, Social and Safety (EHSS) related issues & incidents in respective area.
- Ensure fulfilment of requirement of Hero's ESMS through contractors by providing them training and information on E&S management system (if required) and making necessary provision in their agreement.

Given the footprint of the project will be limited to the sites and their immediate vicinity and the range of stakeholder's dependent on the project site for various usages, HFE should ensure that its hired contractors deploys a social officer or Site In-charge to manage social (including labour and community) issues.

7.2 Training of Personnel & Contractors

HFE should ensure that the job specific training and EHS Induction training needs should be identified based on the specific requirements of ESMS and existing capacity of site and project personnel (including the contractors and sub-contractors). Special emphasis shall be placed on traffic management, stakeholder's engagement and grievance redressal. General environmental awareness shall be increased among the project's team to encourage the implementation of environmentally sound practices and compliance requirements of the project activities. This will help in minimizing adverse environmental impacts, ensuring compliance with the applicable regulations and standards, and achieving performance beyond compliance. The same level of awareness and commitment shall be imparted to the contractors and sub- contractors prior to the commencement of the project.

An environment and social management training programme shall be conducted to ensure effective implementation of the management and control measures during construction and operation of the project. The training programme shall ensure that all concerned members of the team understand the following aspects:

- Purpose of action plan for the project activities;
- Requirements of the specific Action Plans
- Understanding of the sensitive environmental and social features within and surrounding the project areas;
- Aware of the potential risks from the project activities.
- A basic occupational training program and speciality courses shall be provided, as needed, to ensure that workers are oriented to the specific hazards of individual work assignments.
- Training shall be provided to management, supervisors, workers, and occasional visitors to areas of risks and hazards.
- Workers with rescue and first-aid duties must receive dedicated training so as not to inadvertently aggravate exposures and health hazards to themselves or their co-workers.
- Through appropriate contract specifications and monitoring, the employer shall ensure that service providers, as well as contracted and subcontracted labour, are trained adequately before assignments begin.

7.3 Monitoring

In order to implement the ESMP, the on-site team should adhere to a time-bound and action-oriented Environmental and Social Action Plan to implement the mitigation measures provided for each of the identified environmental and social impacts. This ESMP should be monitored on a regular basis, quarterly or half-yearly and all outcomes would need to be audited in accordance with existing EHS commitments.

The monitoring process should cover all stakeholders including contractors, labours, suppliers and the local community impacted by the project activities and associated facilities thereby increasing the effectiveness of suggested mitigations measures. HFE should ensure that all the contractors comply with the requirements of conditions for all applicable permits, suggested action plans and scheduled monitoring. The inspections and audits should be carried out by an internal trained team and external agencies/experts. The entire process of inspections and audits shall be documented and key findings of which should be implemented by the proponent and contractors in their respective areas.

7.3.1 Performance Monitoring and Measurement

The purpose of monitoring is to track the performance of project against the requirement in the SHES. The monitoring outcomes will provide the basis for establishment of key quantitative and qualitative measures for social, environment, health and safety indicators.

As per Hero's Environment and Social management framework, the site level Environment manager will undertake the performance monitoring and will send the analysis report to the SHES Coordinator for performance review. After performance review, SHES coordinator should take necessary actions wherever required, to ensure effective implementation of SHES. The recommendations will be conveyed by SHES coordinator to the site based HSE specialist. The performance monitoring should be carried out annually at each assets level.

7.4 Documentation & Record Keeping

Documentation and record keeping system have been established to ensure updating and recording of requirements specified in ESMP. Responsibilities are assigned to relevant personnel for ensuring that the ESMP documentation system is maintained and that document control is ensured. The following records should be maintained at site:

- Documented Environment Management System;
- Legal Register;
- Operation control procedures;
- Work instructions;
- Incident reports;
- Emergency preparedness and response procedures;
- Training records;
- Monitoring reports;
- Auditing reports; and
- Complaints register, and issues attended/ closed

Table 7-1: Environment Management Plan

SN	Aspect	Impact	Impact Intensity without mitigation	Action	Impact Intensity with mitigation	Monitoring/training Requirement	Responsibility
CONSTRUCTION PHASE							
A	**Physical Environmental Management Plan**						
1	**LANDSCAPE AND VISUAL**	• Visual and landscape impacts due to presence of elements typical of a construction site such as equipment and machinery.	**LOW**	• Ensure the construction site is left in an orderly state at the end of each work day • Construction machinery, equipment, and vehicles not in use should be removed in a timely manner to the extent possible • Maintain uniform size and design of solar panel • Solar panel orientation to be done in such a way that nearby settlements does not face the sun glare problem • Proper handling of waste streams	**NO IMPACT**		Contractor under the supervision of HFE's Personnel
2	**WATER RESOURCE AND QUALITY**	• The water to be sourced from local vendors through borewells • There is a borewell at the site which is used to extract minimal quantity of water. • Construction activities will be limited only to 6-	**MODERATE**	• Periodic monitoring shall be carried out to ensure that the waste water is not finding its way into ground water. • Construct rain water harvesting pit to recharge the ground water • Reduce the frequency of washing to save water • If possible, collect the water after module wash and reuse it for module washing • Conserve water at project site and ancillary facilities and if possible	**LOW**	• Maximum efforts should be made to reuse and recycle water to reduce water consumption. • Machinery and vehicles shall be thoroughly checked for the presence of leaks if any; • Storage of oil on site to be checked	Project Developer/ Contractor under the supervision of HFE's Personnel

SN	Aspect	Impact	Impact Intensity without mitigation	Action	Impact Intensity with mitigation	Monitoring/training Requirement	Responsibility
		7 months' duration therefore a long-term water requirement is not expected. • Possibility of contaminated runoff from the site entering the nearby soil/water bodies. • Waste water from toilets constructed for site office can contaminate groundwater • Considering the limited distribution of impact (within the site), short duration of activities and low intensity, significance of impact is assessed as Low.		recycle and reuse water utilising every opportunity. • Restoration plan to accommodate the loss of ground water. • Paved impervious surface and secondary containment to be used for fuel storage tanks • Adequate drainage of road based on road width, surface material, compaction and maintenance • Leak-proof holding tanks for sanitary waste water to protect the shallow ground water level. • Waste water holding tanks / septic tank to be located at more than 500 m away from bore wells or any other underground water holding tanks.			
3	**AIR QUALITY**	• Fugitive Dust due to movement of project vehicles	**MODERATE**	• The Contractor shall take necessary precautions to minimize fugitive dust emissions from operations involving excavation, grading, and clearing	**LOW**	• Periodic monitoring of air quality during construction phase	Project Developer/ Contractor under the supervision of

SN	Aspect	Impact	Impact Intensity without mitigation	Action	Impact Intensity with mitigation	Monitoring/training Requirement	Responsibility
		and site clearance • Emission from Diesel Generators		of land and disposal of waste. These would include short term measures e.g. sprinkling of water to long term measures e.g. turfing and landscaping. • Practices water sprinkling wherever required on unpaved area but ensure use of tanker water purchased form authorized vendor only. • The contractor shall place construction material in a manner that will minimize dust generation. If possible, material shall be stockpiled against wall so as to work as wind break. • Vehicles speed to be restricted to 20-30 km/hr on unpaved road. This will reduce dust emission. • Raw material should be covered with tarpaulin sheet during transportation and in storage area • Practices water sprinkling wherever required on unpaved area. • All the project vehicles shall have valid PUC certificate • Ensure regular maintenance of project vehicles during construction and operational phase • Turn off the DG sets & machineries which are not in use			HFE's Personnel

SN	Aspect	Impact	Impact Intensity without mitigation	Action	Impact Intensity with mitigation	Monitoring/training Requirement	Responsibility
				• DG sets preferably should be placed away from settlement area. • It will be ensured that exhaust emissions of construction equipment adhere to emission norms as set out by MoEFCC/ CPCB.			
4	**SOIL QUALITY**	Top Soil Loss	**LOW**	• Provide appropriate storage of top soil in an isolated and covered area to prevent its loss in high wind and runoff. It is essential for top soil conservation • Allow only covered transportation of top soil within project site. • Use top soil at the time of plantation on the approach road. • Construction debris shall be reused in paving on site approach road to prevent dust generation due to vehicular movement • Re-vegetation shall be done in the area after the completion of construction, in order to reduce the risk of soil erosion	**NO IMPACT**	• The workforce shall be sensitized to handling and storage of hazardous substances viz. fuel oil, machine oil/fluid etc. • The workers engaged in handling hazardous substances shall be briefed about the possible hazards and the need to prevent contamination.	Project Developer/ Contractor under the supervision of HFE's Personnel
		Soil Contamination		• In case of any accidental spill, the soil will be cut and stored securely for disposal as hazardous waste. • Store hazardous material (like used oil) in isolated room with impervious surface.			

SN	Aspect	Impact	Impact Intensity without mitigation	Action	Impact Intensity with mitigation	Monitoring/training Requirement	Responsibility
				• Filling and transfer of oil to and from the container shall be on impervious surface. • Waste disposal grounds that are in use by the local people should be identified and permission from local administration for use of the same needs to be obtained for disposing domestic wastes.			
5	**NOISE LEVEL**	• Disturbance to habitants • Vehicular noise from heavy vehicles utilized to deliver construction materials and solar plant parts • Noise from DG sets • Construction noise from using mobile equipment, and concrete mixing	**LOW**	• Regular maintenance of construction machinery and equipment shall be carried out to ensure noise emissions are maintained at design levels. • Integral noise shielding to be used where practicable and fixed noise sources to be acoustically treated, for example with silencers, acoustic louvers and enclosures. • Keep stationary source of noise such as DG sets (during construction phase) at farthest point from the settlements • Restrict major noise generating activities during night time 10:00 pm to 6:00 am • Provide personal protective equipment to workers working near DG sets and other high noise source. • Local communities need to be informed about the vehicular movement before start of heavy vehicle carrying materials and	**NO IMPACT**	• It will be ensured that noise emissions of construction equipment adhere to emission norms as set out by MoEFCC/ CPCB • Ensured that heavy vehicles and equipment are not operated in the night time.	Project Developer/ Contractor under the supervision of HFE's Personnel

SN	Aspect	Impact	Impact Intensity without mitigation	Action	Impact Intensity with mitigation	Monitoring/training Requirement	Responsibility
				machines to site. Sensitive locations should be identified and avoided as far as possible from the route and if unavoidable, drivers should be informed to restrict speed at those locations. • Diesel generator sets, if used; will adhere to noise standards of MoEFCC.			
6	**SOLID WASTE AND HAZARDOUS WASTE**	• Contamination of land	**LOW**	• Distribute appropriate number of properly contained litter bins and containers properly marked as "Domestic Waste". • Domestic and construction waste like recyclables viz. paper, plastic, glass, scrap metal waste etc. will be properly segregated and stored in designated waste bins/containers and periodically sold to local recyclers • Any wastage/damaged part of solar panel will be sent back to panel vendor for disposal. • Hazardous wastes shall be stored in leak-proof containers and dispose, to disposal facilities registered with the Central Pollution Board.	**NO IMPACT**	Periodic EHS audits should be conducted to monitor the same	Project Developer/ Contractor under the supervision of HFE's Personnel
7	**CHANGE IN LOCAL TOPOGRAPHY**	• Alteration in natural drainage pattern	**MODERATE**	• Don't allow the considerable alteration of contour level • Provide alternatives to collect surface runoff from the project site during the monsoon period	**LOW**	• The drainage patterns of the area will be maintained. • Storm water drainage will be	Project Developer/ Contractor under the supervision of

SN	Aspect	Impact	Impact Intensity without mitigation	Action	Impact Intensity with mitigation	Monitoring/training Requirement	Responsibility
				• Don't allow exit of runoff from the project site in the adjacent areas. • Design storm water drain considering the natural contour level • Site preparation activities should be designed to avoid any significant elevation of the land or blocking or altering natural drainage channels in the project site. • Site preparation and development shall be planned only after a detailed drainage plan has been prepared for site. • If channels/drains get blocked due to negligence, it will be ensuring that they are cleaned especially during monsoon season.		planned around the site.	HFE's Personnel
B	**Ecological Environmental Management Plan**						
8	**ECOLOGY**	The construction activities will lead to loss of vegetation resulting in displacement of terrestrial species Disturbance to local livestock population	**MODERATE**	• All project activities shall be undertaken with appropriate noise mitigation measures to avoid disturbance to human as well as faunal population in the region. • Activities generating high noise shall be restricted to day time and will be mitigated to minimize the noise level outside the site boundary. • Recovery of ground story (mostly grasses) vegetation under the PV panels and in other places that do	**LOW**	Periodic EHS audits should be conducted to monitor the same	Project Developer/ Contractor under the supervision of HFE's Personnel

SN	Aspect	Impact	Impact Intensity without mitigation	Action	Impact Intensity with mitigation	Monitoring/training Requirement	Responsibility
				not need to remain cleared shall be encouraged to grow. • Movement of construction and transport vehicles shall be restricted to dedicated paths to minimize any harm to small mammals/reptiles within the site. • Transportation of construction material shall be restricted to day time hours in order to minimize noise and disturbance to fauna in the area. • General awareness regarding wildlife shall be enhanced through putting signage, posters, among the staff and laborer's. • Camp and kitchen waste shall be collected in a manner that it does not attract wild animals. • Temporary barriers shall be installed on excavated areas. • The footprints of the construction activities shall be kept to minimum so as to reduce disturbance to flora and fauna. • Planting native, fast growing trees on access roads and/or in nearby barren areas/ schools/ Panchayat office which may also give an alternate habitat to the faunal species especially the bird species and maintain the ecological balance			

SN	Aspect	Impact	Impact Intensity without mitigation	Action	Impact Intensity with mitigation	Monitoring/training Requirement	Responsibility
C	**Social Management Plan**						
1	**ENGAGEMENT OF LOCAL AND MIGRANT LABOR**	• Conflicts between labor and contractor	**MODERATE**	• Employment will be provided to local people wherever possible, especially as unskilled construction workers and security guards • HFE will include clause or provisions related with non-engagement of forced and child labor, gender equity, non-discrimination on employment and opportunity and freedom to express their view in contractor's agreement and HR policy • HFE through its contractors shall ensure that labor is being adequately paid by contractors. Also ensure that wages are being paid as per the requirement of minimum wages act • HFE shall include clause to ensure access of necessary basic amenities and facilities such as drinking water, kitchen, toilet and crèches (for female workers children) • HFE shall conduct internal audits as when required to monitor the performance of contractor. • HFE through the contractor inform the labor about emergency preparedness plan and communication system to be followed during emergency	**LOW**	Periodic EHS audits should be conducted to monitor the same	Project Developer/ Contractor under the supervision of HFE's Personnel

