



Environment & Social Impact Assessment Study for 50MW Solar Farm at Manvi, Karnataka

Clean Solar Power (Gulbarga) Pvt Ltd

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Quality Information

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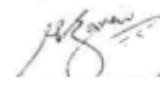


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1. INTRODUCTION

M/s Clean Solar Power (Gulbarga) Pvt Ltd. (hereinafter referred as “CSPGPL”), a special purpose vehicle (SPV) of Hero Future Energies Pvt. Ltd. (hereinafter referred as “HFE”) is developing a 50 MW Solar Project (hereinafter referred as “project”). The proposed solar farm is spread across two (02) villages namely, Machnur and Singaddinni falling in Manvi Taluka of Raichur district, Karnataka India.

HFE is an Independent Power Producers (IPP) and currently has ~500 MW installed project capacity across ten states in the India, with over 1 GW of wind projects and over 500 MW of solar projects in the pipeline. The following are the solar farm projects undertaken by HFE as of May, 2017:

Table 1-1: List of HFE Solar Projects across India

S. No.	Project Location	Capacity
1	Dhar, Madhya Pradesh	30MW
2	Chitradunga, Karnataka	20MW
3	Hiriyur, Karnataka	30MW
4	Medak, Telangana	40MW
5	Barod, Madhya Pradesh	43MW
6	Manvi, Karnataka	50MW

Source: HFE

In order to ensure that the project is established in a manner that is socially responsible and reflects sound environmental management practices, CSPGPL intends to carry out an Environmental and Social Impact Assessment (ESIA) study for the proposed project, in accordance with International Finance Corporation’s (IFC) Performance Standards (PS) on Social and Environmental Sustainability, 2012; Health and Safety Guidelines, 2015; and applicable national legislations. The aim of the study is to provide an assessment of the ability of the project to comply with the requirements of the above mentioned guidelines as required by financial investors. CSPGPL has engaged AECOM India Pvt. Ltd. (hereinafter referred as “AECOM”) to undertake an Environmental and Social Impact Assessment (ESIA) study for the project.

This ESIA report has been prepared on the basis of a reconnaissance survey, baseline environmental monitoring, review of secondary data and consultation with relevant stakeholders. Based on the requirements of the IFC PSs, adequate management plan and systems are also expected to be developed as part of this assessment.

1.1 Project Background

CSPGPL is planning to set up a 50MW (AC) grid connected Solar PV power plant, which has been allotted by Solar Energy Corporation of India (SECI) under Jawaharlal Nehru National Solar Mission (JNNSM) Phase II, Batch III for Karnataka. The proposed project will utilize the module capacity of 310-320 Wp (Watt Peak) for power generation (Trina Solar Modules). The proposed project will be spread over approximate 287.02 acres of land from two (02) villages, Machnur and Singaddinni in Manvi Taluka of Raichur District of Karnataka. Land selected for the proposed development comprises of private rain-fed agricultural land.

The energy generated will be evacuated at the 110/33/11 kV utility substation located at Kurdi Village. The length of the proposed 110KV single circuit transmission line between power plant and utility substation is expected to be approximately 6.8 km. The metering required for power purchase will be done at the utility substation end. The installed capacity at the plant is 55017 kWp (Kilo Watt Peak).

1.2 Purpose and Scope

The study is being undertaken to understand the environmental and social impacts associated with proposed 50MW project in accordance with the requirements of the IFC’s Performance Standards. The scope of work includes:

- Undertaking a reconnaissance survey of the study area viz., about 5 Km around the project location;
- Collection of secondary data from authenticated agencies/authorities and published secondary sources on various environmental and social components such as:

- Land use pattern;
- Demography and socio-economic status;
- Information pertaining to economic profile, land ownership patterns, basic amenities and local infrastructure;
- Biological environment and ecology ;
- Archaeology, sensitive locations and cultural heritage sites.
- Primary monitoring using baseline information on the following:
 - Water quality of the project area;
 - Soil Quality of the project area; and
- Collection of information on forestry, flora and fauna, natural habitats and species of special conservation /scientific interest through primary ecological assessment of the study area;
- Assessment would specifically include impact on glare;
- Study of the various activities during the construction and operational phase of the solar plants to identify the impacts on various environmental components as well as the areas/activities that lead to such impacts;
- Undertaking a public consultation and information dissemination session with project affected persons and other relevant stakeholders;
- Detailed review of land acquisition and compensation process;
- Addressing the potential social and environmental issues relevant to the “IFC Performance Standards”;
- Preparation of Environmental and Social Management Plan (ESMP) that needs to be adopted for mitigation of anticipated impacts due to the project.

The reference framework used for the ESIA study includes:

- IFC Environment and Social Sustainability Framework and Performance Standards (PS) 1 to 8;
- General World Bank EHS Guidelines and sector specific guidelines,
- Applicable local, national and international environmental and social legislation.

1.3 Approach and Methodology

The approach and methodology applied for the execution of the impact assessment study is as provided:

- The relevant project document and Detailed Project Report (DPR) was reviewed to understand the project requirements;
- Regulatory review was undertaken to understand the applicable, local and national legislation and regulatory frameworks;
- A detailed social and environmental assessment of site and surrounding areas was undertaken through:
 - Reconnaissance survey to understand site settings and sensitivities;
 - Discussions with the local community and identification of impacts on them during planning, construction and operation phase of the project;
 - Ecological assessment on flora and fauna of the site and study area through primary surveys and secondary literature review;
 - Collation of secondary information on social aspect of the site, supplemented by consultations with the local communities to understand community perception with regard to the project and its activities.
- Assessment of impacts based on understanding of the project activities and existing baseline status; and
- Preparation of Environment and Social Management Plan.

1.4 Limitations

The study undertaken is structured around the project information as provided by the project proponent, any change in significant activities may result in variation of outcome. Professional judgement and subjective interpretation of facts has been applied for interpretation of various aspects. All information and inferences presented herein are based on the details currently available as per the scope of work, information provided by the client or its representative, existing secondary data, budget and schedule.

1.5 Layout of the Report

The remaining chapters of the report include the following:

Chapter 2: Project Description – This chapter provides information related to various feature of the proposed power plant including power generation process, utilities, water requirement and other proposed infrastructure facilities. It also provides the glimpse of project schedule for approval and implementation.

Chapter 3: Environmental & Social Regulatory Framework – This chapter provides information on Policy, Legal and Administrative framework applicable to the proposed solar project. The section also defines applicability of IFC Performance Standards for the proposed project.

Chapter 4: Environment & Socio-Economic Baseline – This chapter presents the findings based on primary and secondary data on physical and biological environments, to present the baseline environmental condition of the study area. It includes the information regarding micro-meteorology, water environment, air environment, soil environment and ecological environment of the study area.

Chapter 5: Stakeholder Engagement and Consultation - This chapter presents socio-economic profile of the study area based on primary and secondary information. This chapter also presents stakeholder identification process for the project, details of consultations held with key questions and responses extracted from the survey undertaken during site visit.

Chapter 6: Analysis of Alternatives – Alternatives considered for the proposed project are evaluated and discussed in this chapter.

Chapter 7: Evaluation of Impacts – This chapter provides details of the environmental and social impact assessment of the project during construction, operational and decommissioning phases. It expresses the impacts of the proposed project on the various components of environment. Mitigation measures are suggested along with the impact prediction.

Chapter 8: Environmental and Social Management Plan - This chapter deals with the Environmental and Social Management Plan incorporating recommendations to implementation of the suggested mitigation measures to minimize adverse environmental and social impacts during construction, operation and decommissioning phases. The chapter includes management program, organization structure, training, community engagement, monitoring and reporting elements.

Chapter 9: Conclusion and Recommendation - This chapter consolidates the conclusions and recommendations of the ESIA Study carried out for the Solar PV Report.

2 PROJECT DESCRIPTION

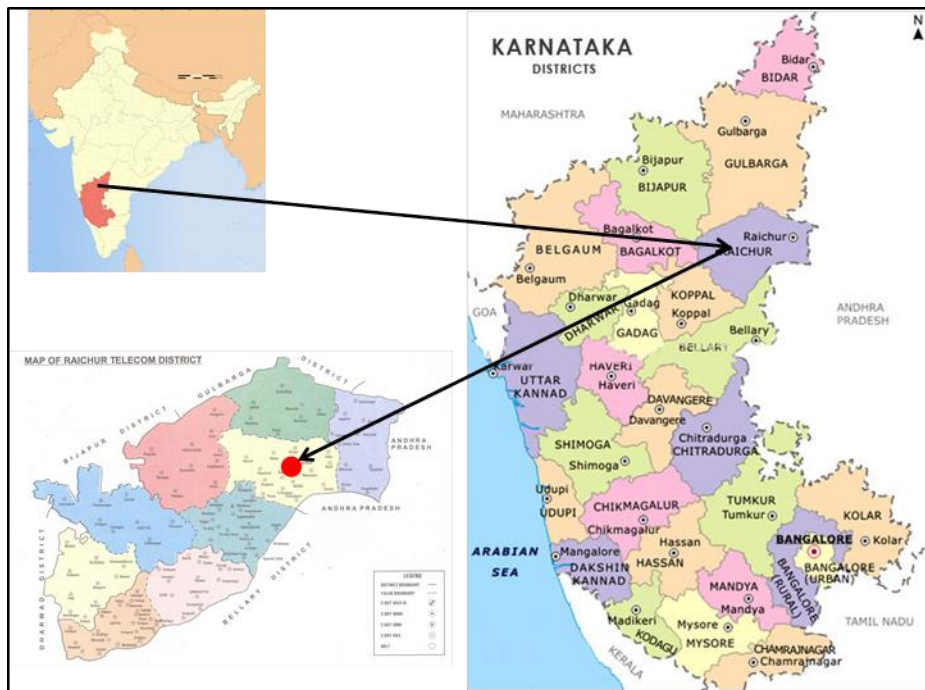
This section presents a description of the site settings and project components along with other associated facilities. This section also elaborates on the various project phases along with its implementation mechanism and schedule.

2.1 Site Description

2.1.1 Site Location

The proposed project site is spread over two villages, namely, Machnur and Singaddinni in Manvi Taluka of Raichur District, Karnataka. The nearest highway is the State Highway – 20 (also known as Bachi-Raichur Highway), which connects Raichur to Lingsugur, and is located at a distance of 1.5km from the site towards the north direction. . The site is located at a distance of 25km from Raichur Town and 95km from Kurnool. Hyderabad airport is the nearest airport at a distance of 200km from Site. There is no railway station within 10 km from the proposed site; however Raichur is the nearest railway station to the site, is located at a distance of 22km in north-east direction. **Figure 2-1** below presents the site location of the proposed project.

Figure 2-1: Location of the Proposed Project



Source: Google images

The site selected for the project comprises of private agricultural land from Machnur and Singaddinni villages of Manvi Taluka which has been identified based on the solar irradiation data, geotechnical investigations, ease of land procurement, benefit and losses due to irradiation, shading analysis, distance from main substation, line construction length and complexity required for line construction. The average global horizontal irradiation in the region is in the range of 1900 kWh/m² to 2050 kWh/m². This irradiance is generally suitable for reasonably good energy generation.

2.1.2 Site Settings

The site area comprises of privately owned agricultural land which is characterised by black cotton soil. The project site is undulating and has an average elevation of about 380 m above mean sea level. There was no agriculture taken place in last 3-4 years due to minimum rainfall and currently is fallow land (as illustrated in **Figure 4-3**). The site comprise of scanty vegetation in form of shrubs and grasses. A small seasonal waterbody is present in north-west direction of the site which remains devoid of water for most of the part of year. A 'Babul Tree' is located on a parcel of land which is worshipped by the locals of the area once a year. Reportedly, the site representatives mentioned that the tree will not be cut and access will be provided to the community. Also, thirteen (13) Neem Trees present within the site premises will not be removed. A man made canal is also situated at a distance of 300m from the site in north-west direction. There was no water observed at in the canal at the time of site visit. The nearest habitation around the site is Machnur village, located at a distance of

1.8km approximately towards the south-west direction. River Krishna flows in south direction of the site at a distance of 20km.



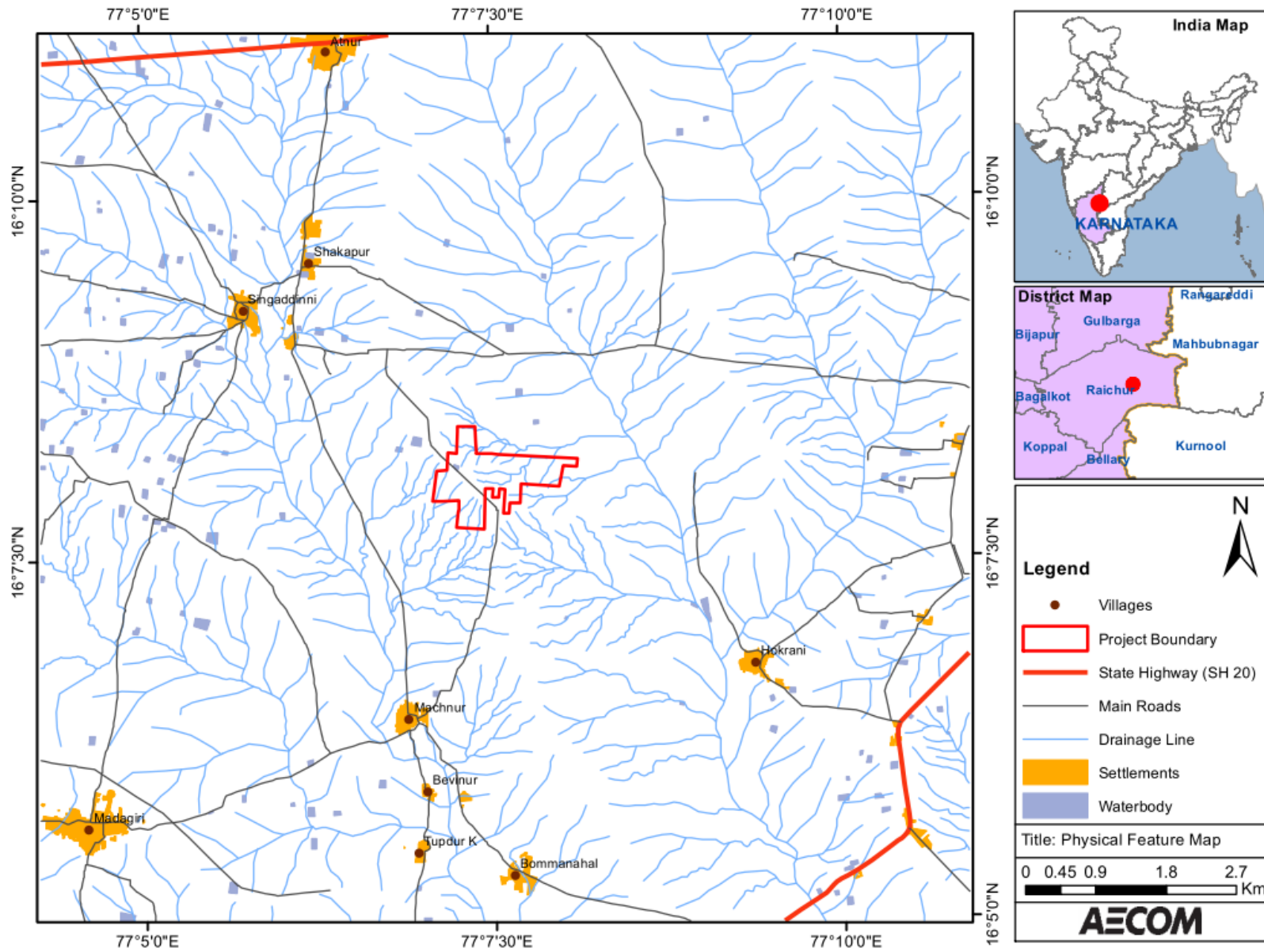
Figure 2-2: View of Man-made pond in the north direction of the site



Figure 2-3: A Babul Tree located in a parcel of land

The physical features of project site are depicted in map below:

Figure 2-4: Physical Features of the Project



2.2 Plant Layout

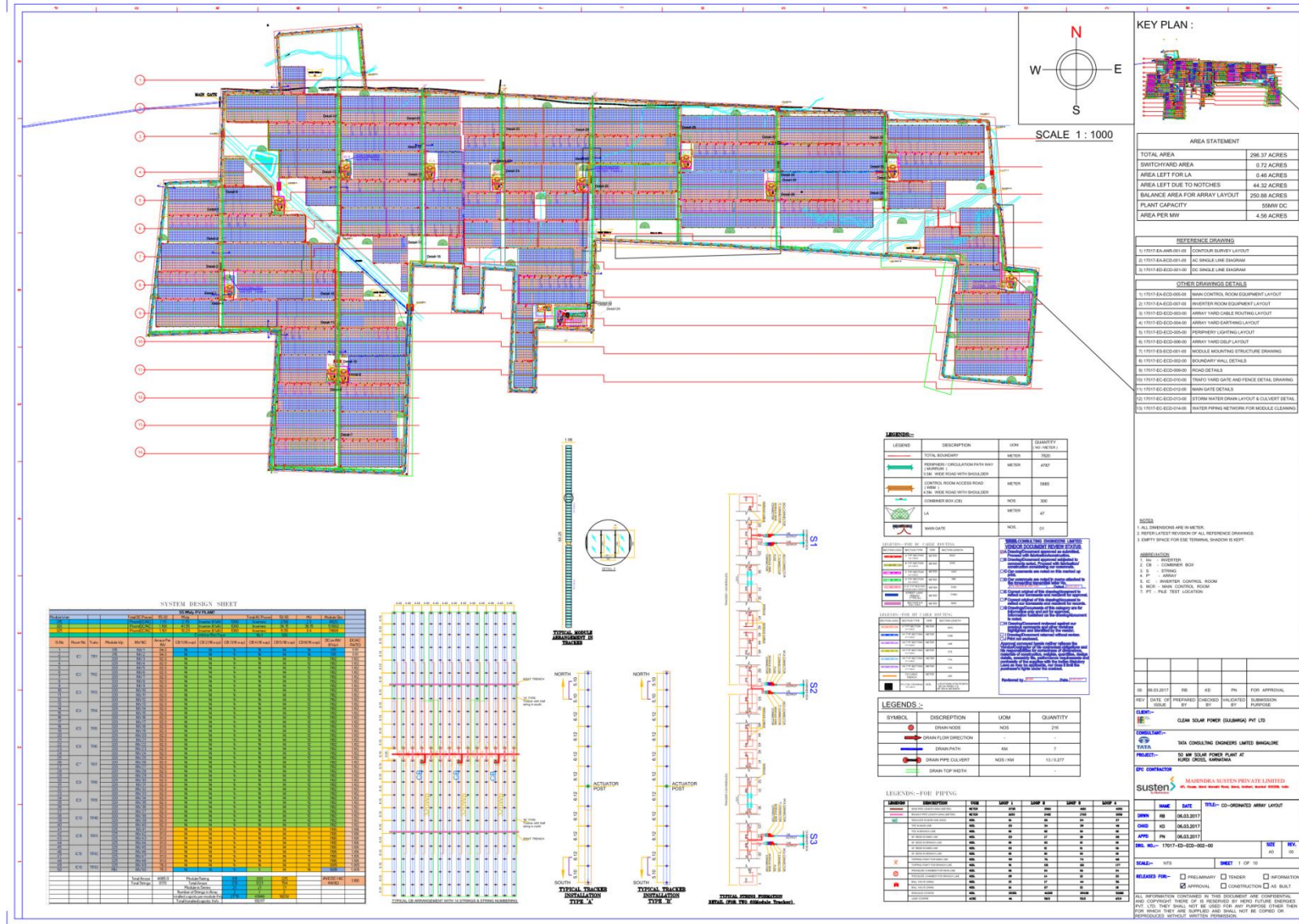
The proposed 50MW (AC) solar power project will be based on poly crystalline silicon (c-Si) Solar Photo Voltaic technology using Module Make Trina Solar for power generation. The energy generated will be evacuated at the 110/33/11 KV utility substation of KPTCL located at Kurdi Village. The length of the proposed 110 kV single circuit transmission line between power plant and utility substation is expected to be ~6.8 km. The plant is expected to generate energy about 95 Million KWh annually. The salient features of the project components have been presented in **Table 2-1** and Figure below and the details have been provided in subsequent sections.

Table 2-1: Details of Proposed PV Power Plant

Parameter	Description	Make
Solar PV Modules -310 Wp	198415	Trina
Module mounting structure	1x42 matrix	HFE Design
Grid interactive inverter	40	ABB/Schneider/Hitachi/equivalent
String Combiner Box	400	Statcon/Trinity touch/equivalent
Cables as per design DC	Set	Lapp/KEI/Polycab/equivalent
Cables as per design AC	Set	KEI/Polycab/equivalent
Substation: Transformer, CTs, Pts, isolators, circuit breakers, surge arrestors	Set	PCI/ABB/Areva/ equivalent
Metering-TVM 0.5s, 415 LT CT based	Set	L&T/Secure/equivalent
Lightning arrester	Set	Jef/Sabo/equivalent
Earthing kit	Set	Jef/Sabo/equivalent

Source: Detailed Project Report

Figure 2-5: Layout of Proposed Project



2.2.1 Project Components

Mounting Structure

Suitable number of array frames shall be provided. The array frame proposed for the site would utilize design with a different tilt angle capability. The array frames will be made up of MS galvanised/ Aluminium and is protected against the salt mist corrosion confirming to IS 2062.

Inverter

Inverter for the proposed plant will be grid connected which will be a combined unit comprising of inverter and necessary protections

Junction Box & Distribution Boards

The array junction box will be used to combine the strings from PV array to one point to avoid complex cabling and losses. The junction box will comply with IP 65 standard. The output from each Combiner Box can be fed to a Dc distribution board which is designed to isolate the solar module part from the inverter for maintenance purpose.

Cables

The multi- strand copper cables will be utilized for the proposed project. The size of the cable will be carefully selected ensuring limited power & voltage drop. All the cabling will be carried out as per the standards.

Earthing & Lightning Protection

The earthing of all outdoor equipments & provision of associated earthing systems electrodes and connections will be as per IS 3043 standards. Earth electrodes will be made up of heavy duty GI pipes 40mm in diameter and 3.5m long. The frames of all electrical equipments & structural works will be earthed by connection to the earth grid by branches of same cross sectional area of earth grid.

2.3 Status of the Project during Site Survey

As on date of the site visit, the project was in construction phase. CSPGPL has engaged M/s Mahindra Susten as EPC Contractor in February, 2017. Mahindra has deployed 30 employees to manage the various ongoing activities at the project site. CSPGPL has also engaged M/s PVR Contractor based out of Hyderabad for construction of 6.8km long transmission line and 32 transmission poles from the project site to Kurdi Cross Sub-station. Contractor Agis Power Pvt. Ltd is also employed for construction of 8km boundary wall around the site. CSPGPL has taken 6 acres of land on lease from Machnur village for construction of labour camp. CSPGPL has also employed 15 security guards through a contractor wherein 8 guards are assigned for night shift (10: pm to 6: am) and 6 guards work in day shift (6: am to 10: pm.). A small first aid centre was provided at the main gate of the construction site with all the necessary equipment and medicines. The land procurement process of 287.02 acres was completed and all the land is in possession of CSPGPL.



Figure 2-6: View of ongoing Construction at the project site



Figure 2-7: View of compacted internal road within the site premises

2.4 Land Requirement

The proposed 50 MW project will be developed on 287.02 acres of land falling in Machnur and Singaddinni villages of Manvi Taluka, Raichur District. The land for the project comprises of privately owned agricultural land and the process of land procurement was completed in February, 2017. Land is purchased through a willing seller -buyer arrangement with the land owners in both the villages (refer to 2.4.1 for further details on land procurement process). There has been no physical displacement occurring due to the land procurement. Reportedly, the site representative mentioned that

approximately 4.56 acres of land is required for development of land for generation of 1MW. The details of land purchased for entire project including area for site development and access road has been provided below:

Table 2-2: Break up of land for Different Project Components

S. No	Project Component	Area in Acres
1	Area for development of array layout	250 acres
2	Switch Yard Area	0.72 acres
3	Area for development of access road	2-4 acre
4	Area left due to undulating slopes and prevalence of drainage pattern.	30 acre

Source: Data Collected onsite

2.4.1 Process for Land Procurement

CSPGPL has engaged a local land aggregator (a local person) belonging to Sirvar village who assisted in land procurement from the land owners of the two villages. Process of land purchase normally involves a land sale deed between the seller and the buyer on a judicial stamp paper. Initially, CSPGPL undertook a survey of land and land rates (registered rate and prevailing market rate) in the area to arrive at a compensation range. The following conditions were considered for the land procurement process:

- 1) The transaction took place with the seller's informed consent; and
- 2) The seller was provided with payments above the prevailing market values.