SN	Aspect	Impact	Impact Intensity without mitigation	Action	Impact Intensity with mitigation	Monitoring/training Requirement	Responsibility
				• HFE through contractor should ensure that labor receive training on health and safety issues involved in the project.			
2	**LABOR ACCOMMODATION (Onsite and offsite Labor camp)**	• Conflicts between labor and local community	**MODERATE**	• HFE to setup onsite labor camp for labors employed through contractors to restrict the interaction of migrated labor with local community as to avoid any conflict.	**LOW**	Grievance Redressal mechanism is being followed and monitored	Project Developer/ Contractor under the supervision of HFE's Personnel
3	**LAND PROCUREMENT**	• Loss of Land • Livelihood • Obstruction to places of relevance • Manhandling Natural Resources of Utility	**MODERATE**	• All the land required is purchased on the basis of willing to sell willing to buy. The land is 100% private. • It should be ensured that maximum employment will be given to the locals w.r.t their capacity and skills. • Implement the recommended complaint resolution procedure (Grievance Redress Mechanism) to assure that any complaints regarding project related components are promptly and adequately investigated and resolved • Provide some alternate way/road so that project should not obstruct the villagers access • The layout for access roads and transmission lines should consider minimum land	**LOW**	• HFE Energies Land and Project Team to understand mitigation measures • Construction contractors should adhere to social obligations, labor laws and international commitments • HFE through contract agreement, should ensure that the contractor should provide the migrant workers adequate information on expected social behavior and hygiene practices to be followed at site • Water usage should be monitored and	Project Developer/ Contractor under the supervision of HFE's Personnel Social Management team for grievance Handling

SN	Aspect	Impact	Impact Intensity without mitigation	Action	Impact Intensity with mitigation	Monitoring/training Requirement	Responsibility
				requirement and should avoid procurement of agricultural land; • Any waste generated during the construction phase should not be accumulated near the religious structure as this might affect the sentiment of the locals.		controlled to minimize the wastewater generation • HFE to ensure that all site personnel and migrant laborers avoid using any community infrastructure facilities like water bodies, electricity etc., without prior permission from the Panchayats	
4	**IMPACT ON INDIGENOUS PEOPLE AND ARCHEOLOGICALLY IMPORTANT SITES**	• Unrest among the community due to dislocation of any structure or thing of cultural belief Impact on indigenous people due to land intake from ST people and use of village resources	**No Impact**	No Impact	**No Impact**	-	-
5	**COMMUNITY ENGAGEMENT**	Community Empowerment	**MODERATE**	Given the short duration of the project construction phase efforts will be made to engage with the community through the Panchayati Raj Institution representatives and key identified leaders of the community.	**LOW**	Continuously throughout the project lifecycle. Grievance Redressal Mechanism should be followed, and grievance	Contractor under the supervision of HFE's Personnel / PRI representatives

SN	Aspect	Impact	Impact Intensity without mitigation	Action	Impact Intensity with mitigation	Monitoring/training Requirement	Responsibility
						register should be maintained onsite.	
6	**OCCUPATIONAL HEALTH AND SAFETY**	• Material handling and storage • Possible injuries associated with working with transmission line laying • Other occupational hazards • Accidents during cutting, chipping and piling • Physical injuries when workers involved in loading/unloading activities and don't adhere to proper ergonomics discipline. • Trip and fall hazards • Violation of the privacy and dignity of women involved in the work force.	**MODERATE**	• All material will be arranged in a systematic manner with proper labelling and without protrusion or extension onto the access corridor. • Loading and unloading operation of equipment should be done under the supervision of a trained professional • All work at height to be undertaken during daytime with sufficient sunlight • Proper PPEs should be provided to workers handling welding, electricity and related components. • Fire extinguishing equipment should be provided in adequate number on site to handle any possible fire outbreaks • An accident reporting, and monitoring record should be maintained • Display of phone numbers of the city/local fire services, etc. at site should be done • The labor engaged for working at height should be trained for temporary fall protection devices	**LOW**	• labor engaged for working at height should be trained for temporary fall • All the workers should be made aware of the possible occupational risks/hazards by the way of an OHS training/awareness program • Accident reporting, and monitoring record is being maintained on site • The labor engaged for working at height are being trained for temporary fall an mishaps are being recoeded. • All the workers have been made aware of the possible occupational risks/hazards by the way of an OHS training/awareness program • An accident reporting, and	Contractor under the supervision of HFE's Personnel

SN	Aspect	Impact	Impact Intensity without mitigation	Action	Impact Intensity with mitigation	Monitoring/training Requirement	Responsibility
		• Other occupational hazards • Diseases due to unhygienic condition				monitoring record should be maintained • Proper hygienic and scientific sanitation facilities for all the laborer's working in the site with spate exclusive arrangements for men & women to ensure the privacy and dignity of all individuals • GRM is properly maintained and followed on site. • Contractor should inform the labor about Emergency Preparedness Plan (EMP) and communication system to be followed during emergency situation.	
OPERATION PHASE							
A. PHYSICAL ENVIRONMENT MANAGEMENT PLAN							
1	**HAZARDOUS WASTE MANAGEMENT**	• Contamination of land and soil	**LOW**	• Broken solar panels, which will be collected in closed containers and will be disposed as per the standards.	**LOW**	Periodic EHS audits should be conducted to monitor the same	Project Developer/ HFE's Personnel

SN	Aspect	Impact	Impact Intensity without mitigation	Action	Impact Intensity with mitigation	Monitoring/training Requirement	Responsibility
2	**SOLID WASTE MANAGEMENT**	• Contamination of land	**LOW**	• Distribute appropriate number of properly contained litter bins and containers properly marked as "Municipal Waste". The waste generated should be disposed as per The Municipal Solid Wastes (Management and Handling) Rules, 2000& amended in 2016. • Domestic waste will be composted and recyclables viz. paper, plastic, glass, scrap metal waste etc. will be properly segregated and stored in designated waste bins/containers and periodically sold to local recyclers.	**LOW**	Periodic EHS audits should be conducted to monitor the same	Project Developer / HFE's Personnel
3	**WATER RESOURCES AND ITS QUALITY**	• No ground water extraction. • Reportedly rain water harvesting will be undertaken at the site hence improving the ground water resources. • Through storm water management, existing natural drain will be aligned in such a way that flows of storm water is maintained	**MODERATE**	• Rain water harvesting plan to be optimum with periodic monitoring for quality. • No deviation in seasonal streams on site should be done • Proper storm water drainage lines to collect surface runoff (during monsoon) from the project site should be constructed. • Storage of oil shall be undertaken on paved impervious surface and secondary containment shall be provided for fuel storage tanks. • Waste water holding tanks / septic tank will be located at more than 500 m away from bore wells or any other underground water	**LOW**	Periodic EHS audits to be conducted to monitor the same	HFE Personnel

SN	Aspect	Impact	Impact Intensity without mitigation	Action	Impact Intensity with mitigation	Monitoring/training Requirement	Responsibility
		outside project area		holding tanks in surrounding areas. • During the washing and maintenance of the solar panels adequate storage area shall be designed to collect the washed water. • Periodic monitoring shall be carried out to ensure that the waste water is not finding its way into surface waters			
4	**WASTEWATER MANAGEMENT PLAN**	• Degradation of ground and surface water quality	**MODERATE**	• Ensure that constructed septic tanks during operation are well contained and impermeable to prevent leakage of wastewater into soil. • Ensure that septic tanks are emptied and collected by contractor at appropriate intervals to avoid overflowing	**LOW**	Periodic EHS audits should be conducted to monitor the same	Project Developer / HFE's Personnel
B	**SOCIAL MANAGEMENT PLAN**						
1	**CORPORATE SOCIAL RESPONSIBILITY**	• Community Empowerment	**MODERATE**	• Employment will be provided to local people wherever possible, especially as unskilled construction workers and security guards	**NO IMPACT**	CSR Activities should be documented	HFE's Personnel
				• Developmental needs and expectations (such as employment in the project or up-gradation of educational, health care facilities, cultural property and infrastructure) of local communities will be identified		Should be conducted continuously through the project cycle.	HFE's Personnel

SN	Aspect	Impact	Impact Intensity without mitigation	Action	Impact Intensity with mitigation	Monitoring/training Requirement	Responsibility
				through the Gram Panchayat, villagers and local administration.			
				• Opportunities for contributing to the economic and developmental needs of villagers through skill training will be explored.		Pertinent training and orientation should be conducted continuously throughout the project cycle.	HFE's Personnel
2	**OCCUPATIONAL HEALTH AND SAFETY OF WORKERS**	• Electrocution • Firing due to short-circuit • Possible injuries associated with working at height • Diseases due to unhygienic condition	**LOW**	• Provide and ensure wearing of personal protective equipment's viz., gloves, helmets, ear plug, safety belt etc. • Ensure effective work permit system following the laws of the state and central level for critical activities such as electrical work and working at height • Prepare emergency communication system and emergency preparedness plan • Ensure proper sanitation facilities.	**LOW**	Periodic EHS audits	Project Developer/ HFE's Personnel

7.5 Environmental Monitoring Plan

The Environmental Monitoring Plan is formulated to ensure and demonstrate compliance with the regulatory and Institutional Agency's EHS requirements. Monitoring of environmental and social parameters and comparing them with benchmarks set by regulatory and institutional authorities will help HFE's assess in the environmental performance and identify gaps or non-conformance ensuring immediate actions. The following environmental parameters will be monitored as when required during project operational phase for compliance.

Table 7-2: Environment Monitoring Program

A. Environmental Quality Monitoring Program

EQI No	Environmental Quality Indicator (EQI)	Monitoring Parameter	Location	Period & Frequency
A.	**CONSTRUCTION PHASE**			
A1	Ambient Air Quality	Measurement of PM_{10}, $PM_{2.5}$, SO_x, NO_x, CO	Village near the project location	Once during construction phase
A2	Ambient Noise quality	Measurement of Noise Pressure Level in dB(A)		Once during construction phase
A3	Ground Water quality	IS 10500 parameters		Once during construction phase
A4	Surface Water quality	IS 2269 parameters	Nearby surface water body /canal /reservoir	Once during construction phase
A5	Soil Quality	Soil parameters viz. pH, SAR, Water holding capacity, Conductivity, Organic Carbon, NPK	Abutting village land & project site	Once during construction phase
B	**Operation Phase**			
B1	Surface Water quality	CPCB parameters	Nearby resource	Annually during operational phase

7.6 Environmental Management Plans

The ESMP is comprised of some site-specific management plans viz. Emergency Management Plan, Waste Management Plan, Storm Water Management Plan, Environmental Monitoring Plan, Traffic Management Plan and Social Development Plan for the Madhugiri 20 MW Solar Power Plant at Malagondanahalli village in Tumkur District of Karnataka. The management plans will be executed through Environmental Social Management System.

7.6.1 Emergency Preparedness and Response Plan

Purpose

HFE, have developed a site-specific Emergency Management Plan for implementation at the entire project location, In the event of an emergency situation so that the loss of life and damage to the properties & natural resources are minimized. This plan outlines a series of emergency actions that will be executed by HFE& its Contractors to ensure preparedness and response to emergency situations throughout the life-cycle of the project.

Definition(s)

Emergency - Any unplanned situation, which presents a threat to the safety of workers and/or damage to the properties and other natural resources deemed valuable at the project site.

Emergencies

The emergency situations that are probable to occur at the site and the probable causes are listed below:

- Fire at site during temporary construction phase which cannot be doused by fire extinguishers; Also fire due to short circuit at the plant and equipment during both construction & operation phase.
- Collapse of any structure
- Outbreak of endemic disease among a large section of construction workers due to contaminated drinking water, unhygienic conditions that have developed at workplace.
- Protests by the local community or other stakeholders at any point of the project lifecycle due to grievances;
- Serious injury or death of employee or sub-contracted worker at work, due to non-work-related illness or work-related accident.
- Onset of any natural disaster like earthquake.

Emergency Management

The following steps should be taken to ensure proper management of emergency or crisis situations:

- The nearest civil hospitals, private health care centres or practitioner clinic should be identified and an agreement should be made with the aforesaid medical centres/practitioners to provide prompt health care services (including ambulance services) in the event of an emergency situation at site.
- A list of important telephone numbers such as fire brigade, health care facility/practitioner, police station, EHS and Social Coordinator, project office, head offices should be displayed at all the prime locations at site & the worker's camp (during construction phase).
- Regular liaising with the police, Gram Panchayats, district administrations should be carried out to ensure that prompt assistance is readily available in the event of an emergency.
- An Emergency Management (including Disaster Management) team comprising of 4-6 professionals both from the developer and contractors' side, during construction phase and 2-3 professionals during operation of the project; should be formed to combat any emergency situation and ensure safety of the life and property at site. For this purpose, 2-3 personnel employed in the plant during operation phase should be trained on Emergency scenarios and their management measures including their roles and responsibilities in case of an emergency situation.
- The workers (staff & contractual workers from both HFE& their appointed contractor/s) should be trained on their duties and emergency preparedness during an emergency. In case of an emergency, all site personnel should be trained to follow the communication lines given below:
  - Personnel at site affected by the emergency situations immediately inform the project office and the external agencies (such as police, fire brigade, ambulance services); In case, project office cannot be reached, the coordinator will be informed directly;
  - The Social, Environment, Health & Safety Coordinator (SEHS) on being informed about the emergency by project offices or by the employee directly; reaches site if necessary, and also follows-up with the aforesaid external agencies for aid;
  - The SEHS Coordinator takes charge of the emergency response and direct further action and co-ordination, including escalating the matter to the higher authority as required.

Responsibilities

The SEHS Coordinator will be responsible for implementing this procedure, which includes

- Ensuring that the emergency preparedness measures are in place;
- Providing training to the personnel at site regarding reporting of the emergencies, and to site office personnel regarding response to emergency calls from the site personnel,
- Direct action-and co-ordination at the time of an emergency

Community health and safety hazards specific to solar energy facilities primarily include the following:

Setback:

The development of project sitemap alter the contour levels which can cause local flooding in the area therefore adequate measures such as storm water drainage, rain water harvesting, etc. should be carried out.

Transmission Line:

Transmission Line should be routed in such a way that it causes least disruption to local communities.

Public Access:

Safety issues may arise with public access to Solar Plants (e.g., unauthorized entry to the Plants). Any public rights of way located within and close to the Solar Plants should be identified prior to construction to establish any measures that may be required to ensure the safety of their users. Prevention and control measures to manage public accesses include:

- Use gates on access roads.
- Where public access is not promoted to the site and/or there are no current rights of way across the site, consider fencing the solar energy facility site, to prohibit public access to the plant.
- Provide fencing of an appropriate standard around the sub-station with anti-climb paint and warning signs.
- Prevent access to solar panel areas
- Post information boards about public safety hazards and emergency contact information.

7.6.2 Community Liaison Plan

The Community Liaison Plan is a critical element of the overall Social Management Plans. Regular transparent communication between both the project and the communities and vice versa is crucial in building positive relationships between the two parties. This relationship should be crucial for managing unexpected situations which might arise during the course of the project. This plan should be read with other social management plan because the liaison which needs to be done for the individual plan is detailed within the plan. The communication plan mainly focuses on the communication issues during the construction stage however it also includes some community Liaison measures for the operation phase as well.