Land parcels measuring to be about 287.02 acres have been identified and procurement process from 26 land owners residing in Machnur and Singaddinni villages is completed as in date of site visit. The list of land sellers is provided in **Appendix A**. During interactions with land aggregator, it was informed that on an average INR 5, 40,000 per one acre of compensation was paid to each land seller on "willing buyer/willing seller" arrangement. The amount paid to the land sellers is double the prevailing market rates (INR 2 lakh per acre). It was understood during community consultations that the land sellers have voluntarily sold their land for the proposed project. It was noted that due to the minimal rainfall received during past few years and low crop production, most farmers have decided to sell their land for the project.

After identification of land, verification of land to be procured was taken by evaluation of Register of Lands of Khetwar Patrika, Records of Rights, Tenancy and Crop Inspection Register (RTC) Form 16, revenue records for last 30 years was undertaken. After confirmation, agreements to sell between land owners and CSPGPL have been executed in February, 2017. As on date of site visit, it was reported that approximately 287.02 acres of land has been procured and execution of agreement to sell with the land owners in name of CSPGPL has been completed. The land owners/sellers are required to obtain permission for conversion of land for non-agricultural Industrial purpose and permission under section 109 of Karnataka Land Reforms Act 1961 for sale deed registration.

Land for Transmission Line

During consultations held with transmission line Contractor M/s PVR Contractor, It was informed that no house or community structures are located under the route of transmission line. An area of 4mx4m or 15m x15m has been taken for installation of pole. Only Right of way has been secured by providing adequate compensation to the land owners where transmission poles are proposed to be installed in Machnur, Kallur and Horkarani villages.

2.5 Power Purchase Agreement

CSPGPL has signed a Power Purchase Agreement with SECI, for distribution of power generated to Bangalore Electricity Supply Company Limited (BESCOM). The electricity produced will be evacuated to 110/33/11 kV Kurdi Cross Sub Station located at a distance of 8km from the proposed site located in South-East Direction.

2.6 Implementation Schedule

The project is envisaged to be commissioned by end of June, 2017. The detailed implementation schedule of the completion of project starting from inception stage is presented in

Table 2-3.

Table 2-3: Implementation Schedule: Project

S. No.	Project Deliverable	Timeline
1.	Procurement of land and hand over to EPC contractor	28 th February, 2017
2.	Survey of Land	5 th March, 2017
3.	Completion of fencing and boundary of site	13 th May, 2017
4.	Transmission Line & Bay Contract	25 th February, 2017
5.	Procurement & Delivery of equipment and solar panels	15 th June, 2017
6.	EPC Contractor – Finalisation	16 th February, 2017
7.	Site Mobilization	30 th March, 2017
8.	Execution of works (civil works and installation of solar panels)	20 th June, 2017
9.	Testing of the solar plant	25 th June, 2017
10.	Process for Commissioning	30 th June, 2017

Source: HFE

2.7 Construction Activities

2.7.1 Site Preparation Works

The proposed project site at the time of site visit was noted to be fallow and unutilized (refer section LULC: 4.3). Site preparation will involve excavation works, clearing of vegetation, and transportation of construction materials. As understood from the ecological assessment, the vegetation cover does not support habitat of significant and threatened species. Thus, it would not lead to any significant loss of important species or ecosystems. CSPGPL has undertaken the clearing of the site and will hand over the site to EPC contractor for further construction and development of solar farm. CSPGPL has contracted M/s Mahindra as EPC contractor for the project. Other subcontractors including RKCC, Surya Coti and M.S. Infra have also been engaged by Mahindra to perform civil works. EPC Mahindra is ISO 9001:2015, ISO 14001:2015 and OHSAS 18001:2007 certified Company. It has formulated an Environment, Quality, and Health & Safety Policy which is endorsed by CEO of Mahindra (dated 17th August, 2016).

2.7.2 Equipment

Various kinds of machineries will be utilized during construction phase like Crane to unload materials, forklift to lift and transport materials, hammer driving piles to provide support for buildings and other structures. Diesel Generators will be utilized for provision of electricity during construction phase.

2.7.3 Labour requirement & Accommodation

During construction stage, the average labour demand for the proposed project is estimated to be about 200 workers. The peak labour requirement for the project will be about 300-350 workers. The unskilled labour and security guards for the project have already engaged from local community through a contractor.

The employment of labour for various works is the responsibility of the respective contractor. CSPGPL has leased 6 acres of land from Machnur village for a year for construction of labour camps by the contractor. Erection, procurement and construction of the proposed project will be supervised by CSPGPL, who have also engaged 15-20 Engineers for construction phase. The Engineers will be accommodated in guest house located at Raichur town, located at a distance of 25 km from proposed site in north-east direction.

2.7.4 Water & Waste water

It is estimated that about 80-85¹ kilo litres of water will be required for the entire construction phase (which includes water requirements for curing works, batching plant and domestic requirement of workers).

¹ 45 liter/day is considered as domestic water requirement for labor working onsite for full day (350 workers and approximately 50 staff/ employees) 10 water tankers with each capacity of 6KL are considered for curing, foundation, piling and batching plant

It will be the responsibility of respective contractors for making arrangements to meet water requirements for construction works and domestic purposes. Water tankers from authorized vendors will be sourced from nearby villages. Waste water generation from the construction activities will be limited to washing and cleaning activities. Adequate number of portable toilets² with septic tank and soak pits will be provided at site to facilitate the disposal of sewage generated.

2.7.5 Waste Generation

Solid waste generation during the construction phase consists primarily of scrapped building materials, excess concrete and cement, rejected components and materials, packing and shipping materials (pallets, crates, Styrofoam, plastics etc.) and human waste. During the construction there will be generation of garbage, for which designated practices of solid waste disposal shall be followed.

2.7.6 Power Requirement

The power requirement during construction phase will be sourced from, 3-4 Diesel Generators sets of different capacities ranging from 15 - 30 kVA. Installation of DG sets will be the responsibility of the respective sub-contractor.

2.8 Operations and Maintenance

The solar photovoltaic system requires least maintenance among all power generation facilities due to the absence of fuel, intense heat, rotating machinery, waste disposal, etc. However, keeping the photovoltaic panels in good condition, monitoring and correcting faults in the connected equipment and cabling are still required in order to get maximum energy from the plant. The maintenance functions of a typical solar PV power plant can be categorized as given.

- 1) Scheduled or preventative maintenance – Planned in advance and aimed at preventing faults from occurring, as well as keeping the plant operating at its optimum level.
- 2) Breakdown maintenance – carried out in response to failures.

2.8.1 Maintenance Requirement

The main objective of the plant maintenance is to keep the plant running reliably and efficiently as long as possible. Efficient operation implies close control not only over the cost of production but also over the cost of maintenance. There are two components in maintenance cost: one is the direct cost of maintenance, (i.e. the material and labour), and the other is the cost of production loss.

2.8.2 Routine Maintenance

Several maintenance activities need to be completed at regular intervals during the lifetime of the system. The energy yield of the plant will be monitored using the remote data acquisition system connected to each inverter. Significant reduction in energy yield will trigger specific maintenance requirements, such as inverter servicing or module replacement. Typical activities required are described below:

- 1) **General maintenance:** Vegetation will need to be cut back if it starts to cause a fire risk or introduce shading;
- 2) **Modules:** Visual inspection and replacement of damaged modules will be required. Cleaning of the module glass surface during long dry periods may be considered. Module cleaning needs to be carried out periodically to remove dust, bird dropping etc.;
- 3) **Wiring and junction box:** Visual inspection for corrosion, damage such as chafing and damage by rodents and birds and for overheating of cables and connections;
- 4) **Inverter Servicing** – Inverter faults are the most common cause of system downtime in PV power plants and therefore, the scheduled maintenance of inverters should be treated as a centrally important part of the O&M strategy. The preventive maintenance of inverters includes visual inspection, cleaning/replacing cooling fan filters, removal of dust from electronic components, tightening of any loose connections etc.

2.8.3 Breakdown Maintenance

Breakdowns can occur due to lack of routine or preventive maintenance, bad climatic conditions, disturbance in utility grid etc. As breakdowns affect energy generation and hence revenue generation, these kind of faults needs to be immediately corrected. Breakdown can occur at any part of the system between solar PV modules to substation end.

² Usual Standard as 1 unit for 15 persons as per IFC EHS Guidelines

2.8.4 Operation and Maintenance Staff

The manpower requirement for the operation phase of the Project has been estimated to be approximately 10 skilled staff (engineers and technicians) and 4 semi-skilled labour for cleaning of solar panels. About 4- 5 security guards will also be deployed during operation phase. Site-In-Charge will be responsible for all site related issues and will coordinate with security guards, operation contractor, and equipment service provider.

2.8.5 Water and Waste Water

The water requirements for the plant will be predominantly for washing of solar PV modules periodically to remove bird droppings, dust and other dirt. Assuming a minimum of 1 litres of water per module, the water requirement for cleaning the whole plant (i.e. 1, 98,415 modules) will be approximately 200 kilo litres, at one time. With a cleaning schedule of twice a month, it is estimated that approximately 400-450 kilo litres of water will be required for cleaning purpose on monthly basis and the requirements will be met through water tankers. A centralized water tank is also proposed to be constructed in south- eastern direction of the plant, which will be filled by the water received from water tankers during operation phase.

2.8.6 Training

It will be necessary to have the operation and maintenance personnel to have requisite qualifications, experience and skill. The Plant Manager will be selected as an experienced person, preferably drawn from similar industry. Adequate training will be provided to operation and maintenance personnel at the Photovoltaic power plant. The training requirements shall cover:

1. The nature, purpose and limitations of all plant and equipments;
2. The detailed operation instructions on each section and equipment of the plant;
3. Normal Start up and shut down program for the plant;
4. The emergency procedures and all related HSE issues according to the standards;
5. The basis for the training shall be the plant's O&M Manual.

2.9 Associated Facilities

2.9.1 Power Evacuation

Power from the solar PV plant is proposed to be evacuated to the 110/33/11 kV grid substation at Kurdi (owned by Karnataka Power Transmission Corporation Limited) which is located at a distance of about 6.8km from the site in South-East direction. CSPGPL has already received approval for construction of 110 kV line of 8km length from project site to 110/33/11 kV substation from KPTCL. According to the approval obtained, CSPGPL is required to purchase land adjacent to Kurdi Sub-Station for construction of 110 kV TB with metering and shall hand over the land along with 110kV TB to KPTCL for maintenance.

2.9.2 Access Roads

An access road of about 1.5km in length and approximate 3 m in width will be developed to provide connectivity to the site from road connecting Singaddinni to Machnur. The land required for development of road has been procured from a land owner of Singaddinni village which is approximately 4 acres.

3 ENVIRONMENTAL AND SOCIAL REGULATORY FRAMEWORK

This section highlights the environmental and social regulations applicable to the proposed solar power project. The section broadly focuses on the institutional framework, applicable environment, health & safety and social legislative requirements, World Bank Operational Policies and IFC Performance Standards relevant to the proposed Project.

3.1 Enforcement Agencies

In India, Ministry of New and Renewable Energy (MNRE) is the nodal agency to manage upcoming solar power projects and the environmental aspects are governed by Ministry of Environment, Forests and Climate Change (MoEFCC), Central Pollution Control Board (CPCB) Central Electricity Authority (CEA) and Central Electricity Regulatory Commission (CERC).

All the permissions and the approvals have to be taken from the concerned ministries, line departments and the local civic bodies for any upcoming project in India. The environmental and social governance approach in the country consists of –

1. Regulatory and implementing entities;
2. Legal framework including policies, acts and laws; and
3. Permitting system.

Table 3-1: Enforcement Agencies and their Functions

S. No	Agencies	Description	Functions
1	Ministry of Environment , Forest and Climate Change (MoEFCC)	Nodal Agency for planning, promotion, co-ordination and overseeing the implementation of environmental and forestry policies and programmes	<ul style="list-style-type: none"> • Environmental policy planning; • Effective implementation of legislation; • Monitoring and control of pollution; • Environmental Clearances for industrial and development projects covered under EIA notification; • Promotion of environmental education, training and awareness; and • Forest conservation, development, and wildlife protection.
2	Central Pollution Control Board (CPCB)	For the implementation of the Water (Prevention and Control of Pollution) Act, 1974	<ul style="list-style-type: none"> • Prevent pollution of streams and wells; • Advise the Central Government on matters concerning prevention, control and abatement of water and air pollution; • Co-ordinate the activities of State Pollution Control Board's (SPCB's) and provide them with technical and research assistance; • Establish and keep under review quality standards for surface and groundwater and for air quality; • Planning and execution of national programme for the prevention, control and abatement of pollution through the Water and Air Acts; and • The CPCB is also responsible for the overall implementation and monitoring of air and water pollution control under the Water Act, 1974, and the Air Act, 1981

S. No	Agencies	Description	Functions
3	Karnataka State Pollution Control Board (KSPCB)	To implements various environmental legislations in the State of Karnataka, Such as Water (Prevention and Control of Pollution) Act, 1974; Air (Prevention and Control of Pollution) Act, 1981; Water (Cess) Act, 1977; some of the provisions under Environmental (Protection) Act, 1986 and the rules framed there under like, Biomedical Waste (Material and Handling) Rules, 2016; Hazardous Waste (Management, Handling and Transboundary Movement) Rules, 2016 and Solid Waste Management Rules, 2016, E-Waste (Management and Handling) Rules, 2011, etc.	<ul style="list-style-type: none"> To plan comprehensive program for the prevention, control or abatement of pollution and secure executions thereof; To collect and disseminate information relating to pollution and the prevention, control or abatement thereof; To inspect sewage or trade effluent treatment and disposal facilities, and air pollution control systems and to review plans, specification or any other data relating to the treatment plants, disposal systems and air pollution control systems in connection with the consent granted; Supporting and encouraging the developments in the fields of pollution control, wastes recycle reuse and eco-friendly practices;
4	Department of Ecology and Environment, Karnataka	Headed by the Principal Secretary, Forest, Ecology and Environment & is under the administrative control of minister of cabinet rank for Forest, Ecology & Environment.	<p>Responsible for the enforcement of various environment related Acts, Rules, Notifications etc., including;</p> <ul style="list-style-type: none"> Implementation of Air (Prevention and Control of Pollution) Act, 1981 Water (Prevention and Control of Pollution) Act, 1974 Environment Protection Act 1986 and notifications issued under the Environment Protection Act. Implementation of National River Conservation Plan & National Lake Conservation Plan. To accord Environmental Clearances in respect of certain categories of industries To take up activities for the protection of Bio-diversity in the State To oversee the activities / functioning of Karnataka State Pollution Control Board To oversee Coastal Zone Management of Karnataka.
5	Petroleum and Explosives Safety Organization (PESO)	PESO is under the Department of Industrial Policy & Promotion, Ministry of Commerce and Industry, Government of India	<p>To deal with the Provisions of</p> <ul style="list-style-type: none"> The Explosive Act, 1884 and Rules, 1983, The Petroleum Act, 1934 and the Rules 2002, The Static and Mobile pressure vessels {Unfired} Rules, 1981 and amendment 2000, 2004; Manufacture, Storage and Import of Hazardous Chemical Rules, 1989 and amendment 2000
6	Ministry of Renewable Energy	Nodal ministry of Government of India for all matters related to new and renewable energy	To develop and deploy new and renewable energy for supplementing the energy requirements of the country a stated on its website
7	Department of Factories, Boilers, Industrial Safety and Health, Government of Karnataka	Nodal agency for implementing various programs and policies for the safety, health and welfare of the workers.	<ul style="list-style-type: none"> To promote and create awareness Industrial Health and Safety; To promote the policies and programs necessary for popularizing the factories Act, building and other construction workers act, and other labour legislations; To promote and implement the protection rights of workers and grievances redressal mechanism.
8	Karnataka Renewable Energy Development Limited (KREDL)	Agency under the purview of Energy Department, Government of Karnataka. Devoted to promote projects for harnessing energy from wind, small-hydro, biomass, solar energy and	<ul style="list-style-type: none"> Promotion & Installation of renewable energy in the State and to initiate all necessary actions for Energy Conservation in the State Generation of awareness about new and Renewable Energy technologies;

S. No	Agencies	Description	Functions
		energy recovery from wastes through private investment.	<ul style="list-style-type: none"> Act as a channel for evaluation of challenges and opportunities arising from law and policy for the promotion of clean energy; Implementation of demonstration projects based on Energy Efficiency and Renewable Energy; <p><i>CSPGPL should obtain a Certificate of Commissioning from KREDL after commissioning of the project. Project should also be registered under the State Nodal Agency.</i></p>
9	Central Electricity Authority (CEA)	Statutory Body constituted under the erstwhile Electricity (Supply) Act, 1948, hereinafter replaced by the Electricity Act, 2003, where similar provisions exists, the office of the CEA is an "Attached Office" of the Ministry of Power.	Is responsible for the technical coordination and supervision of programmes and is also entrusted with a number of statutory functions.
10	Central Regulatory Election Commission	To promote competition, efficiency and economy in bulk power markets, improve the quality of supply, promote investments and advise government on the removal of institutional barriers to bridge the demand supply gap and thus foster the interests of consumers	<ul style="list-style-type: none"> Improve the operations and management of the regional transmission systems through Indian Electricity Grid Code (IEGC), Availability Based Tariff (ABT), etc.; Formulate an efficient tariff setting mechanism, which ensures speedy and time bound disposal of tariff petitions, promotes competition, economy and efficiency in the pricing of bulk power and transmission services and ensures least cost investments; facilitate open access in inter-state transmission; Facilitate inter-state trading; Promote development of power market; and Improve access to information for all stakeholders.
11	Central Ground Water Authority	constituted under Sub-section (3) of Section 3 of the Environment (Protection) Act, 1986 for the purposes of regulation and control of ground water development and management	<ul style="list-style-type: none"> To resort the penal provisions contained in section 15 to 21 of the said act; To regulate and control, management and development of ground water in the country and to issue necessary regulatory directions for the purpose; and Exercise of powers under section 4 of Environment (Protection) Act, 1986 for the appointment of Officers.
12	Gram Sabha or the Panchayats	local bodies which have been defined by the 73 rd Constitutional Amendment Act, 1992	<ul style="list-style-type: none"> Preparation of plans for economic development and social justice and the implementation of such schemes for economic development and social justice, as may be assigned to them. <p><i>A Non- Objection Certificate (NOC) has to be obtained for the project from the Gram Panchayat of Machnur and Singaddinni Villages for procuring land. NOC is yet to be received from the Gram Panchayat.</i></p>

S. No	Agencies	Description	Functions
13	Karnataka Power Transmission Company Limited (KPTCL)	Wholly Owned by Govt of Karnataka. Mainly vested with the functions of Transmission of Power.	<ul style="list-style-type: none"> • Provide innovative, efficient and tailored electricity products and services with a strong emphasis on risk management for itself and its consumer. • Construction of Stations & Transmission Lines and maintenance of Sub-Stations. • Create more business opportunities for other segments in MP power sector and enhance the profitability for each of that segment. <p><i>Approval for route of transmission line from site to 110/33/11 kV substation for power evacuation is to be obtained from KPTCL. Approval has also to be obtained from Electrical Inspectorate, Karnataka for interconnection scheme and bay equipments along with protection equipments.</i></p>

3.2 Applicable Environmental and Social Laws, Regulations and Policies

Various policies released by the Government of India from time to time needs to be addressed while undertaking the projects. Some of the policies (including sector specific) have been discussed briefly in the subsequent sections. The relevant Acts and Rules pertaining to the proposed project is summarised in Table 3-2.

National Environmental Policy 2006: The dominant theme of this policy is that while conservation of environmental resources is necessary to secure livelihoods and well-being of all, the most secure basis for conservation is to ensure that people dependent on particular resources obtain better livelihoods from the fact of conservation, than from degradation of the resource.

National Electricity Policy 2005: The National Electricity Policy 2005 states that Environmental concerns would be suitably addressed through appropriate advance action by way of comprehensive Environmental Impact Assessment and implementation of Environment Action Plan (EAP). As per the policy, adequate safeguards for environmental protection with suitable mechanism for monitoring of implementation of Environment Action Plan and R&R Schemes should be put in place. Open access in transmission has been introduced to promote competition amongst the generating companies who can now sell to different distribution licensees across the country. This should lead to availability of cheaper power.

Karnataka Solar Policy: To harness the potential of the solar resource in the state, Government of Karnataka (GoK) had issued a Solar Policy for the period 2011-2016. In light of the technological advantages unfolding in the sector and achievements made by Solar forefront states, the Karnataka 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. The GOK revised its Solar Policy to Karnataka Solar Policy 2014-21. Objectives of solar policy are:

1. To add solar generation of minimum 2000 MW by 2021 in a phased manner by creating a favourable industrial atmosphere;
2. To translate Karnataka into an investor friendly state;
3. To encourage public private participation in the sector;
4. To encourage decentralized generation & distribution of energy where access to grid is difficult;
5. To promote Research and Development and innovations, skill development in the sector.

Table 3-3: Applicable Environmental and Social Laws, Regulations and Policies

S. No.	Issues	Relevance	Applicable Legislation	Agency Responsible	Applicable Permits and Requirements
1	Environmental Protection	Construction activities will generate air and noise emissions. Scattering of debris and construction material can contaminate the soil, water and surroundings.	The Environment (Protection) Act 1986, as amended in April 2003; EPA Rules 1986, as amended in 2002.	KSPCB MoEFCC CPCB	Compliance under the rules to maintain stipulated standards and environmental management through various supporting rules promulgated under the Act.
2	Prevention and Control of Water Pollution	Waste water generation from construction and operation of the Plant	The Water (Prevention and Control of Pollution) Act, 1974, amended in 1988	KSPCB	Intimation to KSPCB ³ for the upcoming solar power plant Compliance under the Water Act
3	License under Factories Act, 1948	Factory license is required as 'factory' means ' <i>any premises having ten or more workers involved in a manufacturing process</i> '.	Chapter I of The Factories Act, 1948	Factories Inspectorate, Karnataka	CSPGPL will obtain Factory License from the State Government or Chief Inspectorate of Factories, Karnataka before starting operations of the project.
4	Water Cess Collection (a tax on water use and water pollution caused)	Water use and waste water generation	The Water (Prevention and Control of Pollution) Cess Rules 1978, as amended through 16th July 1992and Water (Prevention and Control of Pollution) Cess Act 1977, as amended through 6 th May 2003	KSPCB	Filing of monthly returns as per prescribed format (Form I under the Act), if total consumption of water exceeds 10 kilo litres per day ⁴ . Compliance under the Act
6	Noise Emissions	Noise generated from operation of construction machinery	The Noise (Regulation & Control) Rules, 2000 as amended in October 2002. As per the Environment (Protection) Act (EPA) 1986 the ambient noise levels are to be maintained as stipulated by CPCB for different categories of areas like, commercial, residential and silence zones etc.	KSPCB	There will be generation of Noise during construction activities. Compliance under the rules to maintain stipulated standards.
7	Hazardous Wastes	The proposed project will generate waste oil from diesel generator and	Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016	KSPCB	CSPGPL will take authorization for collection, reception, storage, transportation and disposal of hazardous wastes;

³ As per latest directions of Central Pollution Control Board, dated March 07-3-16, Final report on revised categorization of industrial sectors under Red/ Orange/ Green/ White, solar power projects have been classified under White category of industries. As per the CPCB's direction to SPCB/PPCs, "there shall be no necessity of obtaining Consent to Operate for White Category of industries and intimation to the concerned SPCB/PPC shall suffice." And as per <http://kspcb.kar.nic.in/consentCategory.html#WHITE1>, "white category industries shall not be included in the Consent Mechanism."

⁴ As per the MoEF's Notification dated 6th May 2003, Central Government has exempted all industries consuming water less than 10 kilo litres per day from the levy of Cess.

S. No.	Issues	Relevance	Applicable Legislation	Agency Responsible	Applicable Permits and Requirements
	Management	transformer oil from switchyard. Solvents and chemicals used or cleaning etc.			<p>Filing of annual return under the rules ; Other compliance under the rules authorization by Central Pollution Control Boards to vendors accepting waste/used oil;</p> <p>Liability of the occupier, transporter and operator of a facility: The occupier, transporter and operator of a facility shall be liable for damages caused to the environment resulting due to improper handling and disposal of hazardous waste listed in schedules to the Rules; The occupier and operator of a facility shall also be liable to reinstate or restore damaged or destroyed elements of the environment;</p> <p>The occupier and operator of a facility shall be liable to pay a fine as levied by the State Pollution Control Board with the approval of the Central Pollution Control Board for any violation of the provisions under these rules.</p>
8	Electricity Distribution License	Private sector projects to obtain distribution Licenses from the State Electricity Regulation Committee and to have open access to the transmission lines	The Electricity Act 2003	State Electricity Regulation Committee	CSPGPL should ensure to obtain license under the electricity act and ensure that the Health and Safety requirements specified under the rules are compiled to.
9	Storage of Petroleum products	There will be storage of Diesel at site for operation of generators during construction phase	The Petroleum Act 1934, as amended in August 1976 The Petroleum Rules 1976, as amended in March 2002.	PESO (Chief Controller of Explosives)	The site will store a small quantity of fuel at site. However, in case fuel storage exceeds the limit as stipulated in the Act, required to obtain a license from PESO.
10	Surface Transportation	Movement of construction vehicles and other vehicles for transportation of workers	The Motor Vehicles Act 1988, as amended by Motor Vehicles (Amendment) Act 2000, dated 14th August 2000 The Central Motor Vehicles Rules 1989, as amended through 20th October 2004 by the Central Motor Vehicles (Fourth Amendment) Rules 2004.	State Transport Authority	CSPGPL should ensure compliance of stipulated standards under rule 115. Safety compliance under the rules.
11	Welfare and Work Environment	Engagement of workers for construction and operation of the plant	The Factories Act, 1948 and Karnataka Factories Rules, 1969	Department of Inspectorate of Factories, Karnataka	Construction contractor shall comply with all requirements of factories rules and participate in periodic inspection.

S. No.	Issues	Relevance	Applicable Legislation	Agency Responsible	Applicable Permits and Requirements
					Ensure that no child labour is engaged.
12	Labour	Engagement of Female Labour at site	Maternity Benefit Act, 1961	Department of Inspectorate of Factories, Karnataka	No employer shall knowingly employ a woman in any establishment during the six weeks immediately following the day of her delivery or her miscarriage. No pregnant woman shall, on a request being made by her in this behalf, be required by her employer to do during the period any work which is of an arduous nature or which involves long hours of standing, or which in any way is likely to interfere with her pregnancy or the normal development of the foetus, or is likely to cause her miscarriage or otherwise to adversely affect her health.
13	Child Labour	Engagement of Child Labour at site	The Child Labour (Prohibition and Regulation) Act, 1986	Department of Inspectorate of Factories, 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. CSPGPL will ensure compliance
14	Labour	Engagement of bonded Labour at site	Bonded Labour (Abolition) Act 1976	Department of Inspectorate of Factories, Karnataka	All forms of bonded labour is abolished CSPGPL will ensure compliance
15	Labour	Provision of wages to labour engaged at the site	Minimum Wages Act, 1948	Department of Inspectorate of Factories, Karnataka	Requires the Government to fix minimum rates of wages and reviews this at an interval of not more than 5 years. Every employer shall be responsible for the payment to persons employed by him of all wages required to be paid under this Act. CSPGPL will ensure compliance
16	Labour	Equal wages to male and female workers at site	Equal Remuneration Act 1976	Department of Inspectorate of Factories, Karnataka	It is the duty of an employer to pay equal remuneration to men and women workers for same work or work of a similar nature. CSPGPL will ensure compliance
17	Labour	Engagement of Labour at site	Workmen's Compensation Act, 1923	Department of Inspectorate of Factories, Karnataka	Requires if personal injury is caused to a workman by accident arising out of and in the course of his employment, his employer shall be liable to pay compensation in accordance with the provisions of this Act
18	Public Consultation and Local Grievances	The project is set in rural area.	Karnataka Panchayat Act 1993	Panchayat Union	Provides for application of consent from the respective panchayat body/village administrative officer etc during the project life cycle.

S. No.	Issues	Relevance	Applicable Legislation	Agency Responsible	Applicable Permits and Requirements
					Ensure that all grievances raised by locals related to the project are addressed.
19	Possession of valid license by the engaged contractor.	Contractors or third parties to be involved in the construction works for the proposed project, if required, will also be engaged only subject to availability of valid registration	Building and Other Construction Workers (Regulation Of Employment And Conditions Of Service) Act, 1996 and Contract Labour (Regulation and Abolition) Act, 1970.	Registration Officer	Ensure that contractor/ third party have a valid registration under the Building and Other Construction Works Act and Contract Labour (Regulation and Abolition) Act, 1970.
20	Labour working at the site	Working conditions of contracted Labour working at the site	Contract Labour (Regulations and Abolition) Act, 1970	The Commissioner of Labour, Karnataka	Ensure that all the contracted workers are provided with condition of services, rate of wages, holidays, hours of work as stipulated in the act and rules
21	No Objection Certificate from Gram Panchayat	The project is set in rural area surrounded by Machnur and Singaddinni Village	Karnataka Panchayats Act 1994	Panchayat Union	Provides for application of consent from the respective panchayat body/village administrative officer etc. during the project life cycle. CSPGPL to obtain NOC form Village Gram Panchayats
22	Permission for converting agricultural lands to non-agricultural purpose	he permission for diversion of agricultural land for industrial development, approved by the State Government, under this section shall be deemed to have been granted when permission for purchase of agricultural land is accorded for industrial development	The Karnataka Land Reforms and Certain other Law (Amendment) Act 2014 Karnataka Land Revenue Act, 1964	Deputy Commissioner of the revenue department	CSPGPL is required to ensure that permission is obtained from the revenue department for all the survey numbers diverted for the project.

3.3 IFC Performance Standards

The IFC Performance Standards stipulates that any proposed project shall meet the following requirements throughout the life of an investment by IFC or other relevant financial institution:

- Performance Standard 1: Assessment and Management of Environmental and Social Risks and Impacts;
- Performance Standard 2: Labour and Working Conditions;
- Performance Standard 3: Resource Efficiency and Pollution Prevention;
- Performance Standard 4: Community Health, Safety, and Security;
- Performance Standard 5: Land Acquisition and Involuntary Resettlement;
- Performance Standard 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources;
- Performance Standard 7: Indigenous Peoples; and
- Performance Standard 8: Cultural Heritage.

These performance standards and guidelines provide ways and means to identify impacts and affected stakeholders and lay down processes for management and mitigation of adverse impacts.

Performance Standard 1

PS 1 establishes the importance of:

- Integrated assessment to identify the environmental and social impacts, risks, and opportunities of projects;
- Effective community engagement through disclosure of project-related information and consultation with local communities on matters that directly affect them; and
- The project proponent's management of environmental and social performance throughout the life of the project.

Applicability

The PS 1 is applicable to projects with environment and/or social risks and/or impacts. The proposed project will have environmental and social impacts such as generation of noise and small quantities of hazardous wastes (operation of DG sets etc.). PS 1 is therefore applicable for the project and thus requires an Environmental and Social Impact Assessment (ESIA) study to be conducted before commencement of the project. CSPGPL also needs to develop and implement a project specific Environmental and Social Management System to manage the risks associated with project's operations

Performance Standard 2

PS 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 objectives of the PS 2 are:

- To promote the fair treatment, non-discrimination, and equal opportunity of workers;
- To establish, maintain, and improve the worker-management relationship;
- To promote compliance with national employment and labour laws;
- To protect workers, including vulnerable categories of workers such as children, migrant workers, workers engaged by third parties, and workers in the client's supply chain;
- To promote safe and healthy working conditions, and the health of workers; and
- To avoid the use of forced labour.

Applicability

The PS 2 is applicable to the project and its applicability will be more important during the construction phase as operation phase will only have limited number of staff. It not only covers the main plant employees, but all employees/workers, even those working through contractors. CSPGPL shall provide adequate provisions such as access to clean water, sanitary facilities and other necessary facilities at the construction sites.

CSPGPL shall take measures to prevent child labour, forced labour and discrimination at site. Freedom of association and collective bargaining shall be provided. Wages, work hours and other benefits shall be as per the

national labour and employment laws. CSPGPL will provide a grievance mechanism for workers (and their organizations, where they exist) to raise workplace concerns. In providing a grievance mechanism through which workers may raise workplace concerns, CSPGPL should ensure that matters are brought to management's attention and addressed expeditiously. CSPGPL needs to document all grievances and follow up on any corrective actions.

CSPGPL will extend a safe and healthy work environment to contracted workers and to any other workers who provide project-related work and services. CSPGPL should ensure that training is provided to all workers on relevant aspects of OHS associated with their daily work, including emergency arrangements and OHS briefing for visitors and other third parties accessing the premises. All occupational injuries, illnesses and fatalities are to be documented.

Performance Standard 3

The PS 3 outlines approach to pollution prevention and abatement in line with internationally disseminated technologies and practices with the following objectives:

- Avoid or minimize adverse impacts on human health and the environment by avoiding or minimizing pollution from activities; and
- Promote the reduction of emissions that contribute to climate change.

Applicability

The proposed project is a clean energy project and will not have major pollution sources associated with it. The construction works for the development of project will entail generation of wastes like wastewater, waste oil and construction debris. The operation phase will result in generation of minor quantities of waste such as transformer oil and used oil. CSPGPL should monitor emissions to ensure that the requirements of PS 3 are being met. The frequency with which pollutant emissions are monitored should be appropriate to the nature, scale and variability of potential impacts. GHG emission equivalent which will be avoided due to operation of 50MW solar power project is 292 MTons/MW/Day.⁵

Performance Standard 4

PS 4 recognizes that project activities, equipment, and infrastructure can increase community exposure to risks and impacts. Its main stress is to ensure that the safeguarding of personnel and property is carried out in accordance with relevant human rights principles and in a manner that avoids or minimizes risks to the affected Communities.

Applicability

The applicability of this PS shall be established during the ESIA process, resulting in preparation of an Action Plan to be disclosed to the community. The Applicability will be limited to construction period with movement of heavy machinery / vehicles. Labour and security staff to be engaged from local community.

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 PS 1.

Performance Standard 5

PS 5 recognizes that project-related land acquisition and restrictions on land use can have adverse impacts on communities and persons that use this land. Its main aim is to anticipate and avoid, or where avoidance is not possible, minimize adverse social and economic impacts from land acquisition or restrictions on land use by providing compensation for loss of assets at replacement cost and ensuring that resettlement activities are

⁵ Emission Factor

7.03 x 10⁻⁴ metric tons CO₂ / kWh

(eGRID, U.S. annual non-baseload CO₂ output emission rate, year 2012 data)

Notes:

This calculation does not include any greenhouse gases other than CO₂.

This calculation does not include line losses.

implemented with appropriate disclosure of Information, consultation, and the informed participation of affected persons and community.

Applicability

For the proposed project, a total of 287.02 acres of private has procured from the land owners of Machnur and Singaddinni Villages. The proposed site can be classified as private agricultural land where rain-fed farming was practiced. The project related land became a fallow land over a period of time, due to lack of irrigation facilities and dependency of agriculture on rains which has become scarce in the area.

The required land for the project is about 287.02 acres of private land owned by 26 landowners belonging to Machnur and Singaddinni Villages. The project land primarily comprises of uncultivated land with shrubs and grasses. The land owners on their own volition decided to sell their land parcels due to low productivity of the land parcels over the past five years owing to minimal rainfall. One (1) land aggregators have been engaged by CSPGPL to negotiate with these landowners on an individual basis. The purchase of land was through negotiated settlement at rate higher than prevailing market rate and on a willing buyer/willing seller basis.

As no physical or economic displacement relating to the land transferred for the project has taken place, the requirements of PS 5 are therefore not applicable to the project.

Performance Standard 6

PS 6 recognizes that protecting and conserving biodiversity, maintaining ecosystem services, and sustainably managing living natural resources are fundamental to sustainable development. This standard is aimed to promote the sustainable management of living natural resources through the adoption of practices that integrate conservation needs and development priorities.

Applicability

The proposed project does not involve any diversion of forest land. The plant sites are devoid of vegetation. The project activities are not likely to have any impact on the ecology. The proposed project will involve additional traffic movement which may impact the higher fauna. There are no legally protected areas, wildlife sanctuaries or national parks within 10km of the project site.

Baseline studies for ecological aspects have been described in **Section 5.10** of the report. Being a cleaner source of energy, no significant degradation and loss of ecosystem services are associated with the project.

Performance Standard 7

PS 7 recognizes that Indigenous Peoples, as social groups with identities that are distinct from mainstream groups in national societies, are often among the most marginalized and vulnerable segments of the population. In many cases, their economic, social, and legal status limits their capacity to defend their rights to, and interests in, lands and natural and cultural resources, and may restrict their ability to participate in and benefit from development.

Applicability

The project area or its surroundings does not support indigenous people. No material degradation or adverse impact is expected on land resources on which indigenous peoples are dependent.

Performance Standard 8

PS 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 that clients protect cultural heritage in the course of 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.

Applicability

There are no culturally important sites in or around the project site. However, a 'Babul Tree' is located within the site in south-west direction which is being worshiped by the locals once a year. CSPGPL is required to ensure provision of continued access to the Tree during operation phase of the project. CSPGPL is required to provide a separate internal path connecting main gate to the location of Babul Tree within the project premises. While consulting the site representatives, it was mentioned that the tree will not be cut and access will be provided to the community. It is recommended that a Memorandum of Understanding (MoU) with the Gram Panchayats in the study area is executed for the provision of continued access.

3.3.1 IFC Categorization of Projects

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 as a result of the client's social and environmental assessment and to specify IFC's institutional requirements. The following categories are used by the IFC:

- **Category A Projects:** Projects with potential significant adverse social or environmental impacts that are diverse, irreversible or unprecedented;
- **Category B Projects:** Projects with potential limited adverse social or environmental impacts that are few in number, generally site-specific, largely reversible and readily addressed through mitigation measures;
- **Category C Projects:** Projects with minimal or no adverse social or environmental impacts, including certain financial intermediary (FI) projects with minimal or no adverse risks;
- **Category FI Projects:** All FI projects excluding those that are Category C projects.

IFC therefore categorizes projects primarily according to the significance and nature of 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.

3.4 Applicable Environmental Standards

3.4.1 Ambient Air Quality

As per the IFC EHS guidelines (December 2008), "the ambient air quality standards are ambient air quality levels established and published through national legislative and regulatory processes and ambient quality guidelines refer to ambient quality levels primarily developed through clinical, toxicological, and epidemiological evidence (such as those published by the World Health Organization)". National Ambient Air Quality (NAAQ), as notified under Environment (Protection) Rules 1986 and revised through Environment (Protection) Seventh Amendment Rules, 2009 are given in **Table 3-4**.

Table 3-4: National Ambient Air Quality Standards

Pollutant	Time Weighted Average	Concentration in Ambient Air	
		Industrial, Residential, Rural and other Areas	Ecologically Sensitive Area (notified by Central Government)
Sulphur Dioxide (SO ₂), µg/m ³	Annual*	50	20
	24 Hours**	80	80
Nitrogen Dioxide (NO ₂), µg/m ³	Annual*	60	60
	24 Hours**	100	100
Particulate Matter (size less than 10 µm) or PM ₁₀ , µg/m ³	Annual*	60	60
	24 Hours**	100	100
Particulate Matter (size less than	Annual*	40	40

Pollutant	Time Weighted Average	Concentration in Ambient Air	
2.5 µm) or PM _{2.5} , µg/m ³	24 Hours**	60	60
Ozone (O ₃), µg/m ³	8 Hours**	100	100
	1 Hour**	180	180
Lead (Pb), µg/m ³	Annual*	0.5	0.5
	24 Hours**	1	1
Carbon Monoxide (CO) , mg/m ³	8 Hours	2	2
	1 Hour**	4	4
Ammonia (NH ₃), µg/m ³	Annual*	100	100
	24 Hours**	400	400
Benzene (C ₆ H ₆), µg/m ³	Annual*	5	5
Benzo (O) Pyrene (BaP), particulate phase only, ng/m ³	Annual*	1	1
Arsenic (As), ng/m ³	Annual*	6	6
Nickel (Ni), ng/m ³	Annual*	20	20

Source: Environment (Protection) Seventh Amendment Rules, 2009

* Annual arithmetic mean of minimum 104 measurements in a year taken twice a week, 24 hourly at uniform interval

** 24 hourly or 8 hourly or 01 hourly values as applicable shall be complied with 98% of the time in a year. 2% of the time they may exceed, but not on 2 consecutive days. Note: Whenever and wherever monitoring results on two consecutive days of monitoring exceed the limits specified above for the respective category, it shall be considered adequate reason to institute regular or continuous monitoring and further investigation.

3.4.2 Ambient Noise Standards

As per the EHS guidelines of IFC, for residential, institutional and educational area, the one hourly equivalent noise level (Leq hourly) for day time is **55 dB (A)** while the Leq hourly for night time is prescribed as **45 dB (A)**. Noise standards notified by the MoEF vide gazette notification dated 14 February 2000 based on the *A-weighted* equivalent noise level (Leq) are as presented in **Table 3-5**.

Table 3-5: Ambient Noise Standards

Area Code	Category of Area	Limits in dB(A) Leq	
		Day time*	Night Time
A	Industrial Area	75	70
B	Commercial Area	65	55
C	Residential Area	55	45

Source: MoEF vide gazette notification dated 14 February 2000

Note: * Day time is from 6 am to 10 pm, Night time is 10 pm to 6.00 am;

** Silence zone is defined as area up to 100 m around premises of hospitals, educational institutions and courts. Use of vehicle horns, loud speakers and bursting of crackers are banned in these zones.

3.4.3 Noise Standards for Occupational Exposure

Noise standards in the work environment are specified by Occupational Safety and Health Administration (OSHA-USA) which in turn are being enforced by Government of India through model rules framed under the Factories Act.

Table 3-6: Standards for Occupational Noise Exposure

S. No	Total Time of Exposure per Day in Hours (Continuous or Short term Exposure)	Sound Pressure Level in dB(A)
1	8	90
2	6	92
3	4	95
4	3	97
5	2	100
6	3/2	102
7	1	105
8	¾	107
9	½	110
10	¼	115
11	Never	>115

Note: No exposure in excess of 115 dB(A) is to be permitted.

For any period of exposure falling in between any figure and the next higher or lower figure as indicated in column (1), the permissible level is to be determined by extrapolation on a proportionate scale.

3.4.4 Water Quality standards

The designated best use classification as prescribed by CPCB for surface water is given in **Table 3-7**.

Table 3-7: Primary Water Quality Criteria for Designated Best Use Classes

Designated Best Use	Class of Water	Criteria
Drinking water source without conventional treatment but after disinfections	A	1. Total coliform organisms (MPN/100 ml) shall be 50 or less 2. pH between 6.5 to 8.5 3. Dissolved Oxygen (DO) 6 mg/l or more, and 4. Biochemical Oxygen Demand (BOD) 2 mg/l or less
Outdoor bathing (Organised)	B	1. Total coliform organisms (MPN/100 ml) shall be 500 or less 2. pH between 6.8 to 8.5 3. Dissolved Oxygen 5 mg/l or more, and 4. Biochemical Oxygen Demand 3 mg/l or less
Drinking water with conventional treatment followed by disinfections	C	1. Total coliform organisms (MPN/100 ml) shall be 5000 or less 2. pH between 6 and 9 3. Dissolved Oxygen 4 mg/l or more, and 4. Biochemical Oxygen Demand 3 mg/l or less
Propagation of wild life and fisheries	D	1. pH between 6.5 to 8.5 2. Dissolved Oxygen 4 mg/l or more, and 3. Free ammonia (as N) 1.2 mg/l or less
Irrigation, industrial cooling, controlled waste disposal	E	1. pH between 6.0 and 8.5 2. Electrical conductivity less than 2250 micro mhos/cm, 3. Sodium Absorption Ratio (SAR) less than 26, and Boron less than 2 mg/l.
	Below E	Not meeting A, B, C, D & E Criteria

Source: Central Pollution Control Board

Note: MPN= Most Probable Number

Drinking water quality standards as per IS 10500, 2012 by Bureau of Indian Standards (BIS) is presented in **Table 3-8**.

Table 3-8: Drinking Water Standards as per IS 10500, 2012

S. No	Parameters	Measurement Unit	IS 10500* specification for drinking water Desirable limit (Permissible limit)
1	pH Value	Unit	6.5-8.5 (No relaxation)
2	Turbidity	NTU	1 (5)

S. No	Parameters	Measurement Unit	IS 10500* specification for drinking water Desirable limit (Permissible limit)
3	Colour	Hazen units	5 (15)
4	Total Dissolved Solids	mg/L	500 (2000)
5	Total Alkalinity (as CaCO ₃)	mg/L	200 (600)
6	Nitrate	mg/L	45 (No relaxation)
7	Chlorides (as Cl)	mg/L	250 (1000)
8	Sulphate	mg/L	200(400)
9	Calcium (as Ca)	mg/L	75 (200)
10	Magnesium (as Mg)	mg/L	30 (100)
11	Fluorides (as F)	mg/L	1.0 (1.5)
12	Total Hardness (as CaCO ₃)	mg/L	200 (600)
13	Arsenic (as As)	mg/L	0.01 (0.05)
14	Iron (as Fe)	mg/L	0.3 (No relaxation)
15	Copper (as Cu)	mg/L	0.05 (1.5)
16	Mercury (as Hg)	mg/L	0.001 (No relaxation)
17	Zinc (as Zn)	mg/L	5 (15)
18	Total Chromium (as Cr)	mg/L	0.05 (No relaxation)
19	Barium (as Ba)	mg/L	0.7 (No relaxation)
20	Cadmium (as Cd)	mg/L	0.003 (No relaxation)
21	Conductivity	mS/cm	--
22	Total Suspended Solids (TSS)	mg/L	---
23	Salinity	mg/L	---
24	Oil & Grease	mg/L	---
25	Dissolved Oxygen (DO)	mg/L	---
26	COD	mg/L	---
27	BOD	mg/L	---
28	Phosphate	mg/L	---
29	Lead	mg/L	0.01 (No relaxation)
30	Total Coliform	MPN/100mg	10 (No relaxation)
31	Faecal Coliform	---	---

Source: Bureau of Indian Standards (BIS)

Note: The figures in the brackets indicated permissible limit in absence of alternate source

3.5 Applicable International Conventions

Environmental problems which migrate beyond the jurisdiction (Trans-boundary) require power to control such issues through international co-operation by either becoming a Contracting Party (CP) i.e. ratifying treaties or as a Signatory by officially signing the treaties and agreeing to carry out provisions of various treaties on environment and social safeguards. The relevant international conventions are as provided in the **Table 3-9**.

Table 3-9: Relevant International Conventions applicable to the project

S.No	International Conventions	Salient Features
1	Montreal Protocol on Substances That Deplete the Ozone Layer (and subsequent Amendments)	India signed the Montreal Protocol along with its London Amendment on 17 th September, 1992 and also ratified the Copenhagen, Montreal and Beijing Amendments on 3rd March, 2003.

S.No	International Conventions	Salient Features
2	UN (Rio) Convention on Biological Diversity	India is a party since: 1994-02-18 by: Ratification; Protocol - Party since: 11 th November, 2003.
3	Conventions on the Conservation of Migratory species of wild animals and migratory species	India is contracting party to the convention on conservation of migratory species of wild animals and migratory species.
4	Kyoto Protocol	<p>The Kyoto protocol was signed by India in August 2002 and ratified in February 2005. The convention pertains to the United Nations framework on Climate Change.</p> <p>The 3rd Conference of the Parties to the Framework Convention on Climate Change (FCCC) in Kyoto in December 1997 introduced the Clean Development Mechanism (CDM) as a new concept for voluntary greenhouse-gas emission reduction agreements between industrialized and developing countries on the project level.</p>
5	The Rotterdam Convention on the Prior Informed Consent (PIC) Procedure	The Rotterdam Convention on the Prior Informed Consent (PIC) Procedure for Certain Hazardous Chemicals & Pesticides in international Trade was adopted by India at the Conference of Plenipotentiaries at Rotterdam in 1998
6	International Labour Organization conventions	<p>India has also ratified many of the International Labour Organization conventions that are relevant to the Project including:</p> <ul style="list-style-type: none"> • C1 Hours of Work (Industry) Convention, 1919 (14:07:1921, ratified); • C5 Minimum Age (Industry) Convention, 1919 (09:09:1955, ratified); • C11 Right of Association (Agriculture) Convention, 1921 (11:05:1923, ratified); • C14 Weekly Rest (Industry) Convention, 1921 (11:05:1923, ratified); • C29 Forced Labour Convention, 1930 (30:11:1954, ratified) & C105 Abolition of Forced Labour Convention, 1957 (18:05:2000, ratified); • C100 Equal Remuneration Convention, 1951 (25:09:1958, ratified); • C107 Indigenous and Tribal Populations Convention, 1957 • C111 discrimination (Employment and Occupation) Convention, 1958 (03:06:1960, ratified)

4 ENVIRONMENT AND SOCIO-ECONOMIC BASELINE

4.1 Introduction

This section of the Environment and Social Impact Assessment (ESIA) presents information on the baseline condition of the physical, chemical, biological and social environment within the proposed project area that would comprise of project components and associated facilities. This section of the report describes existing environmental and social conditions based on primary data gathered during the reconnaissance site visit and secondary information sourced from available scientific literature such as field guides, research papers, technical reports etc. Information available in public domain including data from governmental departments such as Indian Meteorological Department and Census of India is also used for establishing the baseline. Information sources for statistical data and maps used in this section are mentioned at the pertinent places.