Objectives:

The Performance Standards mandates continuous communication between project and the different stakeholders e.g. Workers, local community. The onus of initiating the process of communication rests on the project proponent. The project proponent should ensure that disclosure of relevant project information that would help the affected communities understand the risks, impacts and opportunities of the project. The Community Liaison Plan is developed to ensure a clear communication channel between the project and the local community. Even though the focus of the plan is primarily on communication with the community areas where there are likely interactions between the community

and the Contractors such areas have also been covered. The community liaison plan would concentrate on the following aspects:

Communication with the Community: As mandated in the Performance Standards of IFC, HFE should disclose the project details to make the community aware of the important features of the project. A Project Information Booklet would be prepared and distributed in the project affected villages. This booklet should preferably be presented in local language. The booklet in addition to containing the salient features of the project should have a map depicting the boundaries of the plant and its ancillary facilities. The important landmarks e.g. the settlement, schools and the roads, etc. should also be demarcated so that it becomes easy for the people in the villages to relate to the ground conditions. In addition to the project information the booklet should also highlight the impacts on the community as presented in the ESA document and the commitments for the safeguards including the entitlement matrix. To ensure wide circulation of the Project Information Booklet the booklet would be made available at all the schools, Anganwadi Centers, and other public facilities in the project affected village.

To ensure continuity of the flow of information to the community it is suggested that a quarterly Community Information Booklet should be published. During the construction phase the booklet would contain the information about the progress of the project and also information which are pertinent to community e.g. disruption of the transportation links, outcome of consultation process on community development etc. It is that the community Information Booklet be continued even during the operations stage where this also acts as a transfer of information from the project to the community. In addition, it can also be used to share information between the communities e.g. achievement of a particular member of the community or any worker can be published in this booklet.

7.6.3 Waste Management Plan

The Waste Management Plan (WMP) will be applicable to the wastes arising during commissioning and operation of the solar power plant of HFE. Major waste streams from the project include non-hazardous solid waste, wash water generated from panel washing and sewage. WMP is intended to serve as a guideline for HFE and the contractor(s) to manage wastes effectively during the project life cycle. The WMP describes how wastes will be managed during the project life cycle and how the project will:

- Minimize the potential to cause harm to human health and the environment.
- Comply with Indian environmental regulation and IFC Performance Standards.
- Reduce operational costs and reduce any potential liabilities which may arise from waste handling operations.
- This plan also ensures that every waste stream and solid waste materials from the main plant site and bracketed facilities will be managed effectively.

The EPC contractors will manage the waste generated during construction phase like construction debris, packing material, paint containers and filters. The management measures of the aforementioned solid wastes and the hazardous wastes are discussed in detail below:

- The recyclable and non-recyclable non-hazardous solid waste generated onsite should be collected and stored in a temporary waste storage facility from where all wastes will be sent for recycling and disposal to appropriate facilities.
- The reusable wastes like wooden waste and cardboards from packing materials, empty cement bags, construction debris, etc. can also be given to locals for their use or give it back to original equipment manufacturer (OEM).

7.6.4 Storm Water Management Plan

The purpose of Storm Water Management Plan (SWMP) is to ensure prevention and control of any adverse impact caused by un-regulated storm water runoff from the main plant to the nearby natural drainage channels, surface water bodies, public and private properties.

Following measures will be taken as part of the Storm Water Management Plan:

- The peripheral drains will be provided outside the plant boundary during construction phase, which will prevent the silt contaminated surface run-off from site to enter into the adjoining lands.
- No surface run-off from within the solar power plant site will be directly discharged into any nallah/water body.
- Rain water collected from the project site will be used to recharge the ground water through onsite rain water harvesting tank/pits.
- Avoidance of disturbance of flows into natural watercourses i.e. provision should be made for temporary or permanent measures that allow for attenuation, control of velocities and capturing of sediment upstream of natural watercourses.
- Do not divert flows out of their natural flow pathways, thus depriving downstream watercourses of water.

7.6.5 Community Property Resource

During the project construction phase, there might be some sharing of resources by the villagers and the workers working in the 20 MW Solar Power project at study village. To an extent feasible this should be avoided to prevent potential conflicts between the project and the community. The movement of heavy vehicles and machineries might lead to conditions like disruption of electric wires and telephone wires in the project area and along transportation routes. All these damage utilities should be repaired/replaced to normal conditions, at the earliest. An account of the damage to the community resource should be documented and the root cause analysis carried out. The findings of the root cause analysis should also be documented and discussed with the agency/agencies found responsible for the incident. No water should be extracted from surface water bodies which are used by the community for drinking or domestic purpose. Any vacant or barren land, not assigned for project, should not be used for storage of fill/construction material, wastes, etc.

Responsibility: As per norms of solar power projects HFE would take responsibility in this regard. HFE would take responsibility for construction of any road, required to be constructed before the existing road is diverted / closed for use by villagers. HFE (through their EPC Contractor/ project developer and implementing agency) should consult with the community to decide on the alignment of the road and also fix up the likely time line for the construction.

HFE and their contractors should ensure that the sharing of community resource is minimized by organizing necessary support infrastructure/facilities within premises. However, in case where sharing would be essential HFE and/ or their contractors should have an agreement with the Gram Panchayats for the sharing of the resource. In case of damage to community property HFE including its contractors should ensure that it is repaired or replaced to the satisfaction of the community at the earliest. HFE should maintain documentation of all incidents of damages to the community property. All cost for repair/replacement should be borne by HFE or their Contractor(s).

As part of the Environmental and Social Management System proposed, a system should also be developed for recording such incidents and tracking the incident till it is closed to the satisfaction of the community.

7.6.6 Occupation Health and Safety Management Plan

The Occupational Health and Safety (OHS) of the employee and contractual labors will be maintained at the work sites during both construction and operation phase. The OHS Management measures should comply with the Indian Regulatory requirements under OHSAS and the Factories Act 1948, amended 1954, 1970, 1976 and 1987.

Construction Phase: The following occupation health and safety measures will be adopted during the construction phase:

- Provide and ensure wearing of personal protective equipment's viz., gloves, helmets, ear plug, safety belt etc.
- Prepare emergency communication system and emergency preparedness plan
- Ensure provision and maintenance of drinking water and sanitation facilitation for construction workers in accordance with the provision of Contract Labour Act and Building and Other Construction Workers Act.
- Periodic cleaning of work areas will be undertaken and supervised by the contractors to ensure hygienic conditions on site.
- Workers will stop working in extreme natural climatic conditions i.e. heat wave, heavy rain etc.
- Ensure effective work permit system for critical activities such as electrical work and working at height
- All work places will have adequate fire alarms and firefighting equipment's to handle any outbreak of fire in O& M.
- Adequate drinking water will be supplied at workplace for workers onsite and water quality meets drinking water quality standards. HFE needs to ensure it through its contractors.
- Sufficient light and ventilation will be provided for workers working in confined space.
- Periodic health check-up camps for workers onsite will be organized to ensure prevention of occupational health hazards.
- All work areas should have First Aid Kits to manage injuries occurring in the area.
- The switchyard building will be provided with fire extinguishers and sand buckets at all strategic locations to deal with any incident of fire.

Operational Phase: Although no significant occupational health and safety risks are identified during operations, the following mitigation measures need to be adopted:

- Operators are provided with adequate PPEs depending upon nature of the operation and occupation health and safety risks associated with it viz. electrical maintenance activities, replacement of solar panels etc.
- Special emphasis on electrical safety will be laid and all employees will be trained in electrical safety and First Aid
- Standard Operation Procedures (SOPs) will be developed for operational activities likely to have potential occupational health and safety risks
- Periodic medical examination will be undertaken for workers including contractor and subcontractor of the plant.
- Periodic inspections will be carried out to ensure all the above are implemented and any non-conformances will be recorded along with grievance related to OHS issues.
- An EHS coordinator will effectively implement and monitor the OHS Management System and ESMP.

7.6.7 Grievance Redressal Mechanism

HFE have developed a GRM Policy mentioning the procedures for lodging of grievances, processing of grievances, resolving grievances and closing of grievances. Issues raised through grievance redressal system are being addressed with remedial measures on site.

However, it must be ensured that:

- The grievance mechanism should be scaled to the risks and adverse impacts of the project.
- It should address affected people's concerns and complaints promptly, using an understandable and transparent process that is gender responsive, culturally appropriate, and readily accessible to all segments of the affected people at no costs and without retribution.
- The mechanism should not impede access to the country's judicial or administrative remedies.
- The affected people will be appropriately informed about the mechanism

HFE have established a grievance redressal mechanism to receive and address specific concerns on environmental & social issues. If the client anticipates on going risks to or adverse impacts on affected communities, the client will establish a grievance mechanism to receive and facilitate resolution of the affected communities' concerns and grievances about the client's environmental and social performance. The grievance mechanism should be scaled to the risks and adverse impacts of the project. It should address concerns promptly, using an understandable and transparent process that is culturally appropriate and readily accessible to all segments of the affected communities, and at no cost and without retribution. The mechanism should not impede access to judicial or administrative remedies. The client will inform the affected communities about the mechanism in the course of its community engagement process.

- In efforts to develop an effective two-way communication a Grievance Redressal Mechanism should be developed by HFE. The broad outline of the mechanism is as follows:
- The decision on the grievance would be communicated to the aggrieved person within a timeframe to be stipulated during the preparation of the ESAP.
- There should be a single point of contact between the community and HFE for the Redressal of grievance.
- All grievances should be documented and indexed for future reference. The proceeding and actions against each of the grievance should be documented and should also carry this index number for easy traceability.
- If required, the aggrieved community member can also be made a part of the Redressal process, so he is able to place his point of view.
- The Grievance Redressal committee should meet at regular interval and discuss on the grievance and take necessary action.

Communication with Contractor Staff: During the construction phase, there would be an influx of people into the project area. As these people could have cultural differences with the resident population there can be a potential of conflicts arising because of issues related to safety and privacy issues of the women in the surrounding villages, spread of various communicable diseases, nuisance caused by workers due to improper sanitation facilities, etc. It is thus a Community Interaction Brochure would be prepared specifically stating the 'Dos' and 'Don'ts' and requesting proper behavioral actions and discipline amenable with the local customs and traditions during their association with the project. The brochure would also be highlighting the importance of any of nearby cultural place and need to maintain the sanctity and dignity of the place. This Community Interaction Brochure would be made available to all employees during their induction into the project and also when they report back to the project after

leave or absence. A record of the induction or refresher on the community interaction would be maintained.

Responsibility: HFE have prepared all the information disclosure booklets as discussed above. They would also ensure circulation of the booklet among the community in the project affected villages.

HFE would also ensure that the system is made community friendly so that the people who have grievance are encouraged to come forward and register their grievance. It would also ensure that the grievance of the community is discussed and recorded. It would ensure that the issues are closed to the satisfaction of the community members.

During construction HFE and its contractors would ensure that each of the people working on the project is aware of the Do's and Don'ts of community interaction. HFE and their contractors would ensure that the record of the induction and refresher is maintained. All the resources required for the implementation of the different subcomponents of the plan would be provided by HFE and its contractors.

7.6.8 Community Development Plan under CSR

As per the MNRE guidelines, a certain percentage of the total investment made on development of Solar Park (excluding investment on evacuation) and that for setting up of solar power projects in the solar park may be kept aside for the affected area development.

In line with the CSR Regulations, HFE have developed their own CSR Policy for delineating its responsibility as a socially and environmentally responsible corporate citizen. The Policy has laid down the areas of intervention, principles and mechanisms for undertaking various programs in accordance with Section 135 of the Companies Act 2013.

Companies Act, 2013 has introduced mandatory Corporate Social Responsibility Regulations which are effective from 1st April 2014. Section 135 of the Companies Act, 2013 ('the Act'), read with Companies (Corporate Social Responsibility Policy) Rules, 2014 ('CSR Rules') requires every company having:

- net worth of Rs.500 crore or more; or
- turnover of Rs. 1,000 crores or more; or
- net profit of Rs.5 crore or more

Corporate Social Responsibility

Construction Phase

To empower the local community through different development and support programs the project proponent should take some initiatives for Community Development Plan under their CSR Policy in the project affected village in Madhugiri Tehsil respectively of Tumkur District.

The project proponent will develop their own CSR Policy in alignment with its CSR vision, principles and values, for delineating its responsibility as a socially and environmentally responsible corporate citizen. As per CSR Policy, HFE is committed to inclusive growth and local stakeholder involvement as a fundamental value and strives to enhance:

- Social wellbeing
- Economic wellbeing
- Environmental wellbeing
- Local community initiatives

The CSR Activities may include:

- Creating provisions for Employment opportunities to the people who are skilled and semi-skilled in project area villages;
- Supporting the Anganwadi Centres by facilitating them with provisions of exclusive Drinking Water and Toilet facilities for them in project area villages;
- Facilitating the Anganwadi Centres/ Local Schools by providing them with amenities like Chairs, Benches etc.;
- Facilitating in development and creation of Health Infrastructure in the Project Area villages, where it is found to be inadequate;
- Promotion of education, including special education and employment enhancing vocation skills especially among children, women, elderly and the differently abled and livelihood enhancement projects;
- Promoting gender equality, empowering women, setting up homes and hostels for women and orphans, setting up old age homes, day care centres and such other facilities for senior citizens and measures for reducing inequalities faced by socially and economically backward groups etc.

HFE has specific Implementation Mechanism under their CSR Policy. Project proponent should create provisions and support HFE for the above-mentioned matters and any other pertinent issues. Recommendation under CSR Policy are given in **Table 7-3**.

Operation Phase

The CSR activity may continue during Operation Phase to comply with the need and requirement of the areas development and to avoid any conflict during that phase.

Needs/ Gap Assessment for CSR Initiatives

Analysis of above socio economics description and community consultation in project area villages reveals that concern of villagers are linked with the fulfilment of basic needs and improvement of some infrastructural facilities at school/ Anganwadi/ health etc. levels. On the basis of discussion with villagers, land sellers and Panchayat members, following gaps have been identified which needs to be addressed:

Table 7-3: Key Needs/Gaps Identified and Recommendation for CSR Activity

Key Areas	Gaps identified	Recommendation for CSR
Education	• Lack of higher education facilities • Low female literacy rate compared to male • Lack of vocational training in study area villages • Lack of computer literacy in the village. • Lack of sitting arrangements in Primary School	• Awareness program regarding female education at village level. This can be linked with vocational training programme of study area villages • Providing computer literacy program at village level • Providing funds for sitting arrangements
Drinking water	• Limited no. of dug wells, a few hand pumps and one panchayat owned Tank are the main source of drinking water in the study area.	• Providing additional drinking water facilities with help of concerned government dept. • Clean or purified drinking water is expected to significantly affect the quality of life and health for the villagers.
Health	• There is no health facility in the village.	• Organizing awareness camp on general health awareness.

Key Areas	Gaps identified	Recommendation for CSR
	• Alternate/ better health facilities are around 30 Km away from the village. • Major diseases are observed – malaria, typhoid, and tuberculosis.	• Health camps or mobile health clinics, with support of the govt. authorities, can be provided.
Infrastructure and sanitation	• Though, village approach roads are good but access roads within the villages are both paved and unpaved in the study area villages • Around 10% of the people in the study area villages are resort to open defecation	• Organizing awareness camp on sanitation and to be linked with sanitation program in the study area villages. • Low cost community toilets based on best practices to use less water can be worked out with the panchayats intervention. Some initiative linking with Swachh Bharat mission (SBM) can be made.
Agriculture/ Irrigation	• Agriculture is majorly dependent on rain with irrigation through bore wells. But the project affected villages lacks adequate irrigation system.	• Proper link with irrigation programmes that can ease irrigation in the area • Rain water harvesting should be planned wherever possible with the project site to improve groundwater recharge.
Employment opportunities in the area	• Only a little number of SHGs (all under Development of women and children in Rural Areas or DWCRA –DCWRA) found to be present in the study are villages • Majority of the villagers are mostly unskilled • Labourers are mostly seasonal workers and migrate only for a short while in the nearby towns, either as Masons, or carpenter or as seasonal spin mill workers.	• Organizing training/ capacity building program for SHGs regarding entrepreneurship and linkages with bank. • Introduction of processing of dairy and other produce related to livestock.