4.2 Study Area

The proposed solar power plant is located in Machnur and Singaddinni villages of Manvi Taluka of Raichur District. The site is proposed to be developed on private agriculture land at an average altitude of 380 m above mean sea level. Scanty vegetation in form of grasses and shrubs was observed to be present on the landscape of the site. The project area is characterized by rural setup and flat terrain. The nearest highway is the State Highway – 20 (also known as Bachi-Raichur Highway), which connects Raichur to Lingsugur, is located at a distance of 1.5km from site in north direction. The site does not have any encroachments in the present day or reported to have any during the past. The nearest habitation around the site is Machnur village, located at a distance of 1.8km approximately in south-west direction.

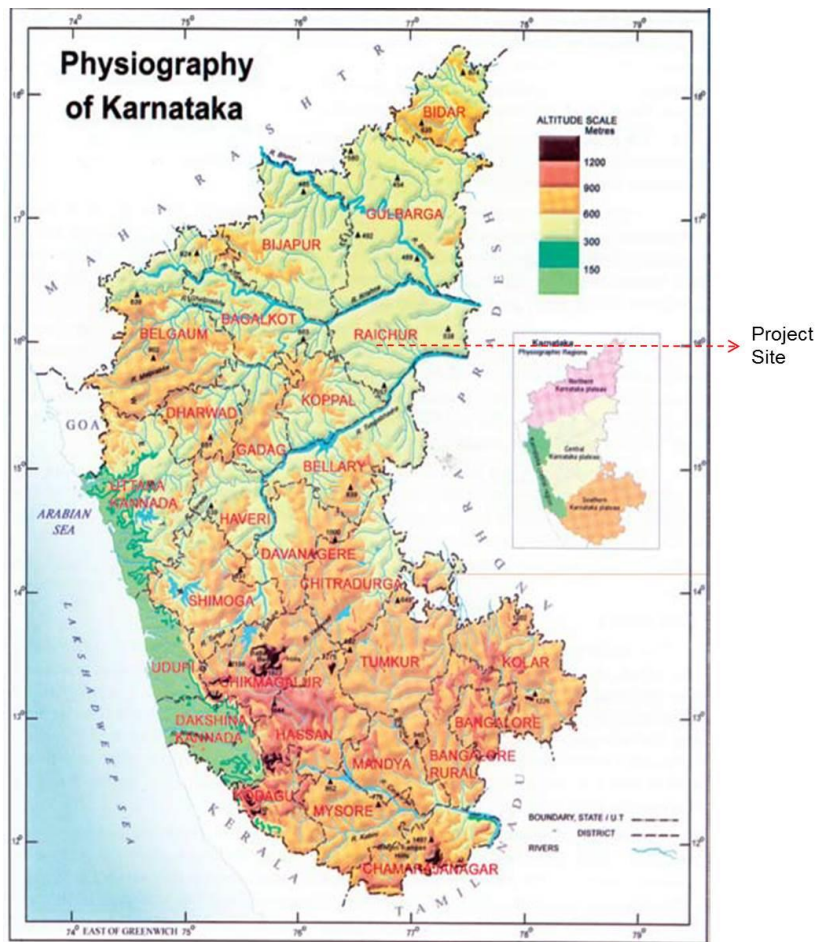
For the purpose of environment baseline assessment, area falling within 5 km radius from the project boundary has been considered as “Study Area”. Details pertaining to both the project talukas and district, from authentic government sources, have been presented where project area / project site specific information was not available in public domain. Primary environmental monitoring was carried out in the study area in August month 2016 and the details are presented in subsequent sections of the Chapter.

4.3 Physiography

Physiographically, Raichur district falls within the well-defined macro region of Deccan Plateau, one of the two major regions, into which the State has been divided. Within the State, it is a part of the Central Karnataka Plateau; one of the four micro regions into which the State has been further divided.

The region represents the transitional surface between the Northern Karnataka Plateau of Deccan Trap and Southern Karnataka Plateau with relatively higher surface. There is no continuous hill ranges found in the district. The elevation of the district ranges between 300 to 650 m above the mean sea level. The district is mainly featured by large plains except a few clusters of hills towards east, west, northwest, centre, and southwest. However, one of the three hill clusters includes a range running through Raichur and Manvi taluks for about 16 km. Another two ranges extend from Raichur towards Yergara and Alampur. Most of the clusters are composed of granite gneisses and partly schist's resulted from erosion of an uplifted plateau. **Figure 4-1** presents the physiography map of the Karnataka showing the proposed project site.

Figure 4-1: Physiography map of Karnataka showing the proposed project site

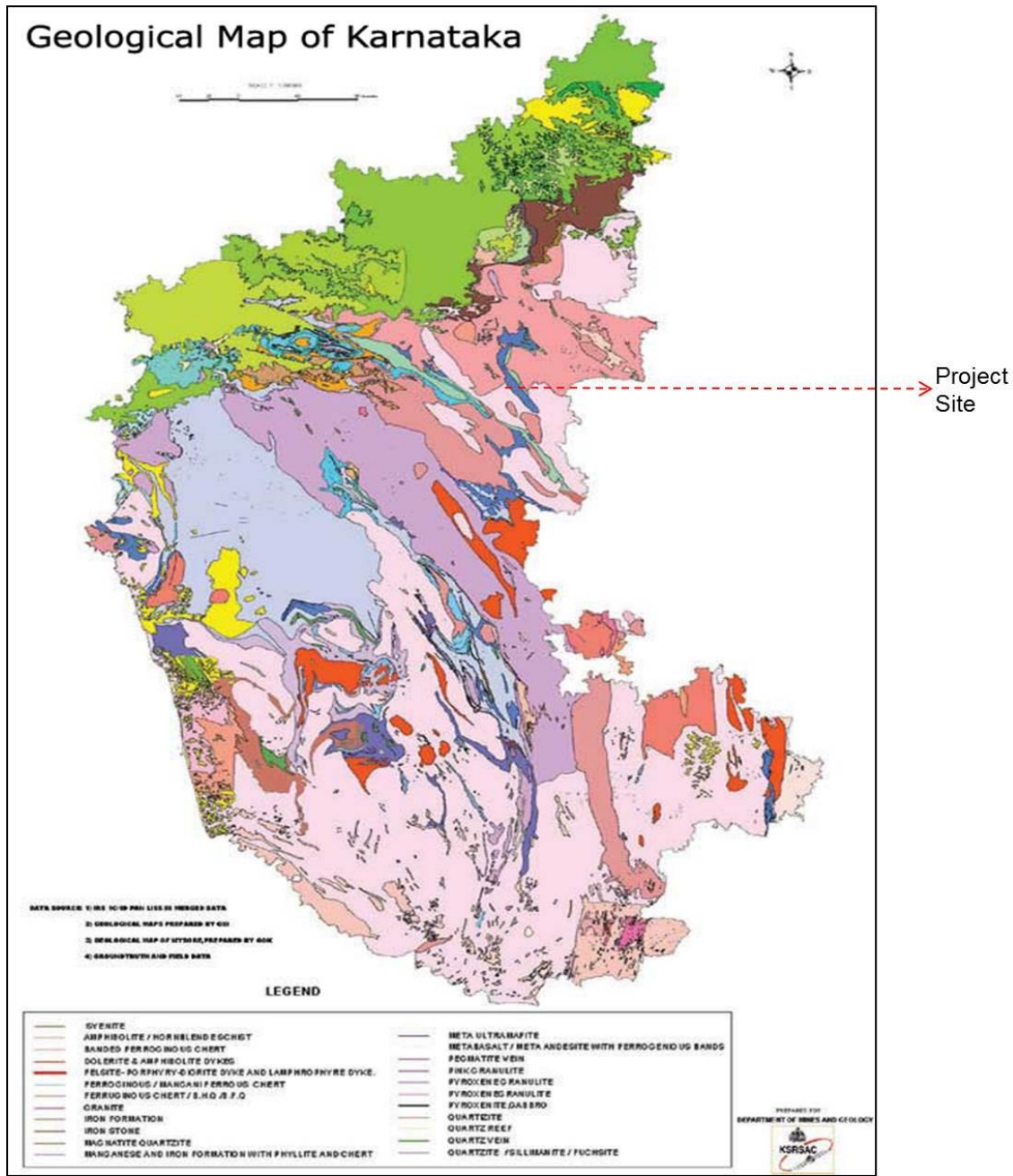


Source: A handbook of Karnataka, 2010.

4.4 Geology

Three major rock types classified as Dharwar series, peninsular gneissic complex and Dykes occur in the district. The Dharwar series occur in the form of three prominent bands viz., the Kushtagi band, the Maski band and the Raichur band. The rocks occurring in Raichur band consist of chlorite, hornblende and dibasic schist and their reconstituted varieties. Peninsular gneissic rocks of grey and pink variety occur in some parts of the district. Large numbers of dykes which are mostly dolerite in composition are seen in the eastern portion of the district. Figure 5-2 that follows presents the geological map of Karnataka showing the proposed project location.

Figure 4-2: Geological map of Karnataka showing the proposed project site



Source: Karnataka State Remote Sensing Application Centre

4.5 Land Use and Land Cover (LULC)

Major land parts of all the taluks including Manvi within the Raichur district are primarily utilised for agricultural purposes. Fallow lands and uncultivable lands also comprise a substantial part of the total available land. Considerably small area of lands which is approximately 2.2% of the total area of the Raichur district and about 1.2% of the total area of the Manvi taluk are covered by forests. **Table 4-1** that follows presents land use pattern in the Raichur district as a percent of the geographic area of the district in the year 2001-2002. **Figure 4-3** presents the land use and land cover map of Raichur District showing the location of proposed project site.

Table 4-1: Land use pattern in Raichur District (2001-2002)

Total	As a % of the District Area
-------	-----------------------------

	Area under forest	Not available for cultivation		Cultivable Wasteland	Uncultivated Land		Fallow Land		Net Area sown	Total Gross Cropped Area	Area sown more than once
		Land put to non-agricultural use	Barren and uncultivable land		Permanent pasture and grazing land	Land under trees and groves	Current fallows	Other fallows			
835843	2.2	2.5	2.4	1.3	2.4	1.6	19.7	5.6	62.5	72.5	10.1

Source: Report on Natural Resource Accounting in Karnataka: A Study of the Land & Forestry Sector (Excluding Mining) - report prepared by Centre for Multi-Disciplinary Development Research.

Land use Profile of Study Area

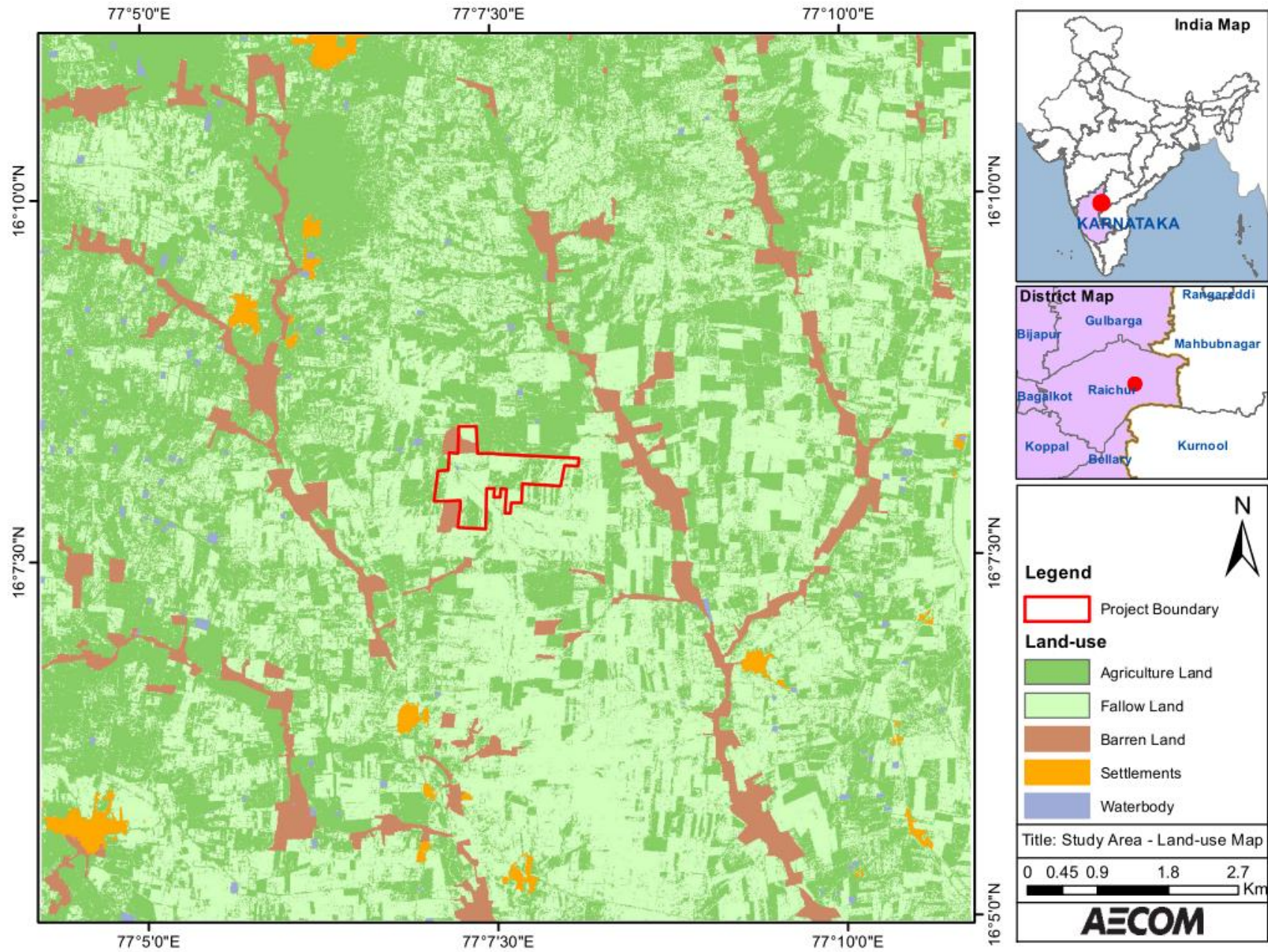
The primary land use of study area is fallow land with 46.28% followed by agricultural land (45.74%). Barren land constitutes 6.53% of the total land use and settlements approximately form 1%. Land use of the study area has been presented in **Table 4-2**.

Table 4-2: Land use pattern in Study Area

S.no	Land Use Name	Area in Sqm	%
1	Settlements	1.3281	0.99
2	Seasonal Waterbody	0.6074	0.45
3	Barren Land	8.7483	6.53
4	Agriculture Land	61.2937	45.74
5	Fallow Land	62.0200	46.28
Total Area in Sqkm		133.9976	100.00

Source: AECOM

Figure 4-3: Land use/ Land cover map of Study Area including Project site

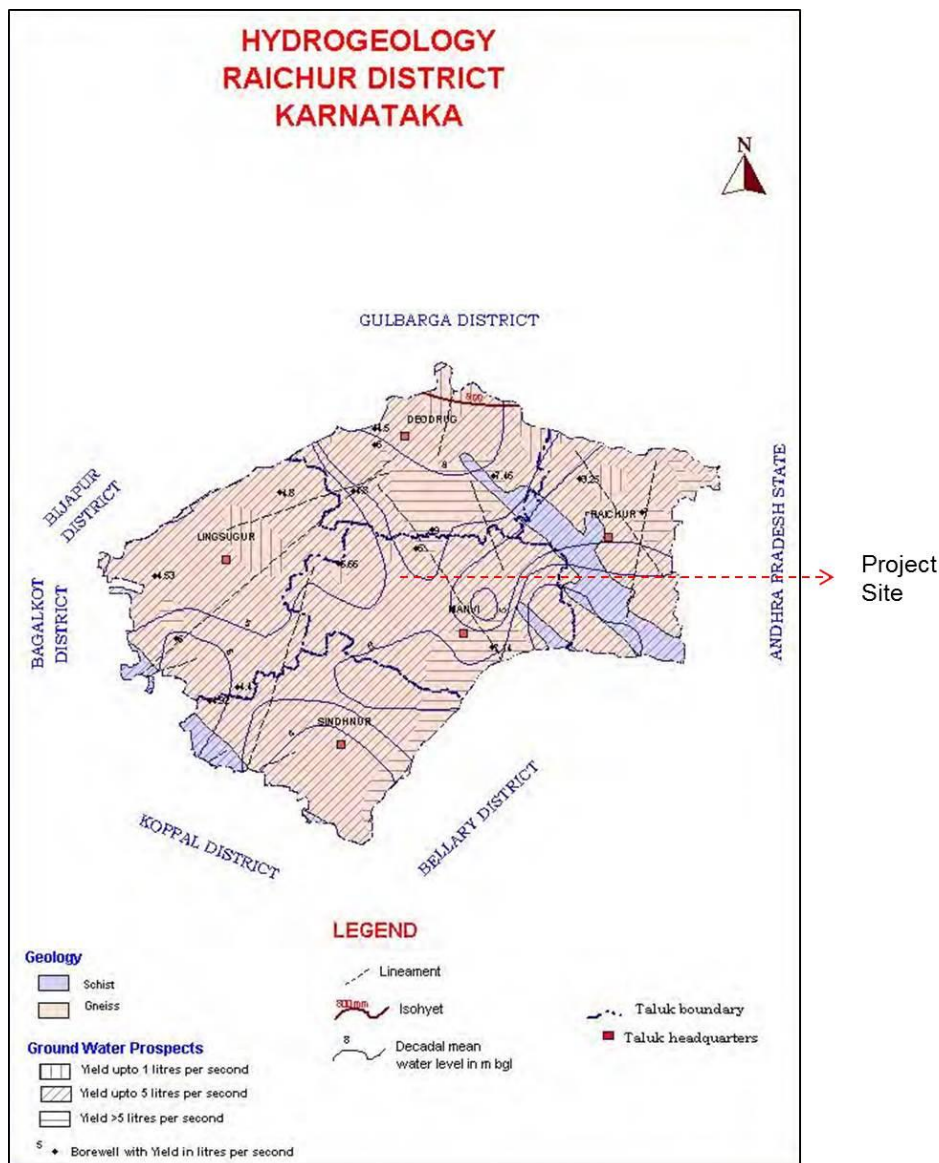


4.6 Water Resources

4.6.1 Hydrogeology

The main rock formations of Raichur district are granites, gneisses and Dharwar schists. These formations create hard-rock aquifers that have low porosities and low hydraulic conductivities. However, secondary porosity is developed due to faults, fractures, joints, and due to weathering, which improves permeability and water yielding capacity of these rocks. Ground water occurs under water table conditions in the weathered and jointed hard rock, and under confined to semi-confined conditions in the fractured rock. Since the district is predominantly covered by black cotton soils, which inhibit percolation and circulation of water, there are pockets of poor quality ground water in the area. The hydrogeology of the Raichur district showing the proposed project site is presented in **Figure 4-4**.

Figure 4-4: Hydrogeology map of the Raichur district showing the proposed project site



Source: Groundwater Information Booklet, Raichur District, Karnataka, July 2013.

4.6.2 Ground water scenario in Manvi Taluk

The depth of water level in the Manvi taluk and the project area in general varies from 2.0 mbgl to 4.0 mbgl during the pre-monsoon period and during the post-monsoon period respectively. The total groundwater resources available in the Raichur district and Manvi taluk are given in the **Table 4-3**.

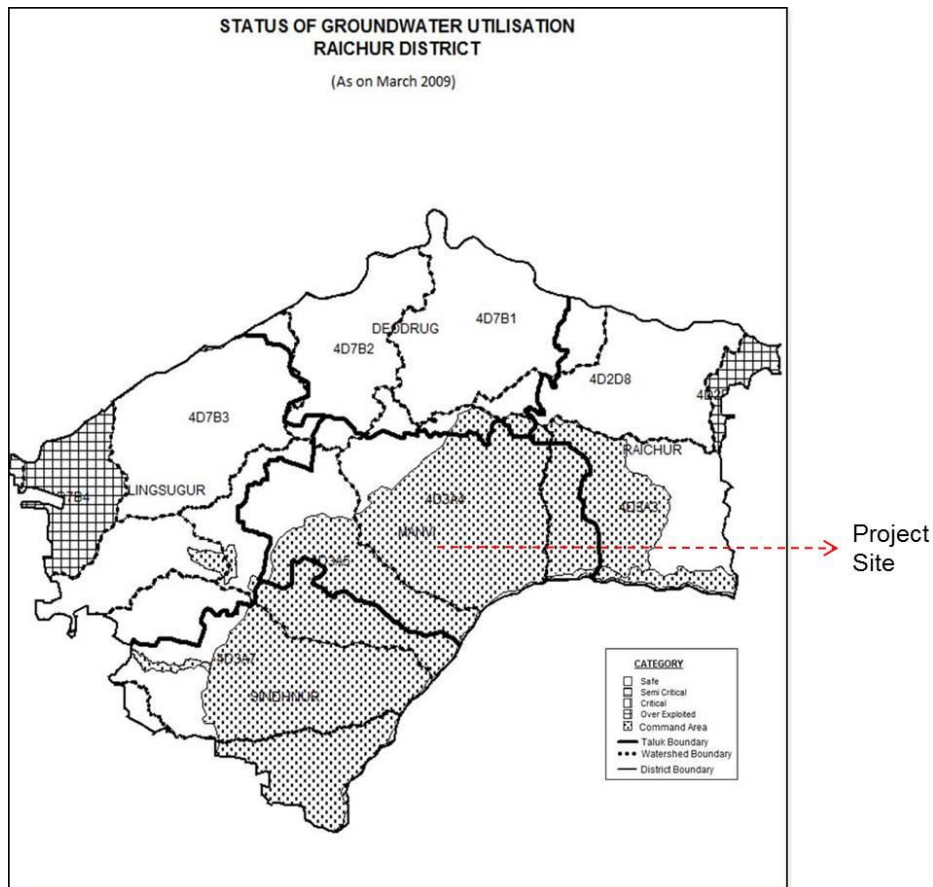
Table 4-3: Groundwater resources of Raichur District and Manvi Taluk (March 2009).

Taluka	Net Annual Ground Water Availability	Existing Gross Ground Water Draft For Irrigation (Ham)	Existing Gross Ground Water Draft For Domestic And Industrial Water Supply (Ham)	Existing Gross Ground Water Draft For All Uses (Ham)	Allocation For Domestic And Industrial Use For Next 25 Years (Ham)	Net Water Availability For Future Irrigation (Ham)	Existing Stage Of Ground Water Development In (%)	Categorization (%)			
								Safe Area (%)	Semi-Critical Area (%)	Critical Area (%)	OE Area (%)
Manvi	34285	5861	501	6362	996	27428	19	100	-	-	-
Total (Raichur District)	82095	23525	2757	26282	4244	55760	Av. 48	-	-	-	-

Source: Groundwater Information Booklet, Raichur District, Karnataka, July 2013.

Major part of the Manvi taluk falls in the canal command area of Tungabhadra Left Bank canal (as presented in in **Figure 5-5**) the groundwater utilisation is in safe zone. The ground water resources in the area are mainly tapped through bore wells and piped water schemes for domestic and irrigation water supply. The status of groundwater utilisation in the Raichur district showing the proposed project site is presented below in **Figure 4-5**.

Figure 4-5: Status map of groundwater utilisation of Raichur district showing the proposed project site



Source: Groundwater Information Booklet, Raichur District, Karnataka, July 2013.

4.6.3 Water Quality Monitoring

Two groundwater samples, one from Singaddinni village and another from Machnur village were collected in June, 2017 to evaluate the water quality in the study area. Details of the sampling locations are given in the **Table 4-4** below.

Table 4-4: Water Quality Sampling Locations

Sampling Locations	Geographical Coordinates	Location Code	Sample
Singaddinni Village	724685.68 m E 1786645.21 m N	WQ-1	Ground Water
Machnur Village	726190.83 m E 1781906.25 m N	WQ-2	Ground Water

Ground Water Analysis

The ground water sample was analysed for parameters as mentioned in IS: 10500:2012 standards and the analysis was undertaken as per IS 3025 and relevant American Public Health Association (APHA) standard methods. The results of the analysis are presented in **Table 4-5**.

Table 4-5: Results of Water Quality Analysis

Sr. No.	Parameter	IS: 10500 (Drinking Water Standards), 2012*	Unit	Ground Water	
				WQ-1	WQ-2
1	Colour	--	Hazen	<5	<5
2	Temperature		°C	26.2	26.5
3	Electrical Conductivity	--	µ-mho/cm	6953	13370
4	Turbidity	1 / 5	NTU	1.2	1.5
5	pH	6.5-8.5	-	7.10	7.11
6	TDS	500 / 2000	mg/l	4088	7804
7	Total hardness	200 / 600	mg/l	1150	1620
8	Alkalinity	200 / 600	mg/l	432	594
9	Chlorides	200 / 600	mg/l	809	1614
10	Sulphate	200 / 400	mg/l	1354	1423
11	Fluoride	1 / 1.5	mg/l	0.2	0.1
12	Nitrate	45	mg/l	24.2	21.3
13	Phosphate	--	mg/l	BDL (DL: 0.01)	0.08
14	Manganese	0.01 / 0.03	mg/l	BDL(DL:0.5)	BDL(DL:0.5)
15	Oil and Grease	--		BDL (DL:2.0)	BDL(DL:2.0)
16	Mercury	0.001	mg/l	BDL (DL:0.005)	BDL (DL:0.005)
17	Calcium	75 / 200	mg/l	240	260
19	Magnesium	30 / 100	mg/l	134	236
20	Iron	0.3	mg/l	1.3	0.1
21	Cadmium	0.003	mg/l	BDL (DL:0.005)	BDL (DL:0.005)
22	Arsenic	0.001 / 0.05	mg/l	BDL (DL:0.005)	BDL (DL:0.005)
23	Lead	0.01	mg/l	BDL (DL:0.005)	BDL (DL:0.005)
24	Zinc	5 / 15	mg/l	0.8	0.5
25	Chromium Hexavalent	--	mg/l	BDL (DL:0.1)	BDL (DL:0.1)
26	Barium	0.7	mg/l	BDL (DL:0.005)	BDL (DL:0.005)
27	Total coliform in MPN/100ml	--	1ml/100ml	220	280
28	<i>E.coli</i> in MPN/100ml	--	1ml/100ml	26	34

* Values indicate Acceptable limits / permissible limit in absence of alternate source

BDL: Below Detectable Limit

DL: Detection Limit

Inferences:

The summary of the analysis of ground water samples results is as follows:

- pH of the ground water sample was observed to within the limit of IS10500:2012 standards;
- Total Alkalinity was observed to exceed the desirable limits of 200 mg/l for both the water samples however the alkalinity levels were within the permissible limit of 600mg/l for WQ-1 and WQ-2.
- The total hardness and TDS content of water samples was observed to be exceeding both; acceptable and permissible limits. It indicates presence of hard water in both water samples;
- Chloride content at both the locations exceeds the acceptable and permissible limits of 200 mg/l and 600 mg/l which indicates contamination of the water by waste water or agricultural / irrigation run-off from use of inorganic fertilizers;
- The presence of Mg^{2+} was observed to be exceeding acceptable and permissible limits in both the samples. This indicates presence of hard water and is non-toxic in nature. Increased levels of magnesium in water samples could be attributed to the use of cattle feed or fertilizer application;
- The concentration of metals like cadmium, lead and copper, arsenic and lead was not detected in both the samples;
- Iron content in WQ-1 is observed to exceed desirable limit of 0.3 mg/L which is 1.3 mg/L. Iron content in WQ-2 is found to be 0.1 mg/L

4.6.4 Drainage Pattern

Raichur district forms a part of Krishna catchment in northern part, while southern part forms the Lower Tungabhadra catchment area. River Krishna enters Raichur district to the North of Uppihal village in Lingasugur taluk and flows for a distance of about 269 sq km. Some of the major streams that join river Krishna are Huttinala, Chiksugurnala, Ramdurgnala, Mandarginala, Kodihallanala and Ramanhallanala. River Tungabhadra enters the district near Singapura village of Sindhanur taluk. Major tributaries of Tungabhadra flowing in the district are Maskinala and Sindhanur nala. **Figure 4-6** presents location of the proposed project site within the Krishna Basin.

Figure 4-6: Krishna Basin map showing the proposed project site



Source: Research Report on Closing of the Krishna Basin: Irrigation, Streamflow Depletion and Macroscale Hydrology, 2007.

4.7 Soil

In major portion of the district black cotton soil and the red soil are predominant. The black cotton soil is generally found where hornblende schist and the gneisses occur. The black cotton soil is locally called as 'Regadas' and the red soil are known as 'Chalkas' or 'Masabs'. The red soils are exclusively utilised for Kharif crops whereas black cotton soils are commonly used for raising Rabi crops.

4.7.1 Interpretation of soil results

The soil quality of the project area was evaluated and samples from two locations were collected and analysed to determine the same. Details of soil sampling locations are presented in **Table 4-6** below. Soil samples have been collected using auger up to a depth of 60 cm below ground level.

Table 4-6: Details of the Soil sampling locations

S. N.	Sampling Locations	Location Code	Geographical Location
1.	Project site- west direction	SQ-1	726705.33 m E, 1784414.49 m N
2.	Project site -east direction	SQ-2	731271.16 m E, 1785281.18 m N

The soil samples were analysed for various physical and chemical parameters of soil and the results of the soil quality analysis are given in **Table 4-7**.

Table 4-7: Results of Soil Quality Analysis

Sr. No.	Parameter	Unit	SQ-1	SQ-2
1	Texture			
	i. Sand	%	7	4
	ii. Silt	%	11	8
	iii. Clay	%	82	88
3	pH	---	8.79	8.30
4	Permeability	%	20	23
5	Porosity	%	63	65
6	Electrical Conductivity	µmhos/cm	724	200.5
7	Total Nitrogen	Mg/kg	1600	1200
8	Phosphorus	Mg/kg	3.2	3.7
9	Sodium	mg/kg	8326	3726
10	Potassium	mg/kg	1248	97.5
11	Cation Exchange Capacity	Meq/L	19.6	22.5
12	Particle Size Distribution	%		
a.	10mm	%	1.4	0.0
b.	4.75mm	%	31.0	6.0
c.	2mm	%	50	19.0
d.	425 micron	%	13.8	57.0
e.	75 micron	%	1.6	18.0

The results of the soil quality analysis were compared with the standard soil classification provided by the Indian Council of Agricultural Research (ICAR) and as given in **Table 4-8** below.

Table 4-8: Standard Soil Classification

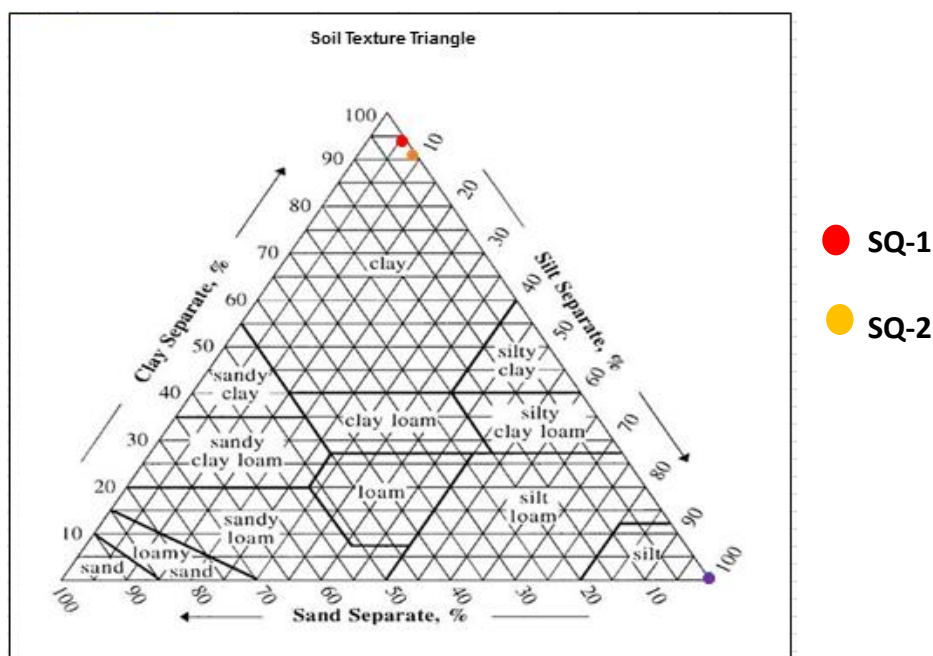
Soil Parameters	Classification	
pH	Normal to saline	6.0 to 8.5
	Tending to become alkaline	8.5-9.0
	Alkaline	Above 9.0
Electrical conductivity (mmhos/cm)	Up to 1.00 – Normal	
	1.01- 2.00 - Critical to germination	
	2.01-4.00 - Critical for growth of the sensitive crops	
	Above 4.00 – Injurious to most crops	

Source: Indian Council of Agricultural Research, New Delhi

Inference

- pH of the soils samples ranged from 8.3-8.8, showing normal to saline in nature at SQ2. Soil Quality at SQ-1 tends to become alkaline at pH of 8.79;
- Electrical conductivity of all the soil samples indicate normal values ranging between 0.2 - 0.8 mmhos/cm;
- Cation Ion Exchange capacity values ranges from 3.5 - 4.5 Meq/100gm;
- The concentration of phosphate in the soil samples collected falls between 3-4 µg/kg while nitrogen lies between ranges 1.2 - 1.6%. Sodium levels lies between range of 16-36 meq/100g and potassium lies in range of 0.25 - 3.2 mg/kg. The Texture Triangle below illustrates the texture of soil samples collected.
- Sodium value (in soluble form) in the samples ranges from 3726-8326 mg/kg.

Figure 4-7: Results of Soil Analysis



4.8 Climate

4.8.1 Temperature

Average temperatures of Manvi taluk ranges from 24°C to 36° C. December and January are the coldest months however April and May are the hottest. Average monthly temperature for the period of six years from 2011 to 2016 is given below in **Table 4-9**.

Table 4-9: Average monthly temperature of Manvi taluk

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2011	24	27	32	34	34	30	29	27	27	27	25	24
2012	25	28	31	34	35	31	29	28	28	27	25	25
2013	26	28	32	35	36	29	27	29	29	28	26	24
2014	26	28	32	36	35	34	30	30	29	29	27	25
2015	26	29	32	35	36	31	31	30	30	30	27	28
2016	27	31	34	37	36	31	29	29	28	28	27	26

Source: <https://www.worldweatheronline.com/manvi-weather/karnataka/in.aspx>

4.8.2 Rainfall

The average annual rainfall of the Raichur district has approximately been calculated as 660mm during 2011 through 2017 with average rainy days being 49 days. Nearly 67% of the rain is received during the southwest monsoon period (June - September) whilst the northeast monsoon (October – December) contributes about 24% of the total rainfall and the pre-monsoon showers (January-May) contribute to the remaining part of the total received rains.

Figure 4-8 given below presents taluk- wise average, minimum and maximum rainfall of the Raichur district. Average monthly rainfall and total annual rainfall of the Manvi taluk from the year 2011 to 2016 is given below in the **Table 4-10**.

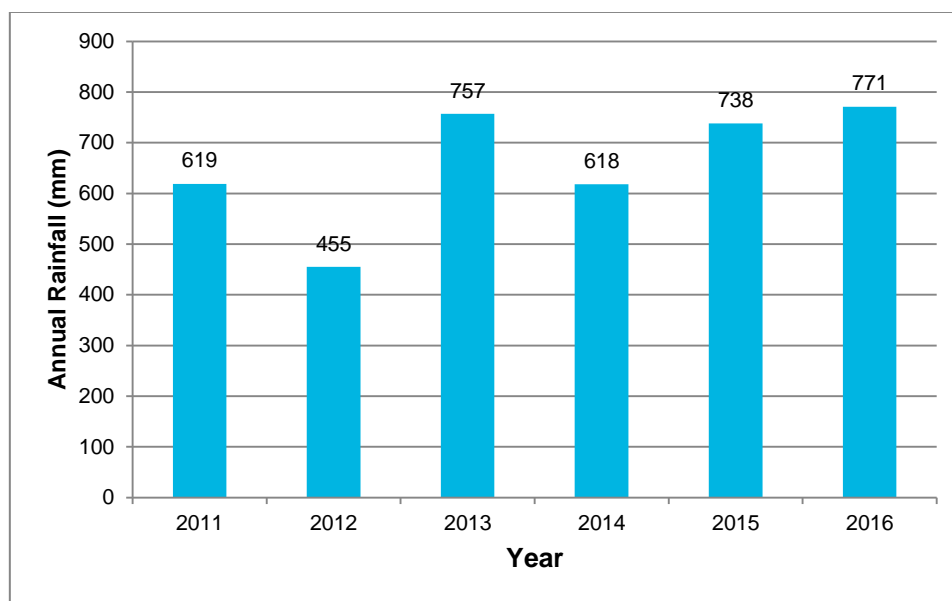
Table 4-10: Rainfall pattern of Manvi Taluk from 2011 to 2016

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Rainfall (mm)
2011	0.00	1.10	0.20	20.67	57.11	49.10	102.30	172.31	58.46	140.61	17.04	0.20	619
2012	1.01	0.00	0.70	32.94	14.97	87.02	74.88	78.41	71.67	63.29	29.62	1.09	455
2013	0.00	12.39	2.11	15.10	21.92	94.39	120.66	77.87	226.95	177.39	7.08	1.40	757
2014	0.00	2.73	23.96	4.80	86.79	18.89	86.75	241.29	79.31	65.12	5.99	2.96	618
2015	2.62	0.60	15.00	43.36	39.90	109.36	22.35	168.81	186.27	99.80	47.01	3.20	738
2016	3.30	0.00	0.00	0.00	48.84	248.10	121.69	74.02	225.74	29.36	15.90	3.60	771

Source: <https://www.worldweatheronline.com/manvi-weather/karnataka/in.aspx>

Figure 4-8 given below shows total annual rainfall pattern of the Manvi taluk from the year 2011 to 2016.

Figure 4-8: Total annual rainfall of Manvi taluk from 2011 to 2016



4.8.3 Wind

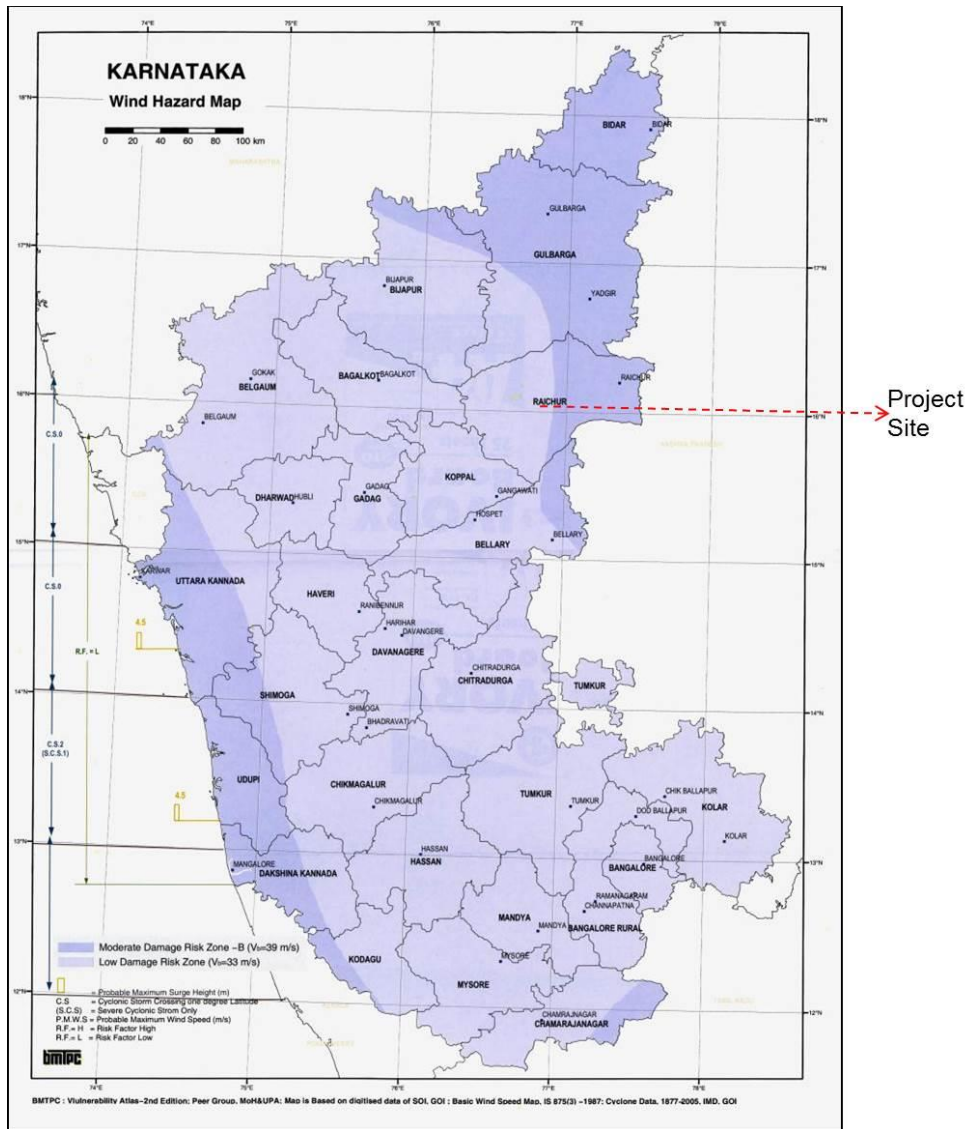
Strong wind prevails in the area during the southwest monsoon season and blows in westerly to south-westerly direction. At the beginning of post monsoon and the cold season, the district experiences light winds and it blows in the directions between northeast and southeast. It blows in the same direction during the months of March and April. In the month of May, the winds are stronger than in March and April. The direction of the wind during the month is between southwest and northwest in the morning and changes its direction in the evening. Sometimes the depressions from Bay of Bengal after becoming diffuse, while crossing the eastern coast, causes strong winds and widespread rain in the district. Also frequent thunderstorm occurs from March to June, September and October. However, the project area falls in the Low Wind Damage Risk Zone. **Figure 4-9** given below presents the Wind Hazard zonation map of Karnataka showing the proposed project site. **Table 4-11** that follows presents average monthly wind speed of the Manvi taluk.

Table 4-11: Average monthly wind speed of Manvi taluk

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2011	6.3	6.3	5.8	5.1	8.3	14.3	14.5	12.8	10.5	5.4	6.9	6.5
2012	7.2	7.4	6.5	5.8	10.3	13.9	13.6	12.5	9.8	6.9	6	7.2
2013	7.8	8.5	7.2	6.7	10.1	13.9	14.8	11.9	8.3	7.2	6	7.2
2014	8.7	7.2	7.6	5.4	8.1	13.4	14.8	10.7	9.2	5.8	6.3	6.7
2015	7.2	7.8	8.1	7.8	10.7	17	17	13	9.2	6.3	8.1	7.4
2016	7.2	8.1	7.8	8.5	10.6	12.8	14.1	13.4	11	6.9	5.4	6.3

Source: <https://www.worldweatheronline.com/manvi-weather/karnataka/in.aspx>

Figure 4-9: Wind hazard map of Karnataka showing the proposed project site



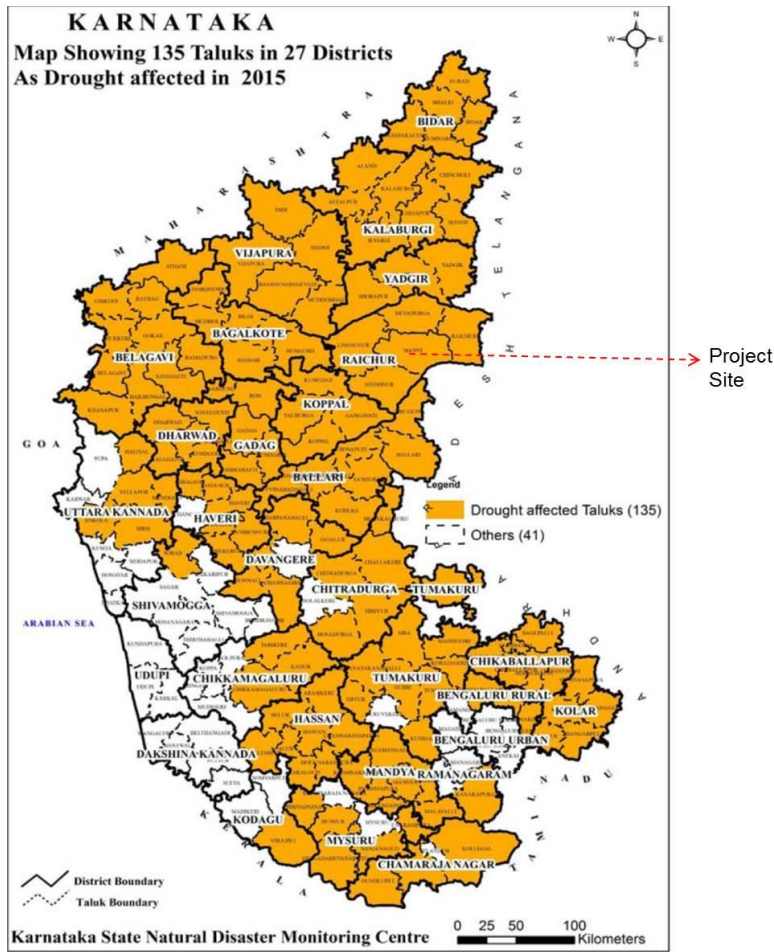
Source: <http://www.ndma.gov.in/karnataka-sdma-office.html>

4.9 Natural Hazards

4.9.1 Drought

Drought is defined as period of abnormally dry weather sufficiently prolonged for lack of water to cause a severe hydrological imbalance in the area affected. The Karnataka state is highly vulnerable to drought as compared to its neighbouring states. About 152.1 Lakhs ha (80%) out of 190.238 Lakh ha is affected by drought in Karnataka. The Raichur district is located in the northern maidan region of the state, which is drought prone. It also falls in the northeast dry agro-climatic zone. Couple with the low rainfall, both quality and quantity of crop yields in the area is affected. **Figure 4-10** given below shows the taluks in Karnataka state affected by drought in the year 2015.

Figure 4-10: Map of Karnataka showing drought affected taluks and the proposed project site

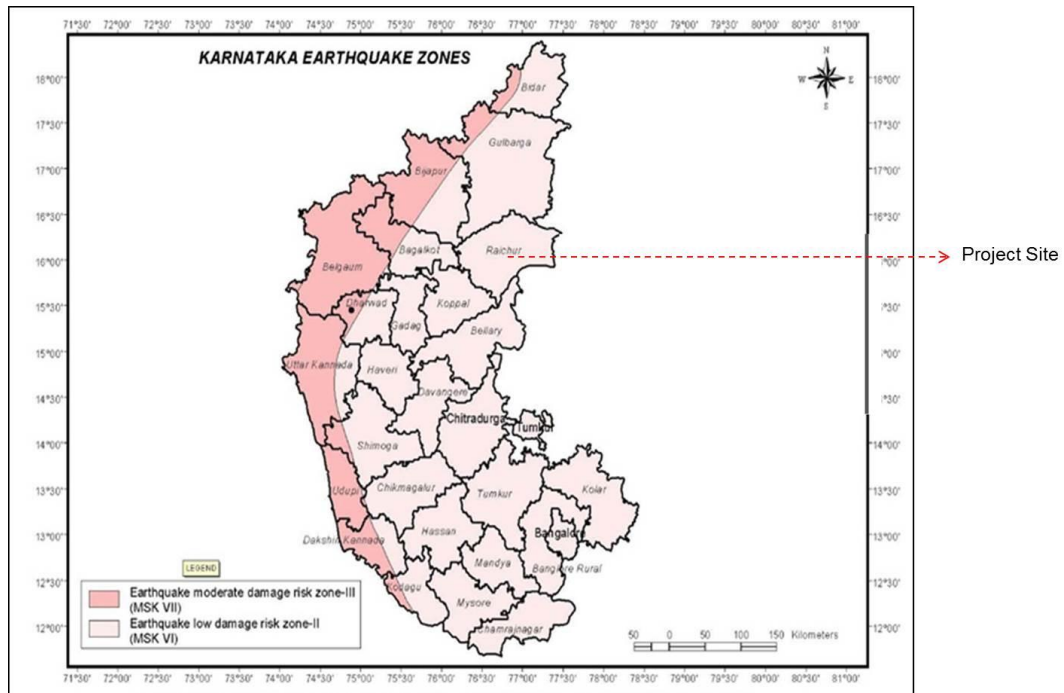


Source: <https://www.ksndmc.org/>

4.9.2 Seismicity

As per the Revised Earthquake Hazard Mapping, 22.13% of the total geographical area of Karnataka state is under Moderate earthquake damage risk zone & remaining area of the state is under low damage risk zone. The proposed project area under Raichur district falls in the Low Damage Risk Zone II (MSK VI) as shown in **Figure 4-11**.