7.6.9 Engagement of Labour

As the project is in pre-construction stage, considering factors involved in construction stage the below matters are given.

Indicators in Labor Engagement

Abolition of child and forced labor: Engagement of child and forced labor by contractor or developer in any form for the project will be unfair with the children' right.

Gender equity and non-discrimination: Discrimination and imbalance in gender equity in employment and opportunity may lead to conflicts between contractor and labor.

Freedom of association and right to collective bargaining: Not giving freedom to labor to express their views and form association may cause conflicts between labor and contractor but this is not applicable for Solar Power plant as the labor requirement is of short duration restricted to construction phase only and number of labor employed is not very large for the same phase.

7.6.10 Road Safety and Traffic Management Plan

Scope and Purpose

The plan encompasses the addressal of community safety related impacts that may arise from the increased vehicular traffic due to movement of heavy equipment/machineries and vehicles along the

site access and approach roads particularly during construction phase. The plan will be regularly updated by the contractor with the project progress and as vehicle movement requirements are identified in detail. Designated traffic coordinator will be responsible for overall coordination of traffic management. Logistic for the solar plant may be transported by road that yet to be confirmed.

During Construction Phase

The following mitigation measures will be implemented during this phase:

- Project vehicular movement will be restricted to defined access routes.
- Proper signage will be displayed at important traffic junctions along the vehicular access routes to be used by construction phase traffic. The signage will serve to prevent any diversion from designated routes and ensure proper speed limits are maintained near residential areas.
- Any road diversions and closures will be informed in advance to the project vehicles accessing the above route. Usage of horns by project vehicles will be restricted near sensitive receptors viz. schools, settlements etc.
- Traffic flows will be timed wherever practicable during period of increased commuter movement in the day.
- Temporary parking facilities should be provided within the work areas and the construction sites to avoid road congestion.
- Vehicular movement to be controlled near sensitive locations viz. schools, colleges, hospitals identified along designated vehicular transportation routes.
- Routine maintenance of project vehicles will be ensured to prevent any abnormal emissions and high noise generation.
- Adequate training on traffic and road safety operations will be imparted to the drivers of project vehicles. Road safety awareness programs will be organized in coordination with local authorities to sensitize target groups viz. school children, commuters on traffic safety rules and signage.
- HFE and their contractor(s) should frame and implement a “No Drug No Alcohol” Policy to prevent road accidents/incidents.

During Operational Phase

Since limited vehicular movement is anticipated during operational phase considering only the daily movement of project personnel any impacts arising from the same can be effectively addressed through implementation of mitigation measures as discussed during the construction phase. In addition, the following measures will be emphasized.

- Use of horns near the villages along the access road to villages, main plant and internal roads should be restricted.
- The vehicular movements along the access roads and highways should be restricted during the night time.
- All the vehicles entering the access roads and plant should have Pollution under Control (PUC) certificates.
- The speed limit in the internal roads should be restricted to 25 km/hr. Proper warning signs and road safety awareness posters should be displayed to create road safety awareness among the personnel accessing the site.

- Periodic Road Safety and Traffic Management campaigns and awareness sessions should be carried out among the villagers and the plant workers/personnel to develop road safety awareness among the people likely to be impacted by the project.
- An emergency road safety plan should be framed by the Proponent to combat any emergency conditions/accidents along the highways, access roads and within plant area.
- The Proponent should frame and implement a “No Drug No Alcohol” Policy to prevent road accidents/incidents.
- The drivers should be given an induction on road safety and traffic management policy.
- A permanent parking lot should be provided within the main plant site (in individual work areas) and the associated facilities.
- Use of seat belts for both drivers and passengers should be made compulsory to minimize death & injuries in the event of an accident.

8 CONCLUSION

The project can be categorized as ***Category B*** as per IFC guidelines and based on this assessment is made which specifies that this project is expected to have limited adverse environment and social impacts which, can be mitigated by adopting suitable mitigating measures.

An environment and social analysis has been carried out looking at various criteria such as topography, air, noise, water resources and water quality, ecology, demography of the area, climate, natural habitat, community and employee health and safety etc.

Brief Assessment of Project:

- **Project Location:** The 20 MW Solar power project has been developed at Malagondanahalli in Madhugiri of Tumkur District, Karnataka by **Clean Solar Power (Tumkur) Private Limited (CSPTPL)** a 100% subsidiary of **Hero Future Energies Pvt. Ltd. (HFE)**. The project is spread over an area of 113 Acres as per HFE.
- **The Project is in** pre-commissioning stage with Solar panels already set up. The project is predicted to be commissioned by January 2018 end.
- The land is an agricultural land and has been purchased from the owners via willing to sell-willing to buy basis.
- **Location of project site w.r.t ecologically sensitive area**: The project area is not located within any ecologically sensitive area. As precautionary measures fencing around the plant have adequate height to protect the entering of wild animals into the park. It is also expected that glare effect from the solar plant will not impact the avian species in the region as other plants are in operation phase and as such no evidence was reported.
- The water requirements for construction and operation phase is fulfilled by the local vendors who extract water from borewells. There is a borewell at the site which is used to extract minimal quantity of water. NOC for ground water extraction is in process.
- Advantage of the proposed plant: The 20 MW proposed plant is located within a contiguous stretch of land, which is purchased through willing seller- willing buyer basis and good faith negotiations. Essential facilities and security thus has been made conveniently within an enclosed area with boundary wall. Areas surround the project area and allied facilities required are being developed gradually by HFE, which is contributing to the overall development of the area.
- Additionally, the site possesses a natural drainage channel running along the site from west to east. The direction of flow has been unaltered. Artificial drains are going to be constructed along the periphery of the project or at strategic places where there are sloping land parcels, to carry the runoffs from the site. These drains will empty itself into integrated drains and will not affect the nearby land regions.
- **Source of Pollution:** The solar power project is based on clean technology and does not likely to cause any significant pollution. Further, the project will help to reduce GHG emissions.
- **Resettlement:** No resettlement and rehabilitation involved in the project. All private lands were purchased through good faith negotiation and willing seller-willing buyer basis.
- **Community Willingness:** Community is aware about the project and does not show any unwillingness for the project due to clean technology. Further, adequate disclosure has been made by HFE/ their contractors during land procurement process. Hence, considering the overall factors and also as information retrieved from the community consultation. Community are welcoming the project along with the rest of the development of the solar project.

- **Project Benefit:** The produced electricity will be evacuated to the state electricity grid (GSS) and will help to cater the energy requirement
- **CSR plan:** The CSR plan focused on community development shall be implemented by the HFE.

Most impacts are expected to occur during the construction phase which are considered to be of a temporary in nature. The main project impacts are associated with clearing of shrub vegetation, waste management and excavation and movement of soils. From this perspective, the project is expected to have a small "environmental footprint". Adequate provisions have been made for the environmental mitigation and monitoring of predicted impacts.

The project will have number of positive impacts which are:

- During the construction phase, local population often supply manpower for services such as those of drivers, vehicle vendors, contractors, watchmen etc.

Proper Grievance Redressal Mechanism (GRM) will have to be implemented by HFE to overcome public inconvenience during the project activities. Based on the environmental and social assessment and surveys conducted for the project, the potential adverse environmental impacts can be mitigated to an acceptable level by adequate implementation of the mitigation measures identified in the ESMP.

Therefore, the solar power plant site will not degrade the quality of surrounding environment, while improving the socio-economic conditions of the surrounding area.

APPENDIX A: MOEF&CC NOTIFICATION

No. J-11013/41/2006-IA.II(I)
Government of India
Ministry of Environment & Forests

Paryavaran Bhavan,
C.G.O. Complex, Lodi Road,
New Delhi-110003.
Telefax: 24362434

Dated the 13th May, 2011

Office Memorandum

Sub: Applicability of environmental clearance for Solar Photo Voltaic (PV) Power Projects – Regarding.

A reference has been received in this Ministry seeking clarification regarding applicability of EIA Notification, 2006 in respect of Solar Photo Voltaic (PV) Power Projects. The matter has been examined.

It is clarified that the Solar PV Power Project are not covered under the ambit of EIA Notification, 2006 and no environment clearance is required for such projects under the provisions thereof.

This issues with the approval of the Competent Authority.

(Dr. S.K. Aggarwal)
Director

To

1. All the Officers of IA Division
2. Chairpersons / Member Secretaries of all the SEIAAs/SEACs
3. Chairman, CPCB
4. Chairpersons / Member Secretaries of all SPCBs / UTPCCs

Copy to:-

1. PS to MEF
2. PPS to Secretary (E&F)
3. PPS to SS(JMM)
4. Advisor (NB)
5. Website, MoEF
6. Guard File

APPENDIX B: KARNATAKA SOLAR POLICY 2014-2021

GOVERNMENT OF KARNATAKA

No EN 21 VSC 2014 Karnataka Government Secretariat,
Vikasa Soudha,
Bengaluru, dated: 22.05.2014

NOTIFICATION

To harness the potential of Solar resources in the State, Government of Karnataka has published Solar Policy vide GO no EN 61 NCE 2011 dated 01-07-2011 for the period 2011-2016. In light of technological advantages unfolding in the sector and achievements made by Solar forefront States, Government formed a Technical Committee vide G.O. No: EN 61 NCE 2011 Dated: 05.09.2013 for suggesting amendments to the existing Solar Policy 2011-16. With change in technology, Solar power, a green source of Energy is being considered as one of the alternative to augment the current sources. To have Energy security and sustainability, more capacity addition in Solar power, it is felt necessary, for a revision in Solar policy. Taking inputs from various stake holders, the Technical Committee has given its recommendation for revision of Solar policy.

Accordingly Government of Karnataka has decided to revise its Solar policy.

Now therefore the Government of Karnataka revises the existing Solar policy and makes the following policy, namely the Karnataka Solar Policy 2014-2021.

Solar Policy 2014-2021

1. Preamble.

The Government of India's Jawaharlal Nehru National Solar Mission (JNNSM) launched in January 2010, with the objective of achieving 34152 MW of solar power capacity by 2022which will be around 3% of the total energy consumption and it is a concentrated effort to tap India's naturally available energy sources and contribute to low carbon sustainable growth in the country, while overcoming its ecological and energy security challenges.

Karnataka is rich in solar resources and solar energy will complement the conventional sources of energy in a large way. The State of Karnataka is blessed with about 240 to 300 sunny days with good solar radiation of 5.4 to 6.2 kWh/m2/day. Karnataka was the first southern state to notify its solar policy in 2011 and was the first state to commission utility scale solar project in India.

Assessment on Solar Potential in Karnataka estimates the energy potential as 20GW. However, considering different factors like availability of waste lands, evacuation infrastructure etc., the moderated potential may be around 10GW. Karnataka has the potential to evolve as a Solar Generation hub in India due to a host of factors.

To harness the potential of solar resources in the state, Government of Karnataka had issued a Solar Policy for the period 2011 - 16. In light of changes unfolding in the sector and achievements made by Solar forefront States, it is felt necessary to go aggressively for higher targets to achieve 3% contribution from Solar Source out of total energy consumption. The advantages of Solar energy are that the grid parity is realized in near future, lower transmission losses, environmental benefits, energy sustainability, lower gestation period, offset of day time peak load etc. considering the fact the Government of Karnataka has decided to review the policy.

APPENDIX C: ILO GUIDELINES

No.6

ILO HELPDESK

ASSISTANCE@ILO.ORG

International Labour Organization

Workers' housing

Housing provided to workers as part of the employment contract should meet certain minimum specifications in respect of the nature and standard of the accommodation and facilities to be made available.

The following guidance is based on international labour standards. National or state regulation will often set baseline specifications as part of housing, labour, health or even fire safety regulations; they should be checked and followed. National employers and workers organizations may also be a good source of information on national law, collective bargaining agreements and customs pertaining to housing for workers; or may be able to refer you to the appropriate statutory authority.

Guiding principles

➡ In providing worker[1] housing, the objective should be to ensure "adequate and decent housing accommodation and a suitable living environment"[2] for workers. This includes upkeep, improvement and modernisation of housing and related community facilities.[3]

It is "generally not desirable that employers should provide housing for their workers directly".[4] Employers are encouraged to help their workers to obtain housing through autonomous private agencies, public housing schemes, or cooperatives.[5] This is because workers living at the work site on property owned or controlled by the employer tend to be less integrated into the local community, and more dependent on the employer. However, certain circumstances, such as when an undertaking is located far from normal centres of population, or where the nature of the employment requires that the worker should be available at short notice may require the employer to provide housing for his or her workers.[6]

If housing is provided by the employer "the fundamental human rights of the workers, in particular freedom of association, should be recognised."[7] Arrangements where accommodation and communal services are provided as payment for work should take care to ensure that the interests of the workers are protected. If rent is charged, it should not cost the worker more than a reasonable proportion of his or her income.[8]

Siting and construction

➡ The housing and related community facilities should be of durable construction, taking into account local conditions, such as liability to earthquakes.[9]

The location of workers' housing should ensure that workers are not affected by air pollution, surface run-off or sewage or other wastes.[10]

Housing Standards

➡ Housing should ensure "structural safety and reasonable levels of decency, hygiene and comfort".[11] The undertaking should ensure the following:

a) a separate bed for each worker;
b) adequate headroom, providing full and free movement, of not less than 203 centimetres;
c) the minimum inside dimensions of a sleeping space should be at least 198 centimetres by 80 centimetres;
d) beds should not be arranged in tiers of more than two;
e) bedding materials should be reasonably comfortable;
f) bedding and bedframe materials should be designed to deter vermin;
g) separate accommodation of the sexes;
h) adequate natural light during the daytime and adequate artificial light;
i) a reading lamp for each bed;
j) adequate ventilation to ensure sufficient movement of air in all conditions of weather and climate;
k) heating where appropriate;
l) adequate supply of safe potable water;
m) adequate sanitary facilities (see below);
n) adequate drainage;
o) adequate furniture for each worker to secure his or her belongings, such as a ventilated clothes locker which can be locked by the occupant to ensure privacy;
p) common dining rooms, canteens or mess rooms, located away from the sleeping areas;
q) appropriately situated and furnished laundry facilities;
r) reasonable access to telephone or other modes of communications, with any charges for the use of these services being reasonable in amount; and

[1] Workers' Housing Recommendation, 1961 (No. 115). The section entitled "Suggestions concerning methods of application," Part I, paragraph 5, encourages "equality of treatment between migrant workers and national workers". Therefore, this guidance applies equally to migrant workers and national workers.
[2] R. 115, General Principles, Part II, paragraph 2.
[3] R. 115, paragraph 3.
[4] R. 115, Part IV, paragraph 12(2).
[5] R. 115, Part IV, paragraph 12(1).
[6] R. 115, Part IV, paragraph 12(2).
[7] R. 115, Part IV, paragraph 12(3a).
[8] R. 115, Part II, paragraph 4, Part IV, paragraph 12(3c) and (4).
[9] R. 115, Suggestions Concerning Methods of Application, Part I, paragraphs 10-11.
[10] R. 115, Suggestions Concerning Methods of Application, Part IX, paragraph 43.
[11] R. 115, paragraph 19.

s) rest and recreation rooms and health facilities, where not otherwise available in the community.