Figure 4-11: Map of Karnataka earthquake zones showing the proposed project site



Source: A handbook of Karnataka, 2010.

4.10 Archaeology and Cultural Heritage Resources

There are no recognized archaeological sites within 1km of the proposed project location. A 'Babul Tree' is located on a parcel of land which was used to be worshipped by the locals of the area once a year.

4.11 Ecological Diversity of the Area

The area falling directly under the physical footprint of the project infrastructure is referred to in this section as the 'Project Site'. The project site, along with the area falling within 5 km radius of the project site boundary, was delineated as the study area for this ecological assessment and is referred to in this section as the 'Study Area'.

The study area was surveyed on the basis of a primary photo-documentation, supplemented by secondary data from governmental sources and scientific publications, as quoted at the pertinent places in this section. The data thus obtained was suitably collated to derive an ecological baseline of the area with respect to its biodiversity and ecosystem services. This section presents an overview of this ecological baseline in terms of its species, habitat and ecosystem services profiles, supported by note on forest type and detailed faunal species lists.

4.11.1 Ecological Context of the Study Area

Geographically, the study area is a part of the Deccan Plateau region of southern India. It is situated in the eastern part of the Raichur Plateau, one of the water-divides separating the catchment of the Krishna River to the north from that of the Tungabhadra River to the south. The study area is largely a plain sloping gently towards the southeast.

The predominant land use of the study area is cultivation, with most of the plains converted into fallow lands. Natural vegetation is limited to farm-bunds, a few uncultivable patches of land, stream-banks, knolls and ridges.

4.11.2 Species Profile of the Study Area

4.11.2.1 Floristic Species

Forest Type

The Champion & Seth survey of the forest-types of India indicates that the natural vegetation of the study-area are form of Southern Thorn Forest (Forest Type 6A/C1), an important forest-type of the Deccan Plateau region of Maharashtra, Karnataka, Telangana and Tamil Nadu.

Such forests are seen in peninsular India, throughout the dry tract to the lee of the Western Ghats. They are met with on shallow dry soil, or deep but sandy soil. The ground is usually flat or in the form of low undulating hills and plateaux.

These are open and low forests dominated by thorny species. The trees tend to be short with low-branching crowns that rarely meet to form a canopy. There is an ill-defined lower storey of large and small shrubs which tend to be spiny and show various xerophytic characters. A thin growth of grass appears during the moist season, but the ground remains largely bare through the rest of the year. Climbers are few, with most of the ones present also showing xerophytic adaptations.

Species associated with this forest-type include:

Trees, such as *Acacia catechu*, *Acacia leucophloea*, *Acacia nilotica*, *Aegle marmelos*, *Ailanthus excelsa*, *Albizia* spp., *Azadirachta indica*, *Balanites aegyptica*, *Chloroxylon swietenia*, *Dichrostachys cinerea*, *Dolichandrone falcata*, *Ficus* spp., *Flacourtia indica*, *Grewia* spp., *Ixora arborea*, *Randia* spp., *Santalum album*, *Strychnos potatorum* and *Zizyphus* spp.;

Shrubs, such as *Capparis decidua*, *Carissa* spp., *Cassia auriculata*, *Dodonaea viscosa*, *Euphorbia nivulia*, *Lantana camara* and *Opuntia elatior*;

Grasses, such as *Aristida* spp., and *Heteropogon contortus*; and

Climbers, such as *Zizyphus oenoplia*.

Ecologically, such thorny woodlands and grasslands are considered to be the effect of excessive cutting and browsing, and thus, not a true climatic formation. Protection of such an area is likely to lead to the regeneration of elements of a tropical dry deciduous forest, while their degradation leads to thorn scrub or secondary grasslands. Any of these main types or their degradation stages may be expected in the study-area.

Source: H.G. Champion & S. K. Seth (2005). A Revised Survey of the Forest Types of India. Natraj Publishers, Dehradun.

4.11.2.2 Faunal Species

This section describes the faunal profile of the study area. It includes the higher faunal species having recorded ranges that include the study area or waterbodies in the catchments of which the study area is situated. Species belonging to each of the higher faunal groups, namely Mammals, Birds, Reptiles, Amphibians and Fishes, are listed separately in the sub-sections that follow.

Each table that follows in this section gives the scientific and common name of each species listed, along with the conservation status assigned to it by the International Union for Conservation of Nature and Natural Resources (IUCN), as well as, the Schedule under which it is listed by the Indian Wildlife (Protection) Act, 1972 (WPA). In each list, species of special conservation concern, namely, the IUCN-designated globally threatened/near-threatened species and those listed in Schedule I of the Indian Wildlife (Protection) Act (1972) indicating the highest level of legal protection accorded to wild species in India, appear in **bold font**.

Mammals

At least thirty-nine mammalian species are reported from the study area. These include species associated with the forests, wetlands and freshwaters of the study area. Of these, seven are designated by the International Union for Nature and Natural Resources (IUCN) as globally threatened or near-threatened - comprising one species designated as Endangered (EN), three as Vulnerable (VU) and three as Near Threatened (NT) - while eight species are protected under Schedule I of the Indian Wildlife (Protection) Act (1972). **Table 1 of Appendix B** provides list of the mammalian species recorded ranges that include the study area.

Birds

At least two hundred and twenty-eight bird species are having recorded ranges in the study area. Of these species, one hundred and fifty-nine are reported as resident to the study area, while sixty-nine are reported as migrants to the study area. These collectively include species associated with the forests, wetlands and

freshwaters of the study area. Of these, fourteen are designated by the International Union for Nature and Natural Resources (IUCN) as globally threatened or near-threatened - comprising four species designated as Critically Endangered (CR), two as Endangered (EN), two as Vulnerable (VU) and six as Near Threatened (NT) - while eight species are protected under Schedule I of the Indian Wildlife (Protection) Act (1972).

Resident Birds

A total of 159 resident birds are recorded from the study area, the details are presented in **Table 2 of Appendix B**. Though individuals of such species may migrate locally and need not occur at a given location throughout the year, the study area is considered to be providing potential habitats to these species at any given time of the year.

Reptiles

At least forty-three reptilian species are reported from the study, the details of which are provided in **Table 3 of Appendix B**. These include species associated with the forests, wetlands and freshwaters of the study area. Of these, two are designated by the International Union for Nature and Natural Resources (IUCN) as globally threatened or near-threatened - comprising one species designated as Vulnerable (VU) and one as Near Threatened (NT) - while one species is protected under Schedule I of the Indian Wildlife (Protection) Act (1972).

Amphibians

At least fifteen amphibian species are reported from the study area. These include species associated with the forests, wetlands and freshwaters of the study area. None of these is designated by the International Union for Nature and Natural Resources (IUCN) as globally threatened or near-threatened or protected under Schedule I of the Indian Wildlife (Protection) Act (1972). **Table 4 of Appendix B** lists the amphibian species reported from the study area.

Fishes

At least fourteen fish species are reported from the study area. These include species associated with the freshwaters of the study area and waterbodies in the catchments of which the study area is situated. Of these, two are designated by the International Union for Nature and Natural Resources (IUCN) as globally threatened or near-threatened - comprising one species designated as Endangered (EN) and one as Vulnerable (VU). None of these species is protected under Schedule I of the Indian Wildlife (Protection) Act (1972). **Table 5 of Appendix B** lists the fish species reported from the study area.

4.11.3 Habitat Profile of the Study Area

The habitats present in the study area may primarily be classified as natural or modified habitats. Natural habitats are areas composed of viable assemblages of plant and/or animal species of largely native origin, and/or where human activity has not essentially modified the area's primary ecological functions and species composition. Modified habitats are areas that contain a large proportion of plant and/or animal species of non-native origin, and/or where human activity has substantially modified the area's primary ecological functions and species composition.

If any of the natural or modified habitats of the study area are of critical importance to the survival of any IUCN-designated Critically Endangered (CR)/ Endangered (EN) species, Migratory species, Congregatory species or Endemic/ Restricted Range species, they may be defined as Critical Habitats.

4.11.3.1 Natural Habitats

The natural habitats of the study area mainly consist of a few copses of thorn scrub, found growing along the slopes of the knolls, and the strips of vegetation growing along the stream-banks.

4.11.3.2 Modified Habitats

The modified habitats of the study area mainly consist of large tracts of rain fed farmlands, fallow farmlands utilized mainly as pasture for livestock, a few habitations and a few roads.

4.11.3.3 Critical Habitats

This sub-section lists the IUCN-designated Critically Endangered (CR)/ Endangered (EN) species, Migratory species, Congregatory species or Endemic/ Restricted Range species having recorded ranges that include the study area or waterbodies in the catchments of which the study area is situated. However, it seems unlikely that any of the habitats observed in the study area are of critical importance to the survival of any of these species.

Critically Endangered / Endangered Species Habitats

Table 4-12 lists the IUCN-designated Critically Endangered or Endangered species having recorded ranges that include the study area.

Table 4-12: Critically Endangered / Endangered Species of the Study Area

Sr. No.	Scientific Name	Common Name	IUCN Status*
Mammals			
1	<i>Manis crassicaudata</i>	Indian Pangolin	EN
Birds			
2	<i>Neophron percnopterus</i>	Egyptian Vulture	EN
3	<i>Gyps bengalensis</i>	White-rumped Vulture	CR
4	<i>Gyps indicus</i>	Indian Vulture	CR
5	<i>Sarcogyps calvus</i>	Red-headed Vulture	CR
6	<i>Ardotis nigriceps</i>	Great Indian Bustard	CR
7	<i>Sypheotides indicus</i>	Lesser Florican	EN
Fish			
8	<i>Tor khudree</i>	Yellow Mahseer	EN

*Status assigned by the International Union for Conservation of Nature and Natural Resources, where – CR – Critically Endangered; EN – Endangered.

4.11.3.4 Migratory Species Habitats

The entire Indian subcontinent, including the study area, falls within the limits of the Central Asian Flyway (CAF), one of the eight globally identified flyways. The CAF connects a large swathe of the Palaearctic region with the Indian subcontinent and contains several well-established routes along which a number of bird-species migrate annually. This flyway covers a large part of the continental area of Eurasia and includes the whole of the Indian sub-continent. Thus, the study-area is very likely to be situated in the flight-path of the various winter, summer and passage visitor-birds migrating either to or through the region in which it is situated.

Table 6 of Appendix A lists the migratory avifaunal species having recorded ranges that include the study area or waterbodies in the catchments of which the study area is situated. The conservation status as per the IUCN Red Data List of Threatened Species and the Schedule under which the species is protected by the Wildlife (Protection) Act (WPA), 1972, of India is mentioned against each species.

4.11.3.5 Congregatory Species Habitats

Table 4-13 lists the relatively congregatory species having recorded ranges that include the study area.

Table 4-13: Congregatory Species of the Study Area

S. No.	Scientific Name	Common Name	IUCN Status*	WPA Schedule
1	<i>Phalacrocorax niger</i>	Little Cormorant	LC	IV
3	<i>Phalacrocorax carbo</i>	Great Cormorant	LC	IV
4	<i>Mycteria leucocephala</i>	Painted Stork	NT	IV

*Status assigned by the International Union for Conservation of Nature and Natural Resources, where NT – Near threatened; LC – Least Concern.

**Schedules I to VI: Indian Wildlife (Protection) Act, 1972.

Sources: R. Grimmett, C. Inskipp & T. Inskipp (2011). *Birds of the Indian Subcontinent*. Oxford University Press, pp 1-528; Salim Ali (2012) reprinted. *The Book of Indian Birds*. Oxford University Press, pp 1-326; IUCN (2017). *The IUCN Red List of Threatened Species*. Version 2017-1; Schedules I to VI: Indian Wildlife (Protection) Act, 1972.

4.11.3.6 Endemic / Restricted Species Habitats

Table 4-14 lists the near-endemic or restricted range species having recorded ranges that include the study area.

Table 4-14: Endemic/ Restricted Species of the Study Area

S. No.	Scientific Name	Common Name	IUCN Status*	Range
<i>Mammals</i>				
1	<i>Macaca radiate</i>	Bonnet Macaque	LC	Southern India
2	<i>Anathana ellioti</i>	Southern Tree Shrew	LC	Southern India
<i>Birds</i>				
3	<i>Perdicula argoondah</i>	Rock Bush Quail	LC	Central & Western India
4	<i>Galloperdix spadicea</i>	Red Spurfowl	LC	Peninsular India
5	<i>Galloperdix lunulata</i>	Painted Spurfowl	LC	Peninsular India
6	<i>Gallus sonneratii</i>	Grey Junglefowl	LC	Southern India
7	<i>Strix ocellata</i>	Mottled Wood Owl	LC	Peninsular India
8	<i>Galerida deva</i>	Sykes's Lark	LC	Peninsular India

*Status assigned by the International Union for Conservation of Nature and Natural Resources, where NT – Near threatened; LC – Least Concern.

Sources: Vivek Menon (2014), *Indian Mammals: A Field Guide*. Hachette Book Publishing India Pvt. Ltd., Gurgaon, India, pp 1-522; R. Grimmett, C. Inskipp & T. Inskipp (2011). *Birds of the Indian Subcontinent*. Oxford University Press, pp 1-528; Salim Ali (2012) reprinted. *The Book of Indian Birds*. Oxford University Press, pp 1-326; IUCN (2017). *The IUCN Red List of Threatened Species*. Version 2017-1.

4.11.4 Ecosystem Services Profile of the Study Area

Informal interactions with residents of the study area and observations made in course of the field work suggest that study area provides the following provisioning, regulating and supporting and cultural services to the local communities.

4.11.4.1 Provisioning Services

The communities living in and around the study area utilizes bore well water for their domestic needs. Agriculture in area is rain fed canal system is also rainfall dependent.

4.11.4.2 Regulating Services

The natural vegetation of the study area in general, reduces the impact of precipitation on the soil-surface, thereby reducing dislodging of soil particles. It also slows down the surface run-off, thereby reducing soil erosion. The slowing down of the surface run-off also increases the percolation of water into sub-surface layers, thereby aiding groundwater recharge. The over ground shoots and underground root systems of the natural vegetation also filter the surface and sub-surface run-off, thereby physically purifying the surface and sub-surface flows. The life-forms inhabiting the seasonal streams and stream-bank wetlands also recycle organic matter in the water, thereby chemically purifying the surface water. Thus, the ecosystems of the study area control soil erosion and regulate the quantity and quality of water available to the local communities.

4.11.4.3 Supporting Services

The flora and fauna of the study-area, through the food-chains they constitute, capture, transfer and recycle nutrients in the air, water and soil of the study area. Such nutrients primarily include carbon, nitrogen and oxygen, along with their natural compounds. The photosynthetic organisms of the study-area create food-reserves that directly or indirectly support the consumers of the area, including the local communities. This primary production supports the continued supply of provisions such as utilized directly by local communities, like wild foods, fodder grasses, fuel wood, and so on. Part of the biomass generated directly or indirectly by the photosynthetic production, upon decomposition, mixes with the sediments transported by the natural wind and water flows, to form new soil that supports the natural and agricultural plant species utilized by the local communities. The natural topography and vegetation of the study area create habitats for a range of fauna, which includes pollinator-species like bugs, bees, butterflies, moths, birds and bats that pollinate natural and agricultural plant species utilized by the local communities. Thus, the natural topography, flora and fauna of the study area provide supporting services, such as nutrient recycling, photosynthetic production, soil formation and pollinator services to the local communities. These services support the local communities' life-sustaining activities, such as farming, food-gathering, cooking and grazing of livestock.

4.11.5 Designated Areas

Designated areas include Legally Protected Areas and Internationally Recognized Areas. Legally Protected Areas include Protected Forests, Reserve Forests, Wildlife Sanctuaries, National Parks and Biosphere Reserves, notified by the Indian nation under the law of the land. Internationally Recognized Areas include Important Bird Areas (IBA), Ramsar Sites and other such natural areas of global importance, designated through international conventions to which the Indian nation is a signatory.

The legally protected area nearest to the project site is Tungabhadra Otter Conservation Reserve which stretches between Madlapur, Koppal Taluka and Kampli, Hospete Taluka and situated about 100 km southwest from the project site. Another protected area located about 115 km southwest from the project site is the Daroji Sloth Bear Sanctuary. Nearest Important Bird Area (IBA) is Hampi Ruins situated about 113 km towards southwest of the project site and the Kolleru Lake Ramsar Site, located approximately 438 km east of the project site.

4.12 Socio-economic Environment

A study of the socio- economic environment of an area is essential as people are the prime recipients of developmental projects around them. An understanding of the livelihood activities, social relations and institutions around the area is thereby important to understand the social and economic aspects of the concerned area. This section of the report summarises the socio-economic characteristics of the study area.

Primary research in the form of stake-holder consultations was conducted to understand the perception and degree of engagement with the project. It was followed by secondary research primarily from the following government publications such as:

- i. Primary Census Abstract 2001 and 2011;
- ii. Village Directory Data, 2011;
- iii. Agricultural Census of 2010-11;
- iv. Relevant national/state/district level government websites.

4.12.1 Study Area

The study area falls in Raichur District of Karnataka. Raichur is located in the eastern part of Karnataka bounded by Yadgir district in the north, Bijapur and Bagalkot district in the northwest, Koppal district in the west, Bellary district in the south, Mahbubnagar and Kurnool districts of Andhra Pradesh in the east. Its lies between 15° 9' and 16° 344' North latitude and 75° 46' and 77° 35' East longitude.

There are two (02) villages namely: Machnur and Singaddinni which fall within the study area of 2km of the proposed project site. The socio-economic baseline data presented below comprises details pertaining to Raichur District, Manvi Taluk and study area villages, Machnur and Singaddinni, respectively.

4.12.2 Administrative Setup

Raichur District consists of five (05) administrative blocks (Talukas) viz. Devadurga, Lingsugur, Manvi, Raichur and Sindhur which comprises of eight hundred and eighty four (884) villages and nine (09) towns. The administration is headed by a Deputy Commissioner.

4.12.3 Review of Secondary Information

The secondary data for the socio-economic assessment has been supplemented from the following sources:

- Primary Census Data 2011, Office of Registrar and Census Commissioner, Government of India;
- Village Data Abstract 2011, Office of Registrar and Census Commissioner, Government of India; and
- National Family Health Survey 2015-16, State Report of Karnataka and District Report of Raichur, International Institute of Population Sciences.

4.12.4 Demographic Profile

This section of the report would elaborate and analyse the demography of the project area. The purpose of demographic profiling is to enable us to get a better understanding of the existent essential statistics in the area.

It will focus on the size, composition and distribution of the population. The data represented below has been derived primarily from the Primary Census Data 2011.

Raichur District has a total population of 1,928,812 which forms 3.2% of the total population of the state of Karnataka. It is the 10th most populous district in the State.

Taluka

Table 4-15: Population of Manvi Taluka

Taluka	Total Population	Total Male Population 49.68%	Total Female Population 50.31%	Rural Population 92.32%	Urban Population 12.53%
Manvi	370670	184163	186507	342205	46465

Source: Census Data 2011

The table above reflects the population of Manvi taluka which is 370670 (which is 19% of total population of Karnataka). The male population of taluka is 49.68 % and female population is 50.31% respectively. The rural population is significantly higher at 92.32 % than the urban population which stands at 12.53%.

Study Area Villages

The population of Machnur and Singaddinni Villages are 1460 and 276 respectively as per the 2011 Census data. Total male population of Machnur Village is 733 and female population is 727. In Singaddinni Village, male population is 136 in number and female population is 140.

Table 4-16: Population of Study Area Villages

Village	Total Population (2011)	Total Male Population (2011)	Total Female Population (2011)
Machnur	1460	733	727
Singaddinni	276	136	140

Source: Census Data 2011.

4.12.4.1 Sex Ratio

Sex ratio is an important socio-economic indicator of the health of a society. A skewed sex ratio is a major concern for the social and economic progress of the society. Sex ratio for Karnataka has increased from 965 in 2001 to 973 in 2011. Karnataka's is 11th in the sex ratio rankings in the country. The sex ratio of Raichur District is 1000 females per 1000 males while sex ratio for Manvi Taluka is 1013 (females per 1000 males). The sex ratio of Machnur Village is 991 females per 1000 males and Singaddinni is 971 females per 1000 males.

4.12.5 Literacy level

For the purpose of literacy level calculation in the Census of India, any person above the age of seven years or above whom can read and write any language with understanding is considered a literate person. The literacy level of the country and the states therein reflects and indicates the socio economic growth of a country. Higher literacy levels indicate higher productivity levels and greater contribution of the citizens to the economic and social progress of the country.

In Raichur District, 50% of the total population is literate with 60% of the males and 42% of females are literate. Manvi Taluka has 47% of total literate population. 56% of males of Manvi Taluka and 38% of females are literates. The study area village's literacy level has been presented below in **Table 4-17**:

Table 4-17: Literacy Level of Study Area Villages

Village	Total Literate Population	Total Male Population with % Literate	Total Female Population with % Literate
Machnur	611	417 (68%)	194 (32%)

Village	Total Literate Population	Total Population with %	Male Literate with %	Total Female Literate Population with %
Singaddinni	161	83 (52%)		78 (48%)

4.12.5.1 Source Census Data 2011

In Machnur village, 611 people are literate out of total population of 1460 which is 42%. Male population (68%) is more literate than their female counterparts (32%). According to Census Data 2011, Singaddinni village has witnessed literate population of 161 which is 58% of the total population. 58% of the male population is literate and literacy level among females in 48%.

4.12.6 Presence of Vulnerable Communities

Scheduled Tribes (STs) and Scheduled Castes (SCs) are considered as vulnerable communities in India as they are considered to be different from the mainstream society of the country. They are considered to be marginalized from the society therefore various schemes and programmes are framed and implemented for their development. Amongst the tribes found in the study area, the major tribes found are Koli Dhor, Gond, Marati and Naikda.⁶The following section elaborates on the presence of these communities in the study area. The Scheduled Caste and Scheduled Tribe population of the District and Taluka level is presented in **Table 4-18**.

Table 4-18: ST and SC Population at District and Taluka Level

S. No.	District/ Taluka	Total population	SC	M	F	ST	M	F
1	Raichur	768004	400933	200359	200574	367071	182101	184970
2	Manvi	167246	78056	38748	39308	89190	43976	45214

For the purpose of protection of their indigenous rights and unique culture, certain areas in the country have been classified as a Scheduled Area (i.e. if fifty percent (50%) of its population have been identified and listed as Scheduled Tribes) as defined under Part V of the Indian Constitution. Karnataka does not fall under the classification of Scheduled Area.

Study Area Villages

Scheduled Caste

As per Census Data 2011, the Scheduled Caste (SC) population is approximately 24% of total population in Machnur village while in Singaddinni village; SC population is 3% of total population. In Machnur village, there are 175 males and 172 females belonging to SC category. Singaddinni village has 4 males and females as SC.

Scheduled Tribes

Machnur Village has a total population of is 1460 wherein the Scheduled tribe (ST) population is 306 which forms 20.9% of the total population. There are 155 males and 151 females. In Singaddinni village there are 99 people belonging to ST which forms 35.8% of the total population of Village. 51 males and 48 females of the village fall in ST category.

Table 4-19: ST and SC Population at Village Level

S. No.	Villages	Total population	SC	M	F	ST	M	F
1	Machnur	1460	347	175	172	306	155	151
2	Singaddinni	276	8	4	4	99	51	48

4.12.7 Land Holding Pattern of the Area

Table 4-20 shows the land holding pattern prevalent in Machnur and Singaddinni Villages. It could be inferred from the table presented below that net sown area for Machnur village is 1301.7 Hectares while for Singaddinni village, it is 659.6 hectares which indicates that most of the population in the two villages are dependent upon agriculture for their livelihood. The total irrigated land area for Machnur is 16 Hectares while for Singaddinni it is

⁶ <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4510769/>

176.8 hectares and the total unirrigated area for Machnur and Singaddinni are 1285.7 hectares and 482.7 hectares respectively which shows that the population are mainly dependent upon rain fed agriculture.