In workers' sleeping rooms the floor area should not be less than 7.5 square metres in rooms accommodating two persons; 11.5 square metres in rooms accommodating three persons; or 14.5 square metres in rooms accommodating four persons. If a room accommodates more than four persons, the floor area should be at least 3.6 square metres per person. Rooms should indicate the permitted number of occupants.

As far as practicable, sleeping rooms should be arranged so that shifts are separated and that no workers working during the day share a room with workers on night shifts.

Sanitation facilities

➡ Adequate sanitary facilities should include a minimum of one toilet, one wash basin and one tub or shower for every six persons. They should be provided at a convenient location which prevents nuisances. Sanitary facilities provided should meet minimum standards of health and hygiene. They should also provide reasonable standards of comfort, including hot and cold fresh running water. There should be separate sanitary facilities provided for men and for women. Sanitary facilities should have ventilation to the open air, independently of any other part of the accommodation. Soap and hygienic paper should be adequately stocked.

Health and safety

➡ As far as possible, floors walls, ceilings and equipment should be constructed to minimize health risks.

The accommodations should be kept free of rats, mice, insects and vermin. In areas where mosquitoes are prevalent, workers should be provided netting.

Measures should be taken to prevent the spread of diseases. Separate facilities should be provided for sick workers to prevent the spread of transmissible diseases among the occupants. Fire safety measures should be taken, including installing and maintaining fire equipment (alarms, extinguishers, etc.). Workers should be trained in fire procedures. Bedding should not contain flammable materials. Radiators and other heating apparatus should be placed so as to avoid risk of fire, and shielded where necessary to prevent discomfort to occupants.

Safety exits should be clearly marked. Adequate means of escape should be provided and properly maintained.

Provisions should be made for workers' physical safety and well-being, and protection of their belongings. Measures should be reasonable and not unduly restrict workers' freedom of movement. Workers should be allowed visits for social relations or business, including trade union business.[12]

Inspection of premises

➡ Premises should be inspected frequently to ensure that the accommodation is clean, decently habitable and maintained in a good state of repair. The results of each such inspection should be recorded and be available for review.

Vacating the premises upon termination of employment

➡ When a worker's contract of employment is terminated, the worker should be entitled to a reasonable period of time to vacate the premises, in accordance with national law and custom.[13]

Consultation

➡ In the design of housing for workers, "every effort should be made to consult those bodies representative of future occupants best able to advise on the most suitable means of meeting their housing and environmental needs."[14]

References

➡ Workers' Housing Recommendation, 1961 (No. 115); full text available at: http://www.ilo.org/ilolex/english/recdisp1.htm.

➡ For comparison, you may also wish to consult the Maritime Labour Convention (MLC), 2006, Title 3, which gives detailed guidance for workers' accommodation for seafarers; full text available at: http://www.ilo.org/ilolex/cgi-lex/convde.pl?C186.

[12] R. 115, Suggestions Concerning Methods of Application, Part IV, paragraph 17.
[13] R. 115, General Principles, Part IV, paragraphs 12(3b) and Suggestions Concerning Methods of Application, Part IV, paragraph 15.
[14] R. 115, Suggestions Concerning Methods of Application, Part IX, paragraph 42.

ILO Helpdesk
Multinational Enterprises Programme
International Labour Office
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1211 Geneva 22, Switzerland
Tel: +41.22.799.6264
Fax: +41.22.799.6354
assistance@ilo.org

APPENDIX D: SAMPLE QUESTIONAIRE FOR COMMUNITY CONSULTATION

Name of the village			Panchayat		
Taluka/Block			District		
Respondent				Date:	
Total Population		Total Male		Total Female	HH No.
Religion	Name	%	Name	%	
Caste/Group	Name	%	Name	%	
	Name	%	Name	%	
Education Level	Illiterate %	Primary %	Secondary %	H.S. %	Graduate %
Occupation	Agriculture %	Business %	Service %	Labour %	Other %
Source Drinking water facility	Tube well	Dug well	Stream	Piped water	Hand pumps
Sanitation facility	Pit latrine %	Sanitary latrine %	Open defecation %	Other %	
Electricity (Available %)			Electricity availability in HH		
Village road type/transport facility					
Schools (distance)	Primary	Middle	H. S.	College	Anganwadi
Health Facility (distance)	Health sub Centre	Primary	Hospital	Others	

Major diseases								
Major crops cultivated	Name	Period	Yield (q/acr)	Rate/q	Name	Period	Yield (q/acr)	Rate/q
Irrigation Facility	Ponds		River		Groundwater		Others	
Average land holding size								
Land rights								
Livestock	Cow		Buffalo		Goat		Pig	Fowl
	Duck		Others					
Grazing areas								
Cooking medium and source	Fuel Wood		Kerosene		Cow Dung Cake		Crop Residue	LPG
	Others							
Common Property Resources (CPR)	Religious and Cultural Places		Sectored Places		Community Hall		Community Ponds	Cremation Ground
	Streams		Canal		River		Others	
Major rituals and festivals	Name		Period		Name		Period	
Fishing area			Name of the					

Forest	Wood	Timber	NTFP	Others	
Any Vulnerable Groups like- landless/homeless- people, Women headed HH, Orphans etc.					
Any program related to child / women health care program					
Any employment generation program					
HH & Cottage industries in the village / area					
Any Scheme / Program related infrastructure / any amenities					
Occurrence any Natural Calamities / industrial / anthropogenic Hazard					

APPENDIX E: SUMMARY OF STAKEHOLDERS CONSULTATION

Stakeholder Group	Village/ Department/ Designation	Name	Methodology	Findings
Project Proponent Hero Future Energies (HFE)	HSE Engineer	Mr. Vinod Chowdary Gunnam	Group interaction	• The background of the 20 MW Solar Power Project • The project is being executed under the SPV namely Clean Solar Power (Tumkur) Pvt. Ltd. on behalf of HFE. • Request letter for land conversion has been sent to KREDL • Power Purchase Agreement (PPA) with Bangalore Electricity Supply Company (BESCOM) is completed. • Certificate of registration for BOCW (Building and Other Construction Workers) is procured. • Principal Labour Registration Certificate has been procured from Dept. of Labour, Govt. of Karnataka • Regular Power Evacuation approval has been received from Karnataka Power Transmission Corporation Limited (KPTCL)
	Manager, Lands	Rajaram Shetty		
Land Aggregator	Land Agregator for Hero Future Energies	Pirushottam Reddy, Malagondanahalli village	One to one interaction	• All the project land is procured willing buyer-willseller basis and good faith negotiation • It was also mentioned by him that no ST land was procured for the project.
Panchayat	Bedattur Panchayat (Panchayat for Malagondanahalli village)	Thimma Reddy, Panchayat President	One to one interaction	• Panchayat is aware of the 20 MW Solar Project and welcome it. • The main source for Irrigation in agriculture bore well. • Piped water supply system through overhead reservoirs shared by adjacent Pulomachi and Appenhalli village
Community	Malagondanahalli village	• Ramanna • Hanumanth Reddy	Group Discussion	• Major livelihood in this area is agriculture. The main crops are Tur, Rice & Maize • Rain-fed agriculture is majorly practiced.

Stakeholder Group	Village/ Department/ Designation	Name	Methodology	Findings
		• Pavana • Chandramma		• Female literacy rate is much lower than male literacy rate in the study area village- Malagondanahalli. • There is no health facility in the village, which is highly required. The nearest PHC is at Bedattur. • People in this area is affected with joint pain, yellowing of teeth etc. may be due to fluoride contamination in the ground water. • Routine immunization programme is conducted. • The community is aware of the upcoming Solar Power Project and is expecting betterment in their livelihood with the initiation of the same.
Land Owner	Malagondanahalli village (Resides at nearby Hanumathapura village)	Venkat Raman Reddy	One to one interaction	• Land is sold at willing to sale- willing to buy basis. • The amount of transaction is satisfactory and much higher to existing rates. • He is expecting over all development in project area.
EPC Contractor	Jakson	• Santosh Singh, Senior Engineer • Rajkumar Chowdhury, Engineer • Laksman Patel, Engineer		• The construction work is on way of completion • The boundary wall and the scada room on way of completion • Incidents records are maintained and followed wherever necessary
Security Agency of EPC Contrcator	Harsha Security Services	• Chandra Mohan, Security Supervisor • Mali Gowda, Security Personnel		• Visitors record is maintained on regular basis • Vehicle movement record is also maintained • Most of the security personnel deputed are from local area.
Labourers	Meera Enterprise (sub-contractor for boundary wall) at Project Site	• Hanumant Ram • Nanhal • Rahul • Purushottom		• Boundary wall are on way of completion • They have been trained for safety on periodical basis • PPEs are provided, which include safety jacket, safety shoe and helmet.

APPENDIX F: STUDY AREA POPULATION DISTRIBUTION AND GENDER RATIO

Study Area	Male	Female	Gender Ratio
Karnataka	30966657	30128640	973
District- Tumkur	1350594	1328386	984
Taluk - Madhugiri	134670	133196	989
Village- Malagondanahalli	61	67	1098

Source: Census, 2011

APPENDIX G: STUDY AREA VILLAGE SCHEDULED CASTE & SCHEDULED TRIBE POPULATION

Study Area	SC Population (%)	ST Population (%)
Karnataka	17.15	6.95
District- Tumkur	18.92	7.82
Taluk - Madhugiri	24.12	12.19
Village- Malagondanahalli	85.94	0.00

Source: Census, 2011

APPENDIX H: LITERACY SCENARIO OF STUDY AREA VILLAGE

Study Area	Total Literate	Male Literate	Female Literate
Karnataka	75.36	82.47	68.08
District- Tumkur	75.14	82.81	67.38
Taluk - Madhugiri	69.85	79.30	60.33
Village- Malagondanahalli	62.39	69.09	55.56

Source: Census, 2011

APPENDIX I: WORKFORCE PARTICIPATION RATE IN STUDY AREA VILLAGE

Study Area	Cultivator	Agri Labour	Other Workers
Karnataka	23.61	25.67	50.72
District- Tumkur	37.35	26.01	36.65
Taluk - Madhugiri	34.71	40.27	25.02
Village- Malagondanahalli	25.88	74.12	0.00

Source: Census, 2011

Female Work Force Participation Rate

Study Area	Male Worker	Female Worker
Karnataka	65.55	34.45
District- Tumkur	61.83	38.17
Taluk - Madhugiri	55.88	44.12
Village- Malagondanahalli	51.76	48.24

Source: Report on District Level Estimates for the State of Karnataka, 2015-16 & Census, 2011

APPENDIX J: FLORA OF THE WORKING PLAN AREA[20]

Botanical Name	Common name	Family
Trees, shrubs, perennial climbers		
Acacia catechu	Khair	Mimosaceae
Acacia leucophloea	White babul	Mimosaceae
Acacia nilotica	Black babul	Mimosaceae
Acacia pennata	Climbing acacia	Mimosaceae
Agave americana	Agave	Agavaceae
Ailanthus excelsa	Bende / dodda	Simaroubaceae
Albizia lebbeck	Siris / Baage	Mimosaceae
Argyreia nervosa	Elephant creeper	Convolvvulaceae
Azadirachta indica	Neem	Meliaceae
Borassus flabellifer	Tal gaha	Arecaceae
Butea monosperma	Muttuga	Fabaceae
Calotropis gigantea	Crown flower	Asclepiadaceae
Calotropis procera	Bili yekkada gida	Asclepiadaceae
Carissa spinarum	Korindamalekalaavu	Apocynaceae
Cassia auriculata	Ranawara or avaram	Caesalpiniaeae
Cassia fistula	Kakke mara	Caesalpiniaceae
Cassia siamea	Seeme tangdi	Caesalpiniaceae
Chromolaena odorata	Siam weed	Asteraceae
Cocculus hirsutus	Daagadi balli	Menispermaceae
Daemia extensa	Juttuve	Asclepiadaceae
Dalbergia sissoo	Sissoo	Fabaceae
Decalepis hamiltonii	Makali beru	Periplocaceae
Dendrocalamus strictus	Bamboo	Poaceae
Dodonaea viscosa	Bandare	Sapindaceae
Emblica officinalis	Nellikkai	Euphorbiaceae
Erythroxylon monogynum	Red cedar	Erythroxylaceae
Eucalyptus tereticornis	Eucalyptus	Myrtaceae
Euphorbia antiquorum	Triangular spurge	Euphorbiaceae
Euphorbia nivulia	Malekalli	Euphorbiaceae
Ficus benghalensis	Aalada mara	Moraceae
Ficus religiosa	Arali mara	Moraceae
Gmelina arborea	Shivane Mara	Verbenaceae
Hemidesmus indicus	Sugankha pala giddda	Asclepiadaceae
Holoptelia integrifolia	Kaladri	Ulmaceae
Ipomoea carnea	Pink Morning glory	Convolvulaceae

[20] *Abbreviations Used: RE – Regionally Extinct in the Wild; CE – Critically Endangered; EN – Endangered; VU – Vulnerable; NT – Neat Threatened; LC – Least Concern*

Botanical Name	Common name	Family
Jatropha curcas	Dodda haralu	Euphorbiaceae
Jatropha gossypifolia	Chikka kaadu haralu	Euphorbiaceae
Lantana camara	Lantana	Verbenaceae
Leptadenia reticulata	Bugudi Hoovina Gedde	Asclepiadaceae
Maytenus emarginata	Tandrasi	Celastraceae
Melia dubia	Malabar Neem	Meliaceae
Mimosa rubicaulis	Rasne / Urisige	Mimosaceae
Muntingia calabura	Jamaica Cherry	Muntingiaceae
Peltophorum pterocarpum	Haladi Gulmohur	Caesalpiniaceae
Phoenix sylvestris	Wild date	Arecaceae
Phyllanthus reticulatus	Karihuli	Euphorbiaceae
Pithecellobium dulce	Seema hunase	Mimosaceae
Pongamia pinnata	Honge	Fabaceae
Prosopis juliflora	Mesquite	Mimosaceae
Prosopis spicigera	Banni	Mimosaceae
Samanea saman	Male mara	Mimosaceae
Sarcostemma acidium	Leafless East Indian Wine	Asclepiadaceae
Spathodea companulata	Nirukai mara	Bignoniaceae
Syzygium cumini	Nerale mara	Myrtaceae
Tamarindus indica	Tamarind	Caesalpiniaceae
Tarenna asiatica	Asiatic Tarenna	Rubiaceae
Tectona grandis	Sagavani	Verbenaceae
Terminalia arjuna	Arjun	Combretaceae
Tylophora indica	Antamula	Assclepiadacae
Vitex negundo	Nirgundi	Verbenaceae
Wattakaka volubilis	Sneeze Wort	Asclepiadaceae
Wrightia tinctoria	Kondamurki	Apocynaceae
Ziziphus glabrata	Irula	Rhamnaceae
Ziziphus horrida	Kotta mullu	Rhamnaceae
Ziziphus mauritiana	Yalachi	Rhamnaceae
Ziziphus oenoplia	Jackal jujube	Rhamnaceae