Table 4-20: Land Holding Pattern in Villages

S.No.	Villages	Fallow lands other than current fallows	Current Fallows	Net Area Sown	Total Irrigated Land Area	Total Un-irrigated Land Area Hectare
1	Machnur	0	12.3	1301.7	16	1285.7
2	Singaddinni	0	11	659.6	176.8	482.7

4.12.8 Presence of Cultural Heritage

There are no sites of cultural or archaeological importance in the project area premises and its vicinity. A 'Babul Tree' is located on a parcel of land within the proposed project premises which is being worshipped by the locals of the area once a year. While consulting the site representatives, it was mentioned that the tree will not be cut and access will be provided to the community.

4.12.9 Workforce Population

Table 4-21 represents the working population demography of the two villages namely Machnur and Singaddinni. The total working population for Machnur is 839 while for Singaddinni village, it is 165. The main working population of Machnur village is 610 while for Singaddinni village is 148. Male working population in the main working category of Machnur village is 387 and female working population is 223. In Singaddinni village, the male working population in main workers category is 89 and female is 59. The marginal working population is 229 and 17 respectively for Machnur and Singaddinni villages respectively. Female marginal working population is higher than male marginal working population which is 201 out of 229 in Machnur village. While in Singaddinni village there are 16 female and one (01) male marginal worker as noted as per the Census Data, 2011.

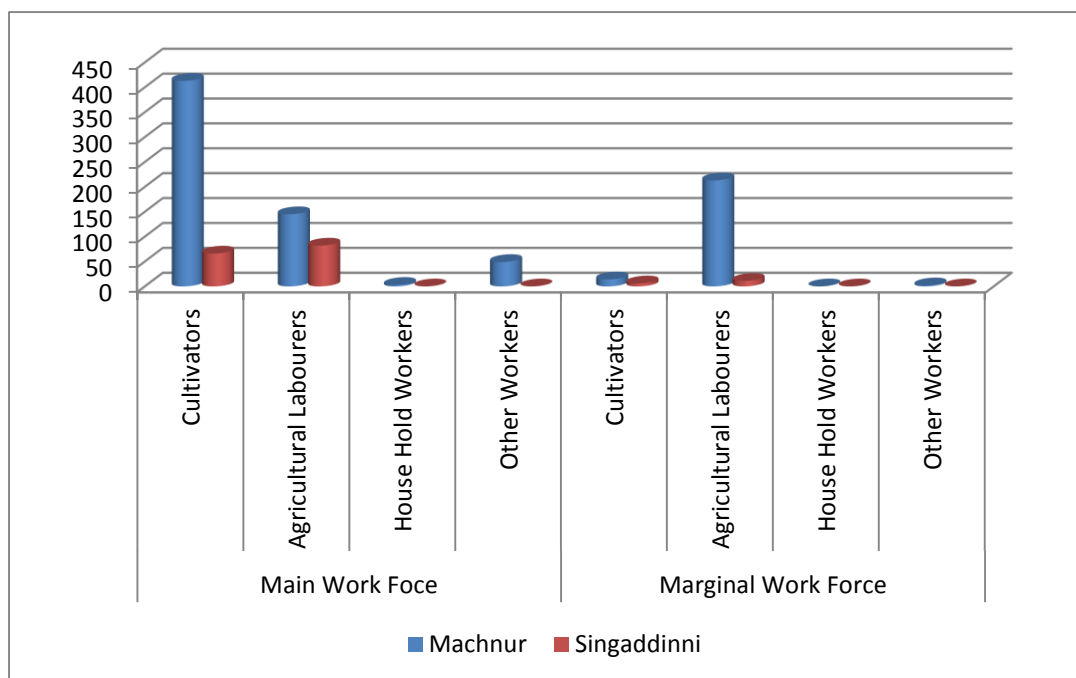
Table 4-21: Workforce Population of the Study Area Villages

Villages	Total Working Population. (2011)	Main Working Population. (2011)			Marginal Working Population (2011)		
		Total	Male	Female	Total	Male	Female
Machnur	839	Total	Male	Female	Total	Male	Female
		610	387	223	229	28	201
Singaddinni	165	Total	Male	Female	Total	Male	Female
		148	89	59	17	1	16

4.12.10 Occupational Pattern of the Area

Livelihood patterns diversify in accordance with the availability of resources and infrastructure in the area. The patterns also depend on the presence of skilled workforce adept in performing the required tasks and responsibilities. The following section elaborates on the existing occupational pattern in the study village. Details of the occupational pattern in Machnur and Singaddinni village have been provided in the **Figure 4-12**.

Figure 4-12: Occupational Pattern in the Villages



From the above graph, it could be inferred that majority of the workers in both the villages belonging to main workforce are cultivators (479) followed by agricultural labours (227) and other workers (49). In Singaddinni village, the main occupation is cultivators and agricultural labourers. Marginal work force in both the villages is prevalent as Agricultural labourers (224) followed by cultivators.

During consultations with land sellers and land aggregator, it was informed the main occupation of majority of the families in both the villages had marginal landholdings and the primary occupation of the villagers is cultivators and agricultural labourers. Many of villagers work in Raichur town or other nearby areas as for the past 3-4years as the agricultural productivity of the project area is low and its returns have been minimal. The prevalent crops in the study area are cotton, bajra and jawar. There are private bore wells installed in the fields for irrigation purposes. However, due to insufficient supply from bore well, agriculture has become rainfall dependent.

4.12.11 Women Work Force Participation in Study Area Villages

The development of a society is evaluated on the basis of how its women are represented and integrated in the mainstream society. Occupational pattern prevalent among the women of the villages have been analysed and presented below:

Main Work Force Pattern

Majority of the women in Machnur village are cultivators (49.8%) followed by agricultural labourers (45.3%). In Singaddinni village, 67.8% of women are agricultural labourers and 32.2% are cultivators.

Table 4-22: Main Workforce Population of Women

Villages	Cultivators	Ag. Labourers	House Hold	Others
Machnur	111 (49.8%)	101 (45.3%)	0 (0)	11 (4.9%)
Singaddinni	19 (32.2%)	40 (67.8%)	0 (0)	0 (0)

Source: Census Data, 2011

Marginal Work Force Pattern

According to census data, 2011 in both the villages' agricultural labourers forms the highest occupation followed by cultivators. Break up of marginal work force participation prevailing for women in both the villages is tabulated below in **Table 4-23**.

Table 4-23: Marginal Workforce Population of Women

Villages	Cultivators	Ag. Labourers	House Hold	Others
Machnur	10 (5%)	190 (94.5%)	0 (0)	1 (0.5%)
Singaddinni	6 (37.5%)	10 (62.5%)	0 (0)	0 (0)

Source: Census Data, 2011

4.12.12 Existing Infrastructure Facilities

The existence and accessibility to certain basic infrastructure facilities and amenities is a critical index of a country's economic and social growth. The absence of basic amenities such as educational and health facilities as well as reliable transportation and communication facilities act as a major obstacle to growth and economic vitality. The section below elaborates on the presence of such amenities on the basis of the Village Data Abstract 2011 and site reconnaissance survey of the Project Affected Villages- Machnur and Singaddinni Villages.

4.12.12.1 Educational Facilities

There is one (01) government primary school in both the villages. For higher education, students travel to Manvi Town which is at a distance of around twelve (12) kilometres.

4.12.12.2 Road and Transportation Facilities

In Machnur and Singaddinni Villages, there are both Kuccha and Pukka roads. The villages are connected to the nearest towns (Manvi, Sindhnur and Lingsugur) area through public and private means of transportation. The state transportation buses and autos are utilized as mode of transportation for travelling to nearby towns and big villages. Private taxis and vans are also available on demand.

4.12.12.3 Communication Facilities

Both villages of Machnur and Singaddinni villages have telephone connectivity and good mobile phone coverage. According to the VDA 2011, there is no railway station near to Machnur in less than 10 km. Bellary Junction Rail Way Station is major railway station which is located at a distance of 124 km from Machnur Village.

4.12.12.4 Banking Facilities

According to the VDA 2011, both Villages (Machnur Village and Singaddinni Villages) have one (01) self-help group which cater to the banking needs of the community members. There is no presence of commercial banks both private and public in both the study area villages.

4.12.12.5 Drinking water and Sanitation Facilities

Machnur village is supplied with treated tap water and hand pump provided by the Panchayat which is available throughout the year. A RO filter has been installed by the Gram Panchayat for provision of drinking water to the community. Singaddinni village is supplied with only one Community Hand Pump wherein water is present throughout the year. During consultations, it was informed that villagers are required to travel to Kallur village for fetching the drinking water from Singaddinni village during summer months, which is located at a distance of 7km in east direction. There is no system for collection of garbage and waste disposal in the both the study area villages.

4.12.12.6 Health Care Facilities

The nearest healthcare centre is in Hokrani village which is around 3.5 km away or Kallur village, located at 7km from the site. There are presently no healthcare centres in the immediate vicinity of the study area affected villages that cater to maternal needs of the community. The nearest hospital is in Manvi Town which is at an approximate distance of xxx from the study area villages.

4.12.12.7 Electricity Connections

As per VDA 2011 power supply is available in both the villages. Consultations with villagers revealed that electricity is available in the households with some frequent power cuts which last for 2-3 hours.

5 STAKEHOLDER ENGAGEMENT AND CONSULTATION

5.1.1 Introduction

Stakeholder Engagement is an important process through which a two way dialogue is created between the project proponent and the stakeholders. The consultation process provided opportunities for the affected communities to express their views on the planned project, whilst providing key information on issues faced by the land sellers.

The details of project associated impacts as gathered through the consultation process from the affected stakeholders have been elaborated in this section. For the purpose of the study, consultations were undertaken with residents of villages who are directly associated with the project by selling their lands. As mentioned in Section 5.10, for the purpose of the study, residents of Machnur and Singaddinni villages were identified and consulted to assess prevailing socio-economic conditions and project associated issues. Stakeholders identified for the project include the following:

- Locals from settlements of villages who have sold their land for the project (Machnur and Singaddinni) (hereinafter referred as project affected population);
- Locals of both the villages;
- Women Respondent;
- Personnel responsible for assisting land procurement for the project (Land aggregators).

5.1.2 Objective and Scope

The stakeholder engagement and consultation process has the following objectives:

- The consultation process provided opportunities for the affected communities to express their views on the planned project, whilst providing key information on issues faced by the land disburers;
- To ensure timely and consistent disclosure of project information to all stakeholders and facilitate their feedbacks, any decision making and concerns;
- To assess awareness levels of the project and to determine the impacts of future developments plans on the project area; and
- To ensure a process by which any grievance, suggestions or general feedback are accepted and addressed in a timely manner and incorporated in the project where applicable and relevant.

Consultations conducted during the stakeholder engagement process involved focus group discussions natural interviews. The following aspects form the structure of consultation process adopted for impact assessment:

- Identification of the relevant stakeholders including all those individuals, groups and organizations potentially influenced by or interested in the project;
- Information disclosure about the project and its potential impacts on livelihoods of locals;
- Verification and validation of proposed site, to avoid infringement of formal/informal rights of the local population;
- Document concerns and aspirations of the stakeholders through discussions; and
- Respond to queries in a neutral manner.

The discussion process involved a questionnaire with a list of open-ended questions addressed to either individuals or groups from project affected villages.

5.1.3 Details of Consultations

Two professionals from AECOM visited the site on 15 and 16th May, 2017 to the proposed site and carried out stakeholder consultations in various forms as described below:

Focussed Group Discussions

As mentioned in Project Description chapter, 287.02 acres of land has been procured through a land aggregator falling in Machnur and Singaddinni villages. At the time of site visit, the process of land procurement and

registration in the name of CSPGPL was completed. Consultations held during the site visit, are confined to availability of land contributors and their associated family representatives. Land aggregator was also consulted to validate land status of locals unavailable for discussions.

Natural Interviews

Natural group discussions were also conducted during site visit the locals and women of both the villages. Natural group discussions are interviews conducted with 'naturally' occurring groups, who have the advantage of being interviewed at a time and place of their convenience. These discussions are generally informal in nature.

5.1.3.1 Land Aggregator

Discussions pertaining to land procurement process were carried out with Mr. Veerprakash Godh (land aggregator) who belongs to sirvar ('Sirawara) village of Manvi Taluka. The land aggregator for the project assisted the land team of the project proponent in securing the land for the project. The person has informed that a total of 287.02 acres is procured from the land owners based on the willing- buyer and willing-seller' arrangement. The land aggregator has also informed that meetings with the panchayat and locals of both the villages were undertaken in January, 2017 and accordingly, information about the land requirement for the solar project was disseminated. The land owners willingly contacted the land aggregator for sale of land at the mutually agreed price. According to the land aggregator, 276 acre of land belonging to seven (7) land seller from Machnur village and rest of the land parcel belonging to land owners from Singaddinni village have been purchased.

5.1.3.2 Land Sellers

Table below presents details of questionnaire used during the consultation process. Summary of responses recorded during the consultations have also been presented in the **Table 5-1**.

Table 5-1: Summary of Responses received from Land Sellers

S. No	Questions	Summary of Responses gathered from Land sellers
1.	Has any land from local villages been acquired for the project?	Land falling in Machnur and Singaddinni has been procured for the project. The land is private agricultural land with dependency on rainfall.
2.	Are the land owners contended with the payment received?	Consultations with locals who sold their lands confirmed a general sense of satisfaction towards the monetary compensation received. The monetary compensation provided for land owners was higher than the market value at an average of INR 5.40,000 per acre. Responders confirmed that the market value previously was INR 2,00,000 per acre on average.
3.	Have any of the land owners who sold their land for the project become landless?	Land seller informed that they have enough land spread out in various parts of Manvi taluka and have not become landless. Land aggregator has also told that a big parcel of land measuring 180 acre falling in Machnur villages has been sold by land owner. The person has bought the land long way back for the purpose of investment only and now currently resides in Raichur Town.
4.	Approximately how many workers were engaged at the land parcel for agricultural purposes?	As the land procured was rainfall dependent, agricultural was discontinued due to lack of rainfall in last few years (3-4 years). As a result, locals are engaged in daily wages activities in nearby towns and are less likely to work as agricultural labourers.
5.	Has there been any change since the advent of this solar project in the area? How has the project affected the livelihoods in general?	There has been no physical displacement of the land sellers as part of the land procurement for the project. There have been limited opportunities created for employment of locals by the project like security personnel, housekeeping staff.
6.	Has the land prices increased because of the project?	Land prices in the immediate vicinity of the project, specifically in the villages where land has been procured have risen considerably.
7.	What is the community's understanding of the Project?	Earlier, no solar projects have been initiated in the region (specifically in the study area). The current project is first of its kind and the communities' understanding of operations associated with such facility is limited. The locals understand that solar plants are generally set up to generate electricity. Respondents perceive that substantial employment

S. No	Questions	Summary of Responses gathered from Land sellers
		opportunities will be created by the project as a result.
8.	Concerns/Issues and expectations of/from to the Project?	Employment opportunities created as a part of the project have been limited, and initiatives have to be taken by the project proponent for integrating more locals for project oriented works. Local of Singaddinni village has a misconception that area is receiving less rainfall due to incoming of the solar project. However, the representative from CSPGPL has clarified the purpose of solar farm and its non-interference with receiving of rainfall.
9.	Overall needs of the community?	Primary requirement from the project is to provide employment opportunities. Some other requirements that are expected to be addressed include good supply of water and better medical facilities in the villages.

5.1.3.3 Women Respondents

Women play a key role both as members of the household and as income generators (agricultural labourers) in a family. Women in Machnur and Singaddinni villages were identified and consulted in order to provide equal participation of views amongst both genders of the community. In addition, to responses summarized in **Table above** responses from women with respect to their socio-economic status were also recorded. The same have been summarized below:

- Most women are uneducated and those who have received education generally have not studied beyond grade eight;
- Most women work as agricultural labourers along with men in the society.
- Women in the society usually are married near the legal age of marriage.
- The nearest healthcare centre is in Hokrani village which is around 3.5 km away or Kallur village, located at 7km from the site. There are presently no healthcare centres in the immediate vicinity of the affected villages that cater to maternal needs of the community. Nearest hospital is in Manvi Town which is at an approximate distance of 12km from the study area villages.
- Some of the concerns that women faced are:
 - Most women in the community are agricultural labourers and are expecting employment opportunities to be created by the project;
 - Women have to travel far to fetch drinking water as the ground water available in the Singaddinni village is a bit salty;

5.1.3.4 Non-Government Organisations (NGOs)

For Women development, STREE SHAKTI scheme has been launched in the study area (Machnur and Singaddinni villages). The scheme was launched during 2000-01 with an objective to empower rural women and make them self-reliant by inculcating the habit of savings and proper utilization of financial resources. Apart from this, Pradhan Mantri Sadak Yojna is also prevalent in the area, which resulted in construction of roads in the area, thereby providing connectivity with the major highways.

5.1.3.5 Consultations with Project Proponent (CSPGPL)

CSPGPL site representatives were also consulted to gather their responses on project activities; amenities provided onsite and relationship with various other stakeholders (locals, contractors). **Table 5-2** summarizes the responses received from the project proponent.

Table 5-2: Summary of Responses received from project proponent

S. No	Questions	Response Recorded
1.	<i>Land Procurement Process:</i> 1. What type of land has been leased/procured for the proposed project and has any private land been acquired or leased?	CSPGPL has acquired 287.02 acres of private agricultural land from Machnur and Singaddinni villages to install the generation modules and operate the facility. The process of land procurement and registration was completed by March, 2017. A total of 286 acres from Machnur village and remaining land parcel have been acquired from

S. No	Questions	Response Recorded
		<p>Singaddinni village for the project. On an average INR 5, 40,000 per acre have been paid to the land contributors for the purchased land parcels.</p> <p>Furthermore, an additional area of 4 acres adjacent to the project site in Machnur village has been leased to the EPC contractor, M/s Mahindra EPC Services Private Limited. The EPC contractor will be using this parcel of land for batching plant and setting up labour camp. M/S PVR Contractor has been entrusted with the responsibility of identification of land requirement for construction of one transmission pole and survey of route of transmission line connecting site to 110/33 kV Kurdi Substation. A total of 32 poles are will be installed for transmission lines falling in Machnur (3 poles), Kallur (8 poles) and Horkarani Villages (21). Each pole will occupy an area of 4mx4m and 15mx15m. A one-time monitory compensation between INR 20,000 will be paid to the land owner.</p>
	Is access to any community structure is restricted due to establishment of the solar project?	There are no culturally important sites around the site except a 'Babul tree' which is worshipped by the land owner of the land parcel. CSPGPL has informed that the tree will not be cut and access will be provided for the land owner. There are also 13 'Neem Trees' within the site boundary which are kept intact and are not removed during site clearing.
2.	<i>Community Engagement:</i> How was the community informed about the proposed project? and Has any prior meetings been undertaken by CSPGPL with the local community?	Initial consultations concluded willingness of land sellers of Machnur and Singaddinni villages to sell land parcels for the Solar Power Project. A mediator helped the consultations and assisted in land procurement whilst individually negotiating land purchase rates. The monitory payment made to the land owners was higher than the market value at an average of INR 5, 40,000 per acre. (Market value prior to project was around INR2, 00, 000 per care on average). Formal systems are currently not in place to undertake disclosures for introducing information relating to operation related activities of the project to local residents.
3.	<i>Grievance Redressal Procedure</i> Have any formal/informal grievances been received? and What measures have been taken to address grievances if any? And does are there any mechanisms in place at the project level.	EPC Contractor M/s Mahindra has informed that an informal grievance redressal system is in place, wherein locals contact Site- In charge of Mahindra or CSPGPL in case of any issues or grievances.
4.	<i>Labour and working conditions</i> 1. How many workers are going to be engaged during the construction and operation phase? Are there any plans to engage locals for during construction/operation phase? 2. What are the arrangements in place for workers and employees during the lifecycle of the project?	During construction stage, the average labour demand for the proposed project is estimated to be about 350-370 workers. The unskilled labour and security guards for the project will be engaged from Machnur and Singaddinni villages. Skilled labour will involve migrant labour. As per the discussions held with representative from Mahindra EPC, around 50 local people from both the villages will be engaged during construction phase as unskilled labours. The security staff will be trained adequately in the use of force and appropriate conduct toward workers and the local

S. No	Questions	Response Recorded
		<p>community, and act within the applicable law.</p> <p>All the migrant labour will come from different parts of India who will be residing at labour colony constructed on leased land adjacent to the site. Adequate sanitation facilities like soak pit and a septic tank will be provided for the labour. Portable toilets will also be installed at the site. Two (2) porta cabins and one medical room have been already provided at site. Mahindra EPC has also engaged around 25 Engineers for construction phase, who are currently accommodated in guest house located at Raichur town. The staff commutes through company vehicles from Raichur town to the site.</p>

5.1.4 Need Base Assessment

A Needs Assessment was undertaken amongst the respondents to highlight the expectations of the local population in the study area from the project proponent. These views were collated in order to comprehend the need of the local community members so that the prioritizing of welfare activities can be drawn out on the basis of these needs in the future in case of implementation of Corporate Social Responsibility (CSR Activities). Locals have given priority to generation of employment opportunities and provision of safe drinking water. It is followed by the need for improved medical facilities in the villages.



Figure 5-1: Consultation with Land Aggregator

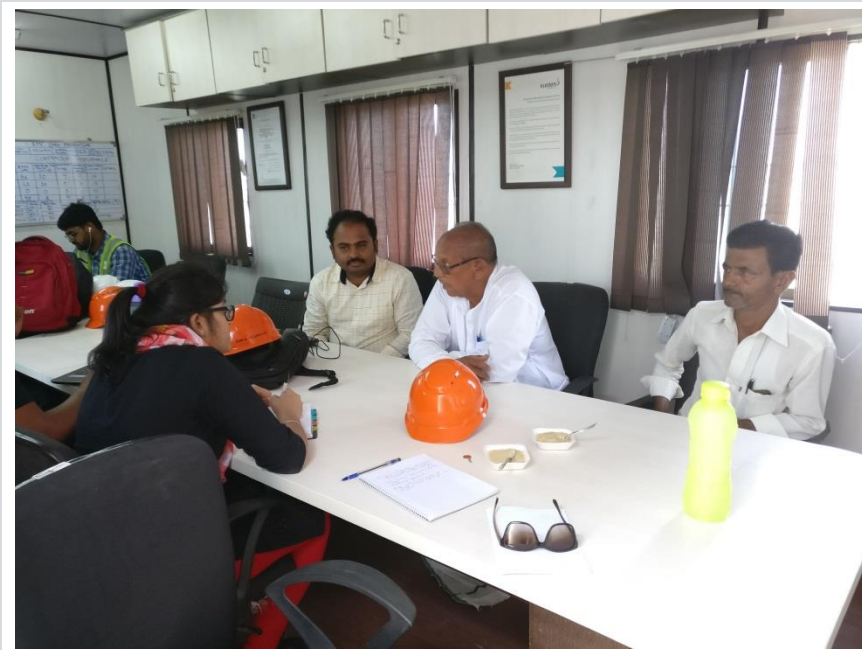


Figure 5-2: Consultations with land sellers



Figure 5-3: Consultations with Women of the villages



Figure 5-4: Consultations with Site Employees

6 ANALYSIS OF ALTERNATIVES

This section of the report presents the analysis of the alternatives considered for the proposed solar power project. The following scenarios have been considered:

1. No Project Scenario;
2. Alternate Location for the proposed project;
3. Alternate Methods of power generation;
4. Alternate Technology for proposed project
5. Alternate routes for transmission lines.

6.1 No Project Scenario

As per the Load Generation Report 2016-2017, Ministry of Power, Government of India, peak power demand for the state of Karnataka for year 2015-2016, was 10,202 MW against the availability of 9,508 MW and hence experienced power deficit of 6.8%. The anticipated peak power requirement for the state of Karnataka for the year 2016-2017 is 11,152 MW against the availability of 9,905 MW. Hence, indicating a power deficit of 1247 MW (11.2%) during 2016-2017. The forecasts for the power requirement for the state of Karnataka as per Central Electricity Authority (CEA)⁷ have been presented in **Table 6-1**.

Table 6-1: Power Forecasts for Karnataka (2016-2017)

Parameter	Requirement	Availability	Surplus(+)/Deficit (-)	%
Peak Electric Load (MW)	11,152	9,905	-1,247	-11.2%

Source: 17th Electric Power Survey

Anticipated month wise power supply position for 2016-2017 is as presented in **Table 6-2**.