List of herbs and herbaceous species found in the core area

Scientific name	Family
Acalypha indica	Euphorbiaceae
Achyranthes aspera	Amaranthaceae
Aerva lanata	Amaranthaceae
Aerva tomentosa	Amaranthaceae
Ageratum conyzoides	Asteraceae
Alternanthera pungens	Amaranthaceae

Scientific name	Family
Alternanthera philoxeroides	Amaranthaceae
Alternanthera sessilis	Amaranthaceae
Alternanthera triandra	Amaranthaceae
Alysicarpus monilifer	Fabaceae
Andrographis echinoides	Acanthaceae
Aristida adscensionis	Poaceae
Blepharis repens	Acanthaceae
Boerhaavia diffusa	Nycataginaceae
Cassia occidentalis	Caesalpiniaceae
Cassia tora	Caesalpiniaceae
Cenchrus ciliaris	Poaceae
Cenchrus setifgera	Poaceae
Chloris barbata	Poaceae
Chrysopogon fulvus	Poaceae
Cleome viscosa	Cleomaceae
Crotalaria medicaginea	Fabaceae
Crotalaria mysorensis	Fabaceae
Crotalaria verrucosa	Fabaceae
Croton bonplandianum	Euphorbiaceae
Cuscuta reflexa	Cuscutaceae
Cyanodon dactylon	Poaceae
Cymbopogon caesius	Poaceae
Cymbopogon coloratus	Poaceae
Cynodon dactylon	Poaceae
Cyperus aristatus	Cyperaceae
Cyperus rotundus	Cyperaceae
Cyperus triceps	Cyperaceae
Dactyloctenium aegyptium	Poaceae
Datura alba	Solanaceae
Datura metel	Solanaceae
Desmodium triflorum	Fabaceae
Dichanthium annulatum	Poaceae
Digera muricata	Amaranthaceae
Digitaria bicornis	Poaceae
Digitaria setacea	Poaceae
Echinops echinatus	Asteraceae
Eclipta alba	Asteraceae
Eclipta prostrata	Asteraceae
Eragrostis tenella	Poaceae
Eremopogon foveolatus	Poaceae

Scientific name	Family
Euphorbia hirta	Euphorbiaceae
Euphorbia thymifolia	Euphorbiaceae
Evolvulus alsinoides	Convolvulaceae
Gomphrena globosa	Amaranthaceae
Hedyotis corymbosa	Rubiaceae
Hedyotis puberula	Rubiaceae
Heliotropium indicum	Boraginaceae
Heteropogon contortus	Poaceae
Hyptis suaveolens	Labiatae
Justicia diffusa	Acanthaceae
Kyllinga triceps	Cyperaceae
Leucas aspera	Lamiaceae
Leucas longifolia	Lamiaceae
Lippia nodiflora	Verbenaceae
Malvastrum coramandelianum	Malvaceae
Merremia gangetca	Convolvulaceae
Merremia tridentata	Convolvulacee
Mollugo hirta	Aizoaceae
Ocimum americanum	Lamiaceae
Ocimum basilicum	Lamiaceae
Ocimum canum	Lamiaceae
Ocimum sanctum	Lamiaceae
Oldenlandia herbacea	Rubiaceae
Oldenlandia umbellata	Convolvulaceae
Oldenlandiua corymbosa	Rubiaceae
Oxalis corniculata	Oxalidaceae
Panicum psilopodium	Poaceae
Panicum repens	Poaceae
Parthenium hysterophorus	Asteraceae
Peristrophe bicalculata	Acanthaceae
Phyllanthus niruri	Euphorbiaceae
Physalis minima	Solanaceae
Polygala arvensis	Polygalaceae
Polygala erioptera	Polygalaceae
Portulaca oleracea	Portulaccaceae
Saccharum munja	Poaceae
Scilla hyacinthina	Liliaceae
Sida acuta	Malvaceae
Sida cordifolia	Malvaceae
Solanum nigrum	Solanaceae

Scientific name	Family
Solanum surattense	Solanaceae
Spermacoce hispida	Rubiaceae
Spermacoce articularis	Rubiaceae
Spermacoce stricta	Rubiaceae
Trianthema decandra	Aizoaceae
Trianthema portulacastrum	Aizoaceae
Tribulus terrestris	Zygophyllaceae
Tridax procumbens	Asteraceae
Vernonia cinerea	Asteraceae
Xanthium strumarium	Asteraceae
Zornia gobbosa	Asteraceae

APPENDIX K: FAUNA OF THE WORKING PLAN AREA

Botanical Name	Common name	Family
Mammals		
Axis	Cheetal/Spotted Deer	III
Bandicota bengalensis	Indian mole rat	IV
Bandicota indica	Bandicoot rat	IV
Canis aureus	Golden Jackal	II
Cynopterus sphinx	Short-nosed Fruit Bat	IV
Dacnomys millardi	Large-toothed giant rat	IV
Funambulus palmarum	Three-striped palm squirrel	IV
Golunda ellioti	Indian bush rat	IV
Herpestes edwardsii	Common mongoose	IV
Herpestes javanicus	Small Indian mongoose	IV
Lepus nigricollis	Indian Hare/Blacknaped Hare	IV
Macaca mulatta	Rhesus Macaque	II
Megaderma lyra	Indian false vampire Bat	IV
Megaderma spasma	Asian false vampire Bat	IV
Mus booduga	Indian field mouse	IV
Mus dunni	House/Rice-field mouse	IV
Parascaptor leucura	White-tailed Mole	IV
Rattus	Common house rat	IV
Soriculus leucops	Indian long-tailed shrew	IV
Sus scrofa	Indian wild boar	III
Vulpes bengalensis	Indian fox	IV
REPTILES	(P=Poisonous)	
Ahaetulla nasutus	Vine snake	IV
Amphiesma stolata	Buffstriped keelback	IV
Bungarus caeruleus	Common krait (P)	IV
Calotes versicolor	Garden lizard	IV
Chameleon zeylanicum	Chameleon	IV
Coelognathus helena	Trinket snake	IV
Daboia russelii	Russell's viper (P)	IV
Dendrelaphis tristis	Bronzebacked tree snake	IV
Echis carinatus	Saw scaled viper (P)	IV
Hemidactylus flaviviridis	Wall lizard	IV
Hemidactylus frenatus	Small wall lizard	IV
Lissemys punctata	Indian plapshell turtle	IV
Lycodon aulicus	Pond Wolf snake	IV
Macropisthodon plumbicolor	Green keelback	IV
Naja	Cobra (P)	II
Oligodon arnensis	Common kukri	IV

Botanical Name	Common name	Family
Oligodon taeniolatus	Variegated or Russell's kukri	IV
Pangshura tentoria	Indian Tent turtle	IV
Ptyas mucosa	Rat snakes	IV
Ramphotyphlops braminus	Blind snake	IV
Varanus bengalensis	Common Indian monitor	IV
Xenochrophis piscator	Checkered keelback	IV
AMPHIBIANS		
Bufo melonosticatus	South Indian Toad	IV
Cacopus bystema	Burrowing frog	IV
Hyla arboria	Tree Frog	IV
Rana hexadactyla.	Ordinary frog	IV
Rana tigrina	Tiger Frog	IV

List of birds either spotted or reported from the study area

Scientific name	Common name	Family	WPA Schedule
Accipiter badius	Shikra	Accipitridae	IV
Acridotheres tristis	Common Myna	Sturnidae	IV
Acrocephalus agricola	Paddyfield Warbler	Sylviidae	IV
Acrocephalus stentoreus	Clamorous Reed Warbler	Sylviidae	IV
Actitis hypoleucos	Common Sandpiper	Scolopacidae	IV
Aegithina tiphia	Common Iora	Aegithinidae	IV
Alauda gulgula	Oriental Skylark	Alaudidae	IV
Alcedo atthis	Common Kingfisher	Alcedinidae	IV
Anas acuta	Northern Pintail	Anatidae	IV
Anas clypeata	Northern Shoveler	Anatidae	IV
Anas penelope	Eurasian Wigeon	Anatidae	IV
Anas poecilorhyncha	Spot-billed Duck	Anatidae	IV
Anas querquedula	Garganey	Anatidae	IV
Anas strepera	Gadwall	Anatidae	IV
Anser indicus	Bar-headed Goose	Anatidae	IV
Anthus hodgsoni	Olive-backed Pipit	Motacillidae	IV
Anthus trivialis	Tree Pipit	Motacillidae	IV
Apus affinis	Little Swift	Apodidae	IV
Ardea cinerea	Grey Heron	Ardeidae	IV
Ardeola grayii	Indian Pond Heron	Ardeidae	IV
Artamus fuscus	Ashy Woodswallow	Artamidae	IV
Athene brama	Spotted Owlet	Strigidae	IV
Aythya ferina	Common Pochard	Anatidae	IV
Bubulcus ibis	Cattle Egret	Ardeidae	IV
Cacomantis passerinus	Grey-bellied Cuckoo	Cuculidae	IV

Scientific name	Common name	Family	WPA Schedule
Cacomantis sonneratii	Banded Bay Cuckoo	Cuculidae	IV
Calidris ferruginea	Curlew Sandpiper	Scolopacidae	IV
Calidris minuta	Little Stint	Scolopacidae	IV
Calidris ruficollis	Red-necked Stint	Scolopacidae	IV
Calidris temminckii	Temminck's Stint	Scolopacidae	IV
Caprimulgus asiaticus	Indian Nightjar	Caprimulgidae	IV
Caprimulgus indicus	Grey Nightjar	Caprimulgidae	IV
Carpodacus erythrinus	Common Rosefinch	Fringillidae	IV
Cecropis daurica	Red-rumped Swallow	Hirundinidae	IV
Celeus brachyurus	Rufous Woodpecker	Picidae	IV
Charadrius dubius	Little Ringed Plover	Charadriidae	IV
Chlidonias hybrida	Whiskered Tern	Laridae	IV
Chrysomma sinense	Yellow-eyed Babbler	Timaliidae	IV
Cinnyris asiaticus	Purple Sunbird	Nectariniidae	IV
Clamator coromandus	Chestnut-winged Cuckoo	Cuculidae	IV
Columba livia	Rock Dove	Columbidae	IV
Copsychus saularis	Oriental Magpie-Robin	Muscicapidae	IV
Coracias benghalensis	Indian Roller	Coraciidae	IV
Coracina melanoptera	Black-headed Cuckoo- shrike	Campephagidae	IV
Coracina melaschistos	Black-winged Cuckoo-shrike	Campephagidae	IV
Corvus macrorhynchos	Large-billed Crow/Jungle	Corvidae	IV
Corvus splendens	House Crow	Corvidae	V
Coturnix coromandelica	Rain Quail	Phasianidae	IV
Coturnix coturnix	Common Quail	Phasianidae	IV
Cuculus canorus	Common Cuckoo	Cuculidae	IV
Cuculus micropterus	Indian Cuckoo	Cuculidae	IV
Cuculus varius	Common Hawk-Cuckoo	Cuculidae	IV
Cypsiurus balasiensis	Asian Palm Swift	Apodidae	IV
Dendrocitta vagabunda	Rufous Treepie	Corvidae	IV
Dendrocygna javanica	Lesser Whistling Duck	Anatidae	IV
Dicaeum agile	Thick-billed Flowerpecker	Dicaeidae	IV
Dicrurus caerulescens	White-bellied Drongo	Dicruridae	IV
Dicrurus hottentottus	Hair-crested Drongo	Dicruridae	IV
Dicrurus leucophaeus	Ashy Drongo	Dicruridae	IV
Dicrurus macrocercus	Black Drongo	Dicruridae	IV
Dinopium benghalense	Black-rumped Woodpecker	Picidae	IV
Dumetia hyperythra	Tawny-bellied Babbler	Timaliidae	IV
Egretta garzetta	Little Egret	Ardeidae	IV
Egretta intermedia	Intermediate Egret	Ardeidae	IV

Scientific name	Common name	Family	WPA Schedule
Elanus caeruleus	Black-winged Kite	Accipitridae	IV
Emberiza bruniceps	Red-headed Bunting	Emberizidae	IV
Eudynamys scolopaceus	Common Koel	Cuculidae	IV
Falco tinnunculus	Common Kestrel	Falconidae	IV
Ficedula parva	Red-breasted Flycatcher	Muscicapidae	IV
Fulica atra	Common Coot	Rallidae	IV
Gallinago gallinago	Common Snipe	Scolopacidae	IV
Gallinago stenura	Pintail Snipe	Scolopacidae	IV
Glareola lactea	Little Pratincole	Glareolidae	IV
Gymnoris xanthocollis	Yellow-throated Sparrow	Passeridae	IV
Halcyon pileata	Black-capped Kingfisher	Alcedinidae	IV
Halcyon smyrnensis	White-throated Kingfisher	Alcedinidae	IV
Haliastur indus	Brahminy Kite	Accipitridae	IV
Hemiprocne coronata	Crested Treeswift	Hemiprocnidae	IV
Himantopus himantopus	Black-winged Stilt	Recurvirostridae	IV
Hirundapus giganteus	Brown-backed Needletail	Apodidae	IV
Hirundo smithii	Wire-tailed Swallow	Hirundinidae	IV
Hydrophasianus chirurgus	Pheasant-tailed Jacana	Jacanidae	IV
Hypothymis azurea	Black-naped Monarch	Monarchidae	IV
Ictinaetus malayensis	Indian Black Eagle	Accipitridae	IV
Ixobrychus minutus	Little Bittern	Ardeidae	IV
Lanius cristatus	Brown Shrike	Laniidae	IV
Lanius schach	Long-tailed Shrike	Laniidae	IV
Leptocoma zeylonica	Purple-rumped Sunbird	Nectariniidae	IV
Lonchura malabarica	Indian Silverbill	Estrildidae	IV
Lonchura malacca	Black-headed Munia	Estrildidae	IV
Lonchura punctulata	Scaly-breasted Munia	Estrildidae	IV
Lonchura striata	White-rumped Munia	Estrildidae	IV
Luscinia brunnea	Indian Blue Robin	Muscicapidae	IV
Luscinia svecica	Bluethroat	Muscicapidae	IV
Lymnocryptes minimus	Jack Snipe	Scolopacidae	IV
Megalaima	Coppersmith Barbet	Ramphastidae	IV
haemacephala			
Megalaima zeylanica	Brown-headed Barbet	Ramphastidae	IV
Merops leschenaulti	Chestnut-headed Bee- eater	Meropidae	IV
Merops orientalis	Green Bee-eater	Meropidae	IV
Merops philippinus	Blue-tailed Bee-eater	Meropidae	IV
Metopidius indicus	Bronze-winged Jacana	Jacanidae	IV
Milvus migrans	Black Kite	Accipitridae	IV

Scientific name	Common name	Family	WPA Schedule
Mirafra erythroptera	Indian Bushlark	Alaudidae	IV
Monticola cinclorhynchus	Blue-capped Rock Thrush	Muscicapidae	IV
Monticola solitarius	Blue Rock Thrush	Muscicapidae	IV
Motacilla cinerea	Grey Wagtail	Motacillidae	IV
Motacilla flava	Yellow Wagtail	Motacillidae	IV
Motacilla maderaspatensis	White-browed Wagtail	Motacillidae	IV
Muscicapa dauurica	Asian Brown Flycatcher	Muscicapidae	IV
Oriolus chinensis	Black-naped Oriole	Oriolidae	IV
Oriolus oriolus	Eurasian Golden Oriole	Oriolidae	IV
Oriolus xanthornus	Black-hooded Oriole	Oriolidae	IV
Passer domesticus	House Sparrow	Passeridae	IV
Pavo cristatus	Indian Peafowl	Phasianidae	I (LC)
Pericrocotus cinnamomeus	Small Minivet	Campephagidae	IV
Pericrocotus flammeus	Scarlet Minivet	Campephagidae	IV
Pernis ptilorhynchus	Oriental Honey Buzzard	Accipitridae	IV
Petrochelidon fluvicola	Streak-throated Swallow	Hirundinidae	IV
Phalacrocorax fuscicollis	Indian Cormorant	Phalacrocoracidae	IV
Phalacrocorax niger	Little Cormorant	Phalacrocoracidae	IV
Phoenicurus ochruros	Black Redstart	Muscicapidae	IV
Phragamaticola aedon	Thick-billed Warbler	Sylviidae	IV
Phylloscopus magnirostris	Large-billed Leaf Warbler	Sylviidae	IV
Phylloscopus trochiloides	Greenish Warbler	Sylviidae	IV
Picus xanthopygaeus	Streak-throated Woodpecker	Picidae	IV
Pitta brachyura	Indian Pitta	Pittidae	IV
Plegadis falcinellus	Glossy Ibis	Threskiornithidae.	IV
Ploceus manyar	Streaked Weaver	Ploceidae	IV
Ploceus philippinus	Baya Weaver	Ploceidae	IV
Pomatorhinus horsfieldii	Indian Scimitar Babbler	Timaliidae	IV
Prinia hodgsonii	Grey-breasted Prinia	Cisticolidae	IV
Prinia inornata	Plain Prinia	Cisticolidae	IV
Prinia socialis	Ashy Prinia	Cisticolidae	IV
Prinia sylvatica	Jungle Prinia	Cisticolidae	IV
Pseudibis papillosa	Indian Black Ibis	Threskiornithidae	IV
Psittacula cyanocephala	Plum-headed Parakeet	Psittacidae	IV

Scientific name	Common name	Family	WPA Schedule
Psittacula krameri	Rose-ringed Parakeet	Psittacidae	IV
Pycnonotus cafer	Red-vented Bulbul	Pycnonotidae	IV
Pycnonotus jocosus	Red-whiskered Bulbul	Pycnonotidae	IV
Pycnonotus leucogenys	White-cheeked Bulbul	Pycnonotidae	IV
Recurvirostra avosetta	Pied Avocet	Recurvirostridae	IV
Rhipidura albicollis	White-throated Fantail	Rhipiduridae	IV
Rhipidura aureola	White-browed Fantail	Rhipiduridae	IV
Rhopodytes viridirostris	Blue-faced Malkoha	Cuculidae	IV
Riparia diluta	Pale Sand Martin	Hirundinidae	IV
Rostratula benghalensis	Greater Painted-snipe	Rostratulidae	IV
Saxicola caprata	Pied Bushchat	Muscicapidae	IV
Saxicola torquatus	Common Stonechat	Muscicapidae	IV
Saxicoloides fulicatus	Indian Robin	Muscicapidae	IV
Stachyris ruficeps	Rufous-capped Babbler	Timaliidae	IV
Streptopelia chinensis	Spotted-necked Dove	Columbidae	IV
Streptopelia decaocto	Eurasian Collared Dove	Columbidae	IV
Sturnus malabaricus	Chestnut-tailed Starling	Sturnidae	IV
Sturnus pagodarum	Brahminy Starling	Sturnidae	IV
Sturnus roseus	Rosy Starling	Sturnidae	IV
Sturnus vulgaris	European Starling	Sturnidae	IV
Surniculus lugubris	Asian Drongo-Cuckoo	Cuculidae	IV
Sylvia curruca	Lesser Whitethroat	Sylviidae	IV
Tadorna ferruginea	Ruddy Shelduck	Anatidae	IV
Threskiornis melanocephalus	Black headed Ibis	Threskiornithidae.	IV
Treron phoenicopterus	Yellow-legged Green Pigeon	Columbidae	IV
Tringa erythropus	Spotted Redshank	Scolopacidae	IV
Tringa glareola	Wood Sandpiper	Scolopacidae	IV
Tringa nebularia	Common Greenshank	Scolopacidae	IV
Tringa ochropus	Green Sandpiper	Scolopacidae	IV
Tringa totanus	Common Redshank	Scolopacidae	IV
Turdoides affinis	Yellow-billed Babbler	Timaliidae	IV
Turdoides caudata	Common Babbler	Timaliidae	IV
Turdoides malcolmi	Large Grey Babbler	Timaliidae	IV
Turdoides striata	Jungle Babbler	Timaliidae	IV
Turdus merula	Eurasian Blackbird	Turdidae	IV
Tyto alba	Barn Owl	Tytonidae	IV
Upupa epops	Common Hoopoe	Upupidae	IV
Vanellus cinereus	Grey-headed Lapwing	Charadriidae	IV

Scientific name	Common name	Family	WPA Schedule
Vanellus indicus	Red-wattled Lapwing	Charadriidae	IV
Vanellus malabaricus	Yellow-wattled Lapwing	Charadriidae	IV
Zoothera citrina	Orange-headed Thrush	Turdidae	IV
Zoothera marginata	Dark-sided Thrush	Turdidae	IV
Zoothera wardii	Pied Thrush	Turdidae	IV
Zosterops palpebrosu	Oriental White-eye	Zosteropidae	IV

APPENDIX L: LETTER TO KREDL

FERO FUTURE ENERGIES

Ref: KREDL/NA/180MW/48
Date: 27/05/2017

To
The Managing Director,
Karnataka Renewal Energy Development Ltd.,
No.39, "Shanthi Gruha"
Bharath Scouts & Guides Building,
Opp.the Chief Post Master General Office,
Palace Road, Bangaluru - 560 001.

Dear Sir,

Sub: Permission to purchase agricultural lands under new deemed conversion solar policy.
Ref: 1. KREDL LOA No. KREDL/07/RPO/GC/1200MWs-269/2016/1233, dated 23-03-2016
2. Govt. Order No. RD 69 LGP 2015

We have proposed to purchase agricultural lands Machagondanahalli & Pulamachi village, ID Halli Hobli, Madhugiri Taluk, Tumkur District in various survey numbers as per the list appended to set up Solar power project and have enclosed necessary documents.

KARNATAKA RENEWABLE ENERGY DEVELOPMENT LIMITED has allocted 20MW to start solar Power Project at the above mentioned taluk vide orders referred at Ref.1.

Pursuant to the amendment of Section 109 of the Karnataka Land Reforms Act (Deemed conversion) vide orders referred at Ref.2 to promote solar power projects by GOK, the Revenue department has simplified 109 procedures in order to avoid inordinate delay in the implementation of the project which is eco-friendly.

Since we have obtained all the necessary documents required to file u/s.109 KLR 1961, we request you to write a letter to the Tumkur Deputy Commissioner office to process of our file U/S.109 KLR 1961 and grant permission to buy the required land (Extent list appended) as per the new deemed conversion solar policy to establish solar power plant.

Thanking you,

Yours faithfully,

For M/s Clean Solar Power (Tumkur) Private Limited

Authorised Signatory.

Enclosures:
1. Filled in form 19A
2. Copy of the Government Order regarding deemed Conversion for Solar Project;
3. Copy of LOA awarded through KREDL
4. Certificate of Incorporation;
5. Memorandum of Articles of Association
6. Detailed project report
7. RTC of the land

K.R.E.D.L. Date 27/05/17 BANGALORE

Shaping positive power

CLEAN SOLAR POWER (TUMKUR) PVT LTD.
CIN – U40101DL2016PTC298461
Regional office: No-302, 3rd FLOOR, PRESTIGE INFANTRY COURT, INFANTRY ROAD, BANGALORE- 560001, INDIA
Registered office: 212, GROUND FLOOR, OKHLA INDUSTRIAL ESTATE PHASE-III, NEW DELHI 110020, INDIA
Corporate office: 202, THIRD FLOOR, OKHLA INDUSTRIAL ESTATE PH-III, NEW DELHI 110020, INDIA
Landline No.+91 11 49598000, Fax No. +91 11 49598022
Email:-info@fenerfutureenergies.com, Website: www.fenerfutureenergies.com

APPENDIX M: POWER PURCHASE AGREEMENT

POWER PURCHASE AGREEMENT

BETWEEN

BANGALORE ELECTRICITY SUPPLY COMPANY (BESCOM)

AND

M/s CLEAN SOLAR POWER (TUMKUR) PRIVATE LIMITED
SPV of (M/s HERO SOLAR ENERGY PRIVATE LIMITED)

FOR

Development of Solar Power Project in the State of Karnataka

For Clean Solar Power (Tumkur) Private Limited

Authorised Signatory

General Manager (Ele),
PP , BESCOM, B'lore.

INDIA NON JUDICIAL

Government of Karnataka

e-Stamp

सत्यमेव जयते

Certificate No.	:	IN-KA50506731079482O
Certificate Issued Date	:	23-May-2016 02:36 PM
Account Reference	:	NONACC (FI)/ kaksfcl08/ SHIVANADA/ KA-BA
Unique Doc. Reference	:	SUBIN-KAKAKSFCL08506413225168330
Purchased by	:	CLEAN SOLAR POWER TUMKUR PVT LTD
Description of Document	:	Article 12 Bond
Description	:	POWER PURCHASE AGREEMENT
Consideration Price (Rs.)	:	0 (Zero)
First Party	:	BESCOM
Second Party	:	CLEAN SOLAR POWER TUMKUR PVT LTD
Stamp Duty Paid By	:	CLEAN SOLAR POWER TUMKUR PVT LTD
Stamp Duty Amount(Rs.)	:	200 (Two Hundred only)

Please write or type below this line

POWER PURCHASE AGREEMENT

This Power Purchase Agreement (PPA) (hereinafter shall be referred to as **"Agreement"**) is entered into on this the **26th day of MAY month, of 2016** year

AMONGST

1. Bangalore Electricity Supply Company Limited, a Company incorporated under the Indian Companies Act, 1956 having its registered office at BESCOM Corporate Office ,K.R.Circle, Bengaluru(hereinafter shall be referred to as **"BESCOM"**, which expression shall, unless it be repugnant to the context or meaning thereof, include it's administrators, successors, and assigns);

AND

For Clean Solar Power (Tumkur) Private Limited

Authorised Signatory

Statutory Alert:

1. The authenticity of this Stamp Certificate should be verified at "www.shcilestamp.com". Any discrepancy in the details on this Certificate and as available on the website renders it invalid.
2. The onus of checking the legitimacy is on the users of the certificate.
3. In case of any discrepancy please inform the Competent Authority.

M/s. Clean Solar Power (Tumkur) Private Limited, a company incorporated under the provisions of the Companies Act, [1956/2013] and having its registered office at No 212, Ground Floor, Okhla Industrial Estate, Phase-III, New Delhi, South Delhi, Delhi-110020, India, (hereinafter shall be referred to as "**Developer**") which expression shall, unless repugnant to the context or meaning thereof, include its successors and permitted assigns and substitutes) of the Other Part.

WHEREAS:

A. Karnataka Renewable Energy Development Limited (hereinafter shall be referred to as "**KREDL**") incorporated under the companies Act, 1956 is a nodal agency of the Government of Karnataka (hereinafter shall be referred to as "GoK") for facilitating the development of renewable energy in Karnataka. GoK had resolved to undertake development of 1,200 MW(AC) (One Thousand and Two Hundred Mega Watt) of solar power in Karnataka to be implemented in 60 Taluks through private sector participation.

B. Pursuant thereto, KREDL had accordingly invited proposals by its "**Request for Proposal (RP)**" dated 20.11.2015 prescribed the technical, commercial terms and conditions for selection of Bidders for undertaking development of solar PV ground mount power plants in Karnataka to be implemented in 60 Taluks. In this regard, KREDL had received proposals from certain bidders including, inter alia, the ReNew Solar Power Private Limited{the single business entity}

C. After evaluation of the Proposal received, KREDL had accepted the bid of the {single business entity/ Consortium} for development of 20 MW (AC) capacity of [Solar PV ground mount Project (Crystalline Silicon Solar Cells and Modules)] in the Madhugiri Taluk with google coordinate of the location as and issued its Letter of Award NoKREDL/07/RPO/GC/1200MWs-269/2016/1233 dated:23.3.2016(herein after called the "**LOA**") [and an Allotment Letter No. NoKREDL/07/RPO/GC/1200MWs-269/2016/1233 dated: 23.3.2016] to the {single business entity/ Consortium} ["**Selected Bidder**"] requiring, inter alia, the execution of this Agreement.

D. {The single business entity/ Consortium has since promoted and incorporated the Developer ("**Special Purpose Vehicle**" or"**SPV**"), in accordance with the terms of RFP and has requested BESCOM through a letter bearing number RP/2016/04 dated 5th April 2016 to accept the Developer as the entity which shall undertake and perform the obligations and exercise the rights of the Selected Bidder under the LOA, including the obligation to enter into this Agreement pursuant to the LOA for executing the Project.

E. {By its letter dated 5th April 2016 the Developer has also joined in the said request of the single business entity/ Consortium to BESCOM to accept it as the entity which shall undertake and perform the obligations and exercise the rights of the single business entity/ Consortium including the obligation to enter into this Agreement pursuant to the LOA. The Developer has further represented to the effect that it has been promoted by the single

5A

For Clean Solar Power (Tumkur) Private Limited

Authorised Signatory

APPENDIX N: CERTFICATE OF REGISTRATION FOR BOCW (BUILDING AND OTHER CONSTRUCTION WORKERS)

FORM II
[See Sub-rule (1) of Rule (16)]
GOVERNMENT OF KARNATAKA
OFFICE OF THE REGISTERING OFFICER

No:LOT/CWWB/RGN-02/2017-18

Office of the Labour Officer,
& Registration Authority, Building And
Other Construction Workers Act,
Kandaya Bhavan, Beside District Court,
Tumkur. Date : 03-05-2017

A certificate of Registration is hereby granted under sub-section (3) of Section 7 of the building and other construction Workers (Regulation of employment and Conditions of Service) Act, 1996, and the rules made there under to **M/s CLEAN SOLAR POWER (TUMKUR)PVT LTD**, having the following particulars subject to conditions laid down in the Annexure.

01	Postal address/location where building Other construction work is to be Carried on by the employer	:	M/s Clean Solar Power(Tumkur) Pvt Ltd, Malagondanahalli,(Vo) Madhugiri(Tq) Tumkur.
02	Name and address of employer including location of the building and other Construction work	:	Mr. Madhusoodana PK M/s Clean Solar Power(Tumkur) Pvt Ltd, Malagondanahalli,(Vo) Madhugiri(Tq) Tumkur.
03	Name and permanent address of the establishment	:	M/s Clean Solar Power(Tumkur) Pvt Ltd, No-302, 3rd Floor, Prestige Infantry Court, 130 Infantry road, Bangalore-01.
04	Nature of work in which building workers are employed or are to be employed	:	Civil Works
05	Maximum number of building workers to the employed on any day by the employer	:	100 No's
06	Probable date of commencement and Completion of work	:	01-05-2017 To 30-04-2018
07	Other particulars relevant to the employment of building workers	:	RS.1000/- SBM Challan No- 168 Date : 03-05-2017

Place : Tumkur
Date : 03-05-2017.

Signature
Registering Officer

ಕಾರ್ಮಿಕ ಅಧಿಕಾರಿ
ತುಮಕೂರು ಜಿಲ್ಲೆ, ತುಮಕೂರು

APPENDIX O: HERO FUTURE ENERGIES SHES POLICY

HERO FUTURE ENERGIES ™

planet positive power

Occupational Health Safety & Environment Policy

Hero Future Energies Private Limited (HFE), the renewable energy venture of the Hero Group, is committed to safeguard occupational health, safety and environment of its employees, contractors, clients, stakeholder and the communities in which we operate. HFE is poised to attain sustainable development by improving occupational health, safety and environmental conditions at all our offices & project locations by adhering to the following practices:

- Adoption of safe work culture at all our project locations and offices.
- Identification and mitigation of significant environmental aspects and occupational health and safety hazards by practicing effective HSE Management System.
- Preventing employees, contractors and interested parties from injury and ill health.
- Preventing & controlling pollution by adopting good Environmental Management Practices.
- Providing regular HSE training to employees associated with us.
- Complying with all relevant legal and other requirements applicable to us.
- Communicating, involving and consulting employees in our HSE Management System.
- Ensuring this policy is communicated and available for employees and other interested parties.
- Ensuring reporting of all relevant incidents and investigating them to prevent recurrence.
- Conducting regular inspection and audits.
- Ensuring commitment towards sustainability by complying with the Green Code of Company, implementing 3R (Reduce, Reuse and Recycle) and I.E.R (Individual Environment Responsibility).
- Ensuring minimum Occupational Health & Safety impact on the society in which we operate by complying with National & International Standards applicable to us.
- Continuous improvement in the HSE performance at all our offices and project locations is an integral part of our work culture.

Sunil Jain
Chief Executive Officer

Rahul Munjal
Managing Director

Hero Future Energies Pvt. Ltd.
(A Hero Group Company)
P +91 11 49538000
F +91 11 49538022
E info@herofutureenergies.com
W www.herofutureenergies.com

APPENDIX P: PRINCIPAL LABOR REGISTRATION CERTIFICATE

22/4/2017

GOVERNMENT OF KARNATAKA

DEPARTMENT OF LABOUR

ALC-B-1/CLAP-1050005503/2017-18

Office of the Assistant Labour Commissioner
BENGALURU-1
Karmika Bhavan
Bannerughatta Road
Near Dairy Circle,
Bengaluru-29

Fee:Rs 3000

Date:22/04/2017

FORM-II
(See Rule19(1))

CERTIFICATE OF REGISTRATION

A Certificate of Registration containing the following particulars is hereby granted under sub-section(2) of Section 7 of the Contract Labour(Regulation and Abolition) Act 1970 and the rules made thereunder to M/s Clean Solar Power (Tumkur) Pvt. Ltd., Maragondanahalli Village, Madhugiri Taluka, Tumkur District, M/s Clean Solar Power (Tumkur) Pvt. Ltd. No. 332, 3rd Floor, Prestige Infantry Court, 130 Infantry Road, Bangalore - 560001.

Registration Details :

1, Nature of work carried on the Establishment	Solar Plant Developers
2. Names and address of Contractors	As Per Annexure
3. Nature of the work in which contract labour is employed or is to be employed	As Per Annexure
4, Maximum number of contract labour to be employed on any day through each	200
5, Other particulars relevant to the employment of contract labour.	The Conditions of Licence contained in the Licence issued to each of the Contractors shall be complied with. If any conditions of Licence is violated/contravened then the Principal Employer shall be held responsible for such violation

Assistant Labour Commissioner
Bengaluru-1, ಬೆಂಗಳೂರು

APPENDIX Q: REGULAR EVACUATION APPROVAL SAMPLE PAGE

KARNATAKA POWER TRANSMISSION CORPORATION LIMITED

Fax No : 080-22292204
Phone No: 080-22210416

Office of the
Chief Engineer (Ele)
(Planning & Co-ordination)
2nd Floor, KPTCL,
Kaveri Bhavan,
Bengaluru 560009

No: CEE (P&C)/ SEE (Plg)/EE (PSS)/KCO-93/81141/F-936 **Date: .04.2017**

1500 - 515

26 APR 2017

To,
M/s. Clean Solar Power (Tumkur) Pvt Ltd,
(SPV of Hero Solar Energy Pvt Ltd)
212, Ground Floor,
Okhla Industrial Estate PH-III,
New Delhi - 110020

Sir,

Sub: Regular Evacuation scheme for your proposed 20 MW solar project in Madhugiri Taluk, Tumakuru District- reg

Ref: 1) Your letter no: KPTCL /Evacuation /180MW /25 dated: 06.12.2016

2) KREDL LOA letter no: KREDL /07/RPO /GC /1200MWs-269/ 2016/ 1233 dated: 23.3.2016 issued to M/s Hero Solar Energy Pvt Ltd for Madhugiri taluk, Tumkur District & Paid Rs. 20,90,000/- facilitation fee to KREDL vide Rt.No: 342 dated 25/5/2016.

3) KREDL Letter no: KREDL /07 /RPO /GC /1200MWs-269 / 2016 /2359 dated: 5.7.2016-Regarding invitation of tenders not based on KPTCL Feasibility.

4) KREDL Letter no: KREDL /SG /07 /F-78 /SECI / 2016 /2706 dated: 3.8.2016 regarding facilitation fees

5) KERC letter addressed to MD, KREDL vide letter no: KERC /S /F-31 /Vol-1131 /16-17 /1092 dated: 21.7.2016

6) KERC letter addressed to MD, BESCOM vide letter no: KERC /S /F-31 /Vol-1131 /16-17 /1196 dated: 22.7.2016

7) KREDL Letter no: KREDL /SG /07 /F-73 /KERC / 2016 /2896 dated: 23.8.2016

8) T.O. note approved by MD, KPTCL in connection with processing 1200MW KREDL Projects on 23.8.2016

9) KERC letter addressed to ACS, Vikas Soudha vide letter no: KERC /S /F-31 /Vol-1131 /16-17 /1443 dated: 29.8.2016

10) T.O. letter no: 12716-717 feasibility report furnished by KPTCL on 27.2.2016 to MD KREDL

APPENDIX R: THE ENVIRONMENT AND SOCIAL POLICY

AECOM
Built to deliver a better world

Annexure I Environment and Social Policy

Hero Future Energy (HFE) is committed to generate Clean Power leading to a Greener Planet for our future generations HFE intends to introduce environment and community friendly source of energy through renewable options. HFE is committed to environmental excellence in all its activities. HFE will maintain cordial relations with community we work with. We shall strive to limit our direct impacts on the environment and community while delivering our projects.

- We will provide utmost weightage to environmental and social considerations for all our operations;
- We shall strive for reduction of pollution and waste generation through improvement in operational efficiency;
- We will focus on energy and resources conservation measures ;
- We will involve with community and stakeholders to mutually benefit from all our projects;
- We will comply with all applicable laws and regulations
- We will preserve and enhance biodiversity in our projects
- We will ensure commitment towards sustainability by complying with the Green code of Company, implementing 3R (Reduce, Reuse and Recycle) and IER (Individual Environment Responsibility)
- We will communicate the environmental and social policy to all employees, customers and other stakeholders and ensure it is available to the public
- We will review the environmental and social policy to ensure their continuing applicability and relevance to our operations and evolving stakeholder expectations

The corporate policy shall be signed by the Chief Executive Officer of HFE.

The policy shall be communicated to HFE employees, contractors and associated stakeholders. The signed policy shall be displayed at the corporate office, all project companies and on the website of the company.

APPENDIX S: CSR POLICY

POLICY NO. HFE/CSR01	CSR POLICY
HERO FUTURE ENERGIES HERO FUTURE ENERGIES PVT. LTD.	

1.0 OBJECTIVE

1.1 HFE is dedicated to contribute in the Country's development by focusing on economic, social and environmental capital towards enhancing societal sustainability. Our endeavour is to provide inclusive growth at our project locations by working on improving/providing basic amenities to communities around our project sites and generate possibilities of employment.

1.2 To contribute to the Prime Minister's National Relief Fund or any other fund set up by the Central Government at the time of natural calamity or engage in Disaster Management system.

1.3 To contribute to any fund setup by the Central Government or State Government(s) including Chief Minister's Relief Fund, which may be recognized as CSR activity;

1.4 To promote sustainability in partnership with industry associations, like the Confederation of Indian Industry (CII), PHD, FICCI, NGO's, Government schemes like Swachh Bharat etc.

1.5 Undertake CSR programs in collaboration or through Raman Kant Munjal Foundation.

2.0 GUIDING PRINCIPLE OF THE POLICY

2.1 The Policy shall be governed by the provisions of the relevant Act made there under.

3.0 APPLICABILITY

3.1 This Policy is applicable to HFE for implementing CSR as per Clause **135** of the Companies Act, **2013**

3.2 Eligibility Criteria - The CSR provisions within the Act is applicable to Companies with an annual turnover of **1,000** crore INR and more, or a net worth of **500** crore INR and more, or a net profit of five crore INR and more. The Act encourages Companies to spend at least **2%** of their average net profit in the previous three years on CSR activities.

4.0 COVERAGE

4.1 This Policy lays down guidelines of implementing projects falling under CSR framework.

5.0 RESPONSIBILITY AND AUTHORITY

5.1 Approval, renewal and change in this Policy is the responsibility of HR, under approval of the CEO and MD.

5.2 Monitoring and implementation of this Policy is the responsibility of the CSR Committee.

6.0 REFERENCE

6.1 Clause **135** of the Companies Act, **2013**

POLICY NO. HFE/CSR01	CSR POLICY

HERO FUTURE ENERGIES

HERO FUTURE ENERGIES PVT. LTD.

11.0 RESPONSIBILITIES OF CSR WORKING COMMITTEE

11.1 The CSR committee shall formulate and recommend a CSR strategy and Policy to the Board, indicating the activities as specified in Schedule VII of the Act.

11.2 recommend the amount of expenditure to be incurred on the activities indicated in the Policy.

11.3 monitor the CSR policy regularly.

12.0 CSR STRATEGY

12.1 Our Company will implement projects which will have definite beginnings, ends, expected outputs and outcomes as well as budgets associated with it.

12.2 The projects that will be undertaken may be of a short duration (a few months) or multi-year.

12.3 We will implement projects either through in-house teams or in partnership with other agencies or a combination of both. In case of multi-year projects, same will be reviewed on an annual basis or as at such time as may be decided by the Committee..

12.4 Selected projects will be grouped as per their implementation period in a 1- year plan, 2-year plan and a 3-year plan. These plans will be presented annually at the meeting of CSR committee of the Board.

13.0 CSR PROGRAMMES

13.1 Project to be implemented under CSR in a specific area will depend on the needs of local community. People of the local community will be involved in decision making regarding programmes to be undertaken. A detailed due diligence of the area/community would be done to identify the critical needs and their prioritization and a project will be shortlisted.

13.2 Once the Project is shortlisted then a Detailed Project Report will be prepared therafter and presented to the Board level CSR Committee for Approval.

13.3 Following is a list of CSR Programmes that will be undertaken

13.3.1 Preserving natural resources eg. Creating water pools, Rain water harvesting.

13.3.2 Basic amenities eg. Providing access to water, electricity, education, toilets, health care etc.

13.3.3 Possibilities of employment

13.3.4 Any other that can be added to the list as and when finalised after discussion.

14.0 CSR Fund

14.1 The corpus for the purpose of carrying on the aforesaid activities would include the following:

14.1.1 2% of the average Net Profit made by the Company during immediately preceding three Financial Years.

14.1.2 any income arising there from.

14.1.3 surplus arising out of CSR activities carried out by the Company and such surplus will not be part of business profit of the Company.

POLICY NO. HFE/CSR01	CSR POLICY

HERO FUTURE ENERGIES

HERO FUTURE ENERGIES PVT. LTD.

15.0 CSR PROCESS

15.1 Following are the list of activities that will be undertaken as part of the implementation of CSR Process

15.1.1 Framing the CSR Strategy

15.1.2 Operationalizing the institutional mechanism

15.1.3 Due diligence of the implementation partner

15.1.4 Project development

15.1.5 Project approval

15.1.6 Finalising the arrangement with the implementing agency

15.1.7 Progress monitoring and reporting

15.1.8 Impact measurement

15.1.9 Report consolidation and communication

16.0 FOLLOW – UP AND REVIEW

16.1 After the CSR project has been implemented in any area, the CSR working Committee will do a follow-up on regular basis to check whether the desired outcome has been achieved or not and whether the project implemented is operating as per the plan. In case, there is a gap in the desired result and actual implementation then corrective action needs to be taken and reporting to be done accordingly.

17.0 CSR TO SUBMIT ANNUAL REPORT

17.1 CSR Committee shall in each calendar year prepare, in such form and at such time as may be prescribed, an annual report and submit the same to the employer and the District Officer.

18.0 ATTACHMENTS

Description	Format No.
CSR Committee	HFE/CSR01/F1
Detailed Project Report	HFE/CSR01/F2
Annual Report	HFE/CSR01/F3

19.0 AMENDMENT

This Policy is subject to change at the sole discretion of the Management but in accordance with the provisions of the Companies Act.

APPENDIX T: GRIEVANCE REDRESSAL MECHANISM

Grievance Redressal Mechanism

a) What is Grievance Redressal Mechanism Procedure?

Grievance Redressal Mechanisms focus to meet requirements, prevent and address community concerns, reduce risk, and assist processes that create positive social change.

b) Why it is necessary?

Managing community grievances is equally important, especially in the present arrangement of land purchase where there is a likelihood of people not being satisfied. There could be grievances due to the way construction activities are carried out or Labour movement in local area etc. HFE needs to mitigate such issues either by getting directly involved or by ensuring that mitigation is done by its contractors.

c) What is uniqueness of our Grievance Redressal Mechanism?

- Provides a predictable, transparent, and credible process to all stakeholders, resulting in outcomes that are fair, effective, and lasting;
- Builds trust as an integral component of broader community relations activities and between employees;
- Enables more systematic identification of emerging issues and trends, facilitating corrective action and community engagement.

d) Grievance Committee formation

A site level Grievance Redressal Committee (GRC) consisting of representatives from the contractors and HFE officials has formed. The GRC is designed at three levels – Levels I to III. The representatives proposed at different levels of the GRC are as below:

Three tier approaches

Level 1

- Site Supervisors and Site HR Officer of Contractor
- Liaison Officer

Level 2

- E&S Supervisor
- Liasion Officer
- HR Head of contractor at site

Level 3

- CEO
- HSE Lead
- Corporate HR

- The GRC meet at project site on monthly basis and on corporate level as and when the grievances are filed by the workers or persons from community.
- The complaints escalated to the higher level if the lower level fails to address the grievance to the satisfaction of complainant.

Arcadis India Pvt. Ltd.

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Logixtechno Park,
Plot No.5, Sector 127 Noida
T: (0120) 4368 400

Arcadis.com