Table 6-2: Anticipated month wise power supply position for Karnataka (2016-2017)

Month	Demand (MW)	Availability (MW)	Surplus (+)/ Deficit (-)	
			MW	%
April 16	10,362	8,363	-1,999	-19.3
May-16	9,681	8,459	-1,222	-12.6
Jun-16	9,619	8,646	-973	-10.1
July-16	9,342	9,175	-167	-1.8
Aug-16	9,218	9,265	48	0.5
Sept-16	9,565	8,801	-765	-8.0
Oct-16	9,465	8,935	-531	-5.6
Nov-16	9,392	8,974	-418	-4.5
Dec-16	9,787	9,150	-637	-6.5
Jan-17	10,030	9,747	-283	-2.8
Feb-17	10,234	9,905	-330	-3.2
Mar-17	11,152	9,708	-1,443	-12.9
Annual	11,152	9,905	-1,247	-11.2

As on 30th November, 2016 Karnataka state has a total power generation capacity of 17684.03 MW from all the sources. Out of which, 8142.88 MW is contributed by thermal and 475.86 MW is contributed by nuclear. Hydro

⁷ 17th Electric Power Survey

(renewable) and RES (MNRE) contribute 3599.80 MW and 5465.49 MW respectively⁸. Details are presented in **Table 6-3**.

Table 6-3: Installed Capacity (in MW) of power utilities in Karnataka State (as on 30th November, 2016)

Ownership/ Sector	Model wise break up						Grand Total	
	Thermal				Nuclear	Hydro (Renewable)		RES* (MNRE)
	Coal	Gas	Diesel	Total				
State	4220.00	0.00	127.92	4347.92	0.00	3599.80	155.33	8103.05
Private	2060.00	0.00	106.50	2166.50	0.00	0.00	5310.16	7476.66
Central	1628.46	0.00	0.00	1628.46	475.86	0.00	0.00	2104.32
Sub-total	7908.46	0.00	234.42	8142.88	475.86	3599.80	5465.49	17684.03

* RES include SHP, BP, U&I, Solar and Wind Energy as on 30.09.2016

SHP = Small Hydro Projects (≤ 25 MW), BP=Biomass Power, U&I=Urban & Industrial Waste Power, RES=Renewable Energy
MNRE=Ministry of New and Renewable Energy

Table below gives the details of allotted and commissioned renewable energy sources in Karnataka State till December 31st 2016.

Table 6-4: Allotted and Commissioned Renewable Energy Sources as on December 2016

S. No	RE Source	Allotted	Commissioned
1	Wind	15403.215	3201.44
2	Hydro	3020.86	843.46
3	Solar	3034.36	384.86
4	Co-Gen	1916.85	1317.05
5	Bio Mass	376.18	134.03
6	Municipal Solid Waste	25.50	0.00
Total		23776.96	5880.83

Source: Karnataka Renewable Energy Development Limited (KREDL)

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 240 to 300 sunny days with good solar radiation. Karnataka was the first southern state to notify its solar policy in 2011 and the first state to commission utility scale solar power project in India.

Karnataka receives an average insolation of 5.55 kWh/m²/day annually. Insolation varies from 4.5 to 7.0 kWh/m²/day throughout the year. All districts of the state receive average insolation of 5.5 to 6.5 kWh/m²/day annually except Kodagu (5-5.5 kWh/m²/day) as presented in **Figure 6-1**.

⁸ www.cea.nic.in/reports/monthly/installedcapacity/2016/installed_capacity-03.pdf

Figure 6-1: Average Annual Solar Insolation (kWh/m²/day) in Karnataka

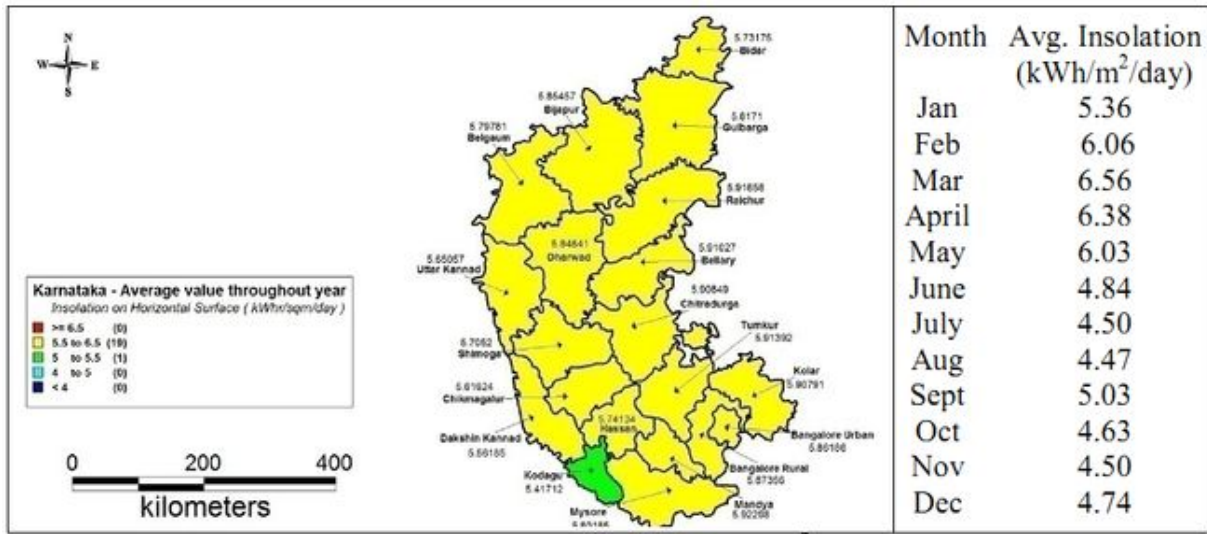
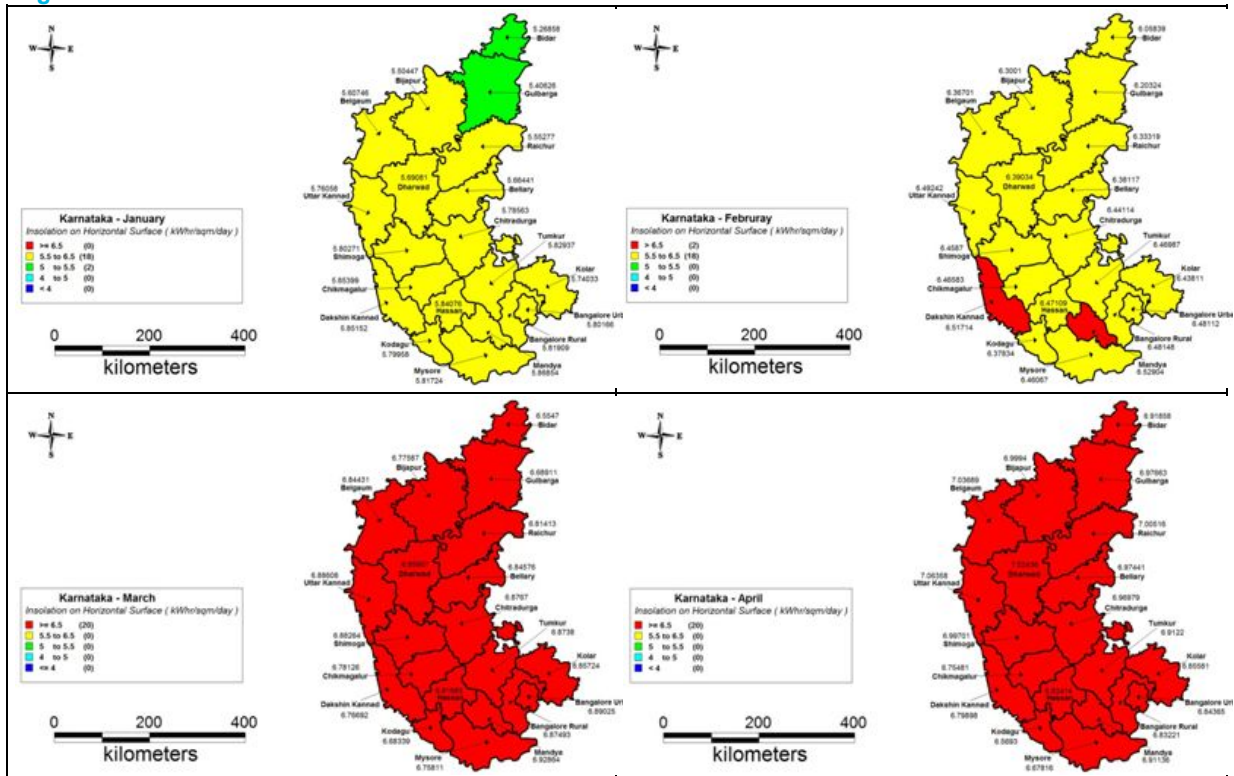
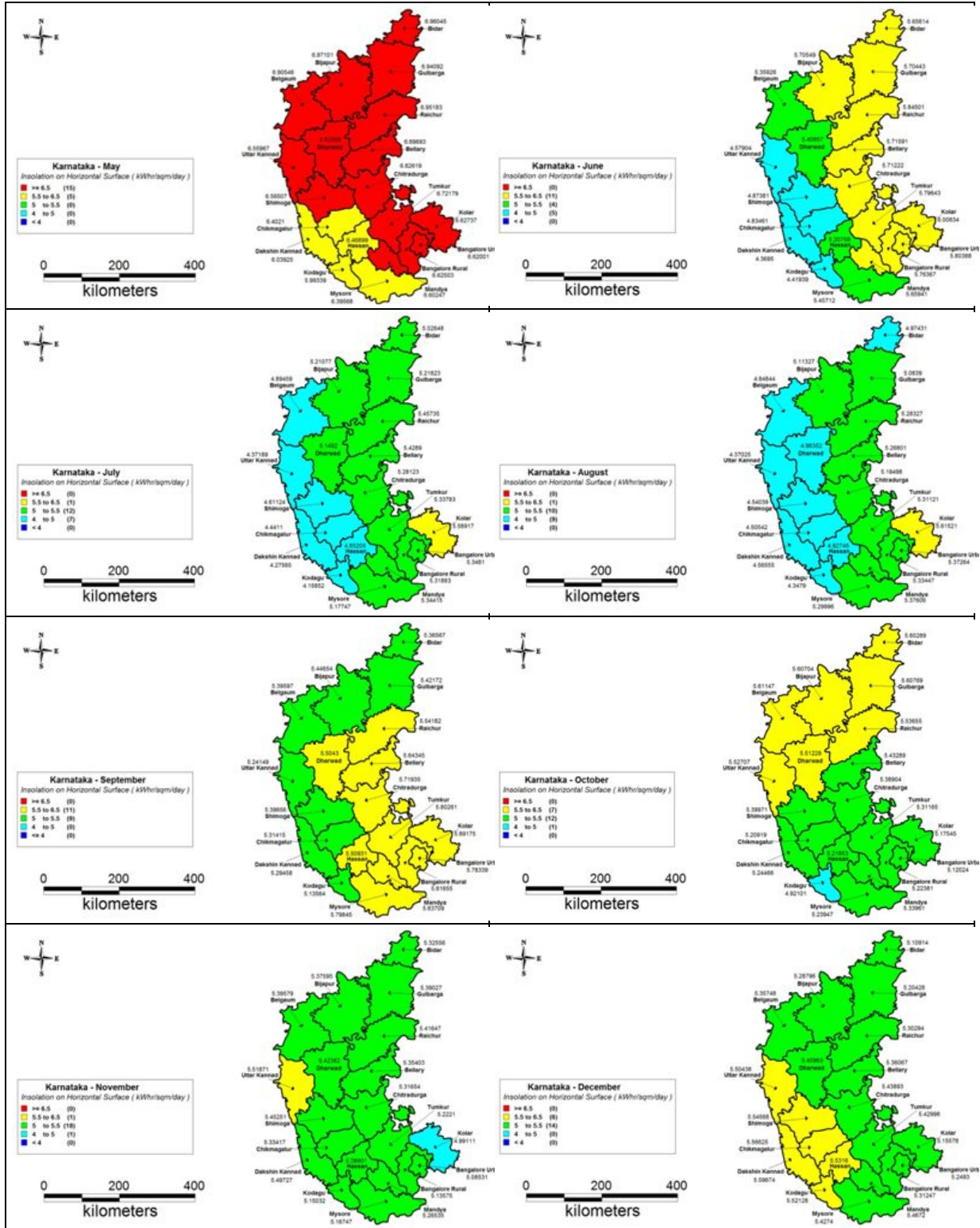


Figure 6-2 below presents the month wise insolation for Karnataka State.

Figure 6-2: Month wise insolation on horizontal surface for Karnataka State





As per the prevailing technical norms, any place with DNI more than or equal to $5.00 \text{ kWh/m}^2/\text{day}$ is considered suitable for solar thermal power projects that use only direct solar radiation. As regards SPV power projects, they use both direct and diffuse radiation and hence values below $5.00 \text{ kWh/m}^2/\text{day}$ are also acceptable. However, As per Karnataka Renewable Energy Development Limited (KREDL), annual average global horizontal irradiation at Manvi taluka is 5.94 kWh/m^2 .

Table 6-5: Average GHI and DNI values at Project Taluka

Taluka	Latitude	Longitude	Altitude	Annual Average GHI (kWh/m^2)	Annual Average DNI (kWh/m^2)
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Lingsugur	16° 10' 12"	76° 31' 12"	499	5.94	5.47
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Source: Karnataka Renewable Energy Development Limited (KREDL)

GHI: Global Horizontal Irradiance

DHI: Direct Normal Irradiance

Solar Radiation at Site

Proposed project site experiences an average global horizontal irradiance on month basis falling in range of 1900 to 2050 kWh/m² as detailed in Table 6-6 below. This irradiance is generally suitable for the reasonably good energy generation. **Table 6-6** below presents the levels of irradiance (month wise) at the proposed project site.

Table 6-6: Month Wise level of Irradiance for the site region

Months	Average Monthly Global Horizontal Irradiance (kWh/m ² /mth)
January	142
February	155
March	203
April	213
May	225
June	189
July	145
August	138
September	161
October	174
November	144
December	136
Average	168

Source: Detailed Project Report

The proposed project is an opportunity to utilize the solar potential of the area for power generation. A “No Project Scenario” will not address the issue of power shortage. An alternative without the project is undesirable, as it would worsen the power supply-demand scenario, which would be a constraint on economic growth.

To evaluate further, both the options of ‘Proposed Project’ and ‘No- Project’ Alternative have been assessed against potential environment and social impacts that are envisaged. Going forward with the proposed project alternative is considered the best possible option as opposed to ‘No Project’ since the proposed project is considered a green and environmental solution to meet energy requirements as the solar energy is renewable clean technology with no emissions as well as the global and local trend for energy generation.

Table 6-7: Comparison of overall environmental impacts as a result of the Proposed Project against the ‘No-Project’ Alternative

Environmental and Social Components	Proposed Project	No-Project Alternative
Terrestrial Ecology	S-	*
Air Quality	*	*
Noise Generation	*	*
Wastewater Generation	S-	*
Waste Generation / Disposal	S-	*
Soil & Groundwater Quality	X	*
Health & Safety	S-	*
Socio-economic Impacts	S+	X
Traffic Disturbance	X	*
Land Use	X	*
Archaeology / Cultural Property	X	*
Energy Production	S+	*
Employment and Job Opportunity	S+	*

Notes:

X: Denotes potential for impact, which is not considered significant

S- : Denotes Potential Significant Adverse Impact

S+: Denotes Potential Significant Beneficial Impact

*: Denotes no change to the existing situation

6.2 Alternate location for the project site

Solar power projects are non-polluting energy generation projects and are dependent on the availability of sufficient solar irradiation. State of Karnataka receives good amount of solar irradiation. The project proponent has carried out assessment studies in order to understand the power generation potential of the site. The following additional criteria have been considered for site selection:

1. **Easy Access:** Easy access to site or connectivity with main road or highways help in transportation of materials, man and machinery required during construction; the site is well connected by road and rail to Bangalore, Mumbai, Hyderabad and other major cities like connectivity with SH 20 and SH-23 (Raichur-Koppal Road);
2. **Shadow:** Shadow free or minimum shadow area improves plant generation. There are no major structures within 1km of the site.
3. **Settlements:** Site is located away from major settlements;
4. **Ecologically Protected Area:** The site does not fall under any ecologically protected area. The land procured for the project comprises of rain-fed agricultural land which has been purchased through willing-buyer/ willing-seller arrangement;
5. **Electrical infrastructure:** Grid sub-station is present at a distance of about 8 km from the proposed site, will allow minimum transmission losses and also saves transmission cost of project.
6. **Climate:** Proposed site experiences moderate rainfall, solar irradiation in the range of 1900-2050 kWh/m²/month, low relative humidity, is good for setting up of a Solar power plant;
7. **Topography:** Minimum undulation of land with minimum vegetation is good for solar power plant. Site selected is a large stretch of land with minimum shading and little undulation. Proposed site is covered with black soil with very less vegetation, mainly comprising shrubs and grasses.

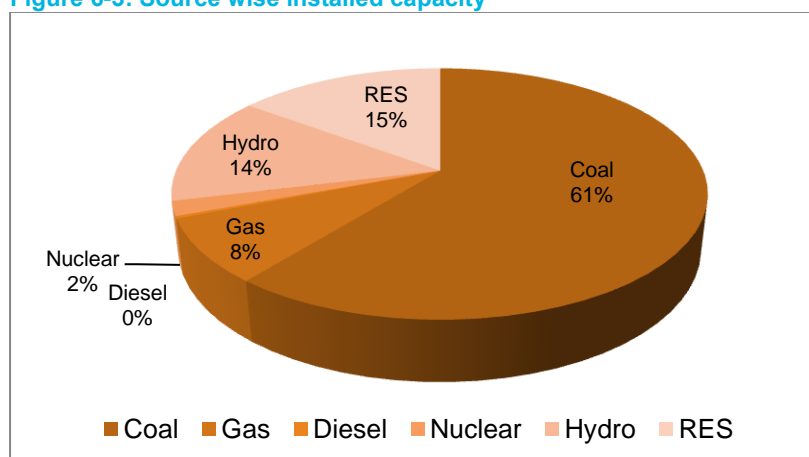
Therefore, considering all the above details of the location and site settings, the identified site was chosen as a suitable option for the project.

6.3 Alternative Sources of Power Generation

India has an installed capacity of 308.83 GW as of 30th November, 2016. In terms of fuel, coal-fired plants account for 60.8% of India's installed electricity capacity followed by renewable energy and hydropower which accounts for 14.9% and 14.0% respectively. Gas fired thermal power plants and nuclear plants account for 8.2% and 1.9% respectively. The source wise installed capacity in India is presented in **Figure 6-3**. The various power generation options as discussed in the earlier section can be evaluated on the levelised cost of power generation which includes the capital and O&M costs, reliability of power generation in terms of plant load factor and the greenhouse gas (GHG) emission. The comparative analysis of various power generation options based on these factors has been presented in **Table 6-8**.

The power generation options using conventional sources offer advantages such as lower levelised costs of power generation and higher plant load factors. The operation and maintenance of solar power projects does not typically involve air emissions or effluent discharges.

Figure 6-3: Source wise installed capacity



Source: Ministry of Power, 2012

Note: Breakup of RES (Renewable Energy Source) is as on 30th September 2016

There are no fuel requirements or large quantities of water required for the operation of the solar plant. GHG emissions and other environmental pollution (stack emissions, ash management etc.) issues are also insignificant. Also, there are no significant social issues associated with solar power projects.

Table 6-8: Comparative analysis of Various Power Generation Options

Alternative	Cost (₹/kWh) *	Plant Load Factor **	Average Lifecycle GHG Emission (tonnes CO ₂ e/GWh)***
Coal	2.5	65-85%	888
Natural Gas	3.9	70-85%	500
Hydro	3.8	30-50%	26
Nuclear power	2.5-5.7	65-85%	28
Wind Energy	4.2	25-40%	26
Solar	15.3-17.1	10-15%	85

Source: * - LBNL, CERC, CSTEP & NPCIL

** - Renewable UK

*** - World Nuclear Association Report

India being a signatory to the United Nations Framework Convention on Climate Change (UNFCCC) has formulated a National Action Plan on Climate Change (released in June 2008) to promote the development of renewable energy in the country. The Ministry of New and Renewable Energy (MNRE), GOI has been promoting new and renewable energy sources in a big way in India. The government of India envisages 30,000 MW of grid interactive renewable energy in the 12th five year plan (2012-2017) from renewable power generation. While about 10,000 MW is expected to be generated from solar, the balance is to be realized by wind and other renewable energy systems. The Electricity Act 2003 clearly mandates state electricity boards to adopt a minimum percentage for the procurement of electricity from renewable energy sources.

Various policy measures such as Jawaharlal Nehru National Solar Mission (JNNSM) Feed-in-Tariff, Accelerated Depreciation (AD), Generation Based Incentives (GBI), Renewable Purchase Obligations (RPO) and Renewable Energy Certificates (RECs) have helped in the rapid growth of Renewable Energy deployment in the country. Along with above demand and supply side measures to promote Renewable Energy growth in India, various states have come up with their state Solar Policies to provide an enabling framework for growth of Renewable Energy in India.

The proposed power plant has been allotted by Solar Energy Corporation of India (SECI) under Jawaharlal Nehru National Solar Mission (JNNSM) Phase II, Batch III for Karnataka. The benefits of the Jawaharlal Nehru National Solar Mission (JNNSM) which is part of the eight mission documents under India's National Action Plan on

Climate Change (NAPCC), and a significant contribution to low carbon sustainable development strategy for the Indian economy are as follows;

1. To create an enabling policy framework for the deployment of 20,000 MW of solar power by 2022
2. To create favourable conditions for solar manufacturing capability, particularly solar thermal for indigenous production and market leadership
3. To promote programmes for off-grid applications, reaching 1000 MW by 2017 and 2000 MW by 2022
4. To achieve 15 million sq. meters solar thermal collector area by 2017 and 20 million by 2022
5. To deploy 20 million solar lighting systems for rural areas by 2022.

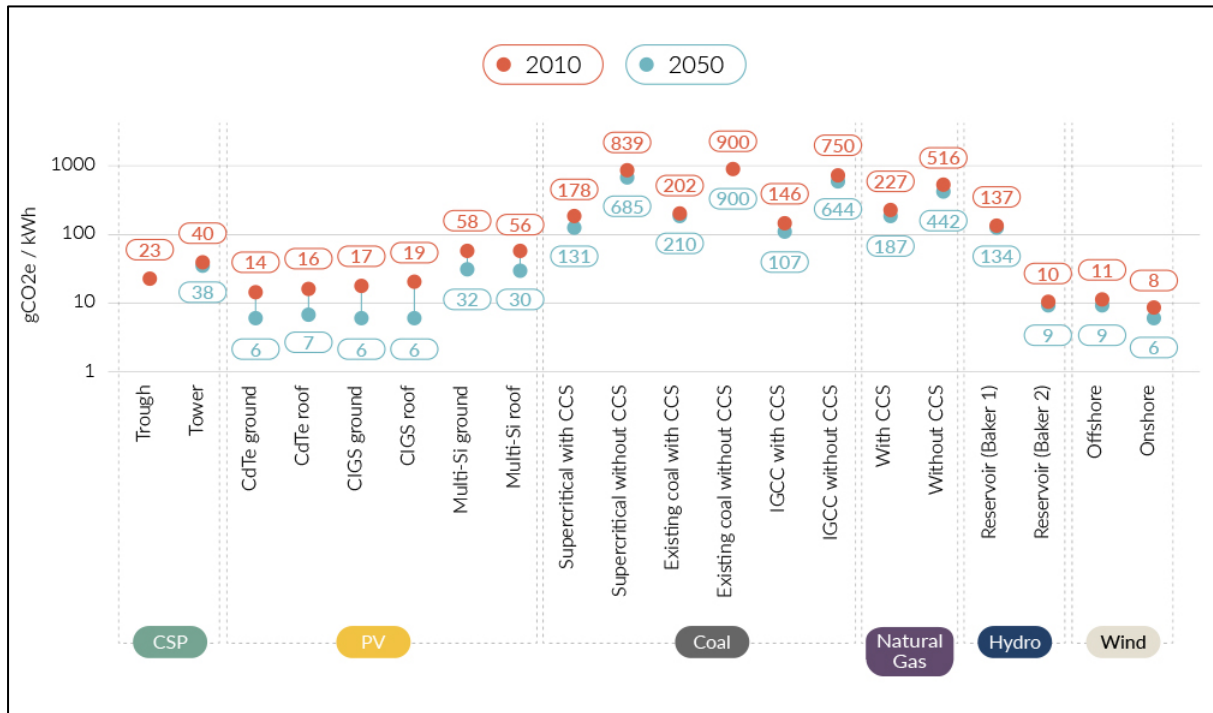
Therefore, considering various factors such as favourable environmental and social settings; low GHG emissions during the entire project life cycle; availability of lands, solar power generation is the most appropriate alternative in the Project area.

6.4 Alternate Technology for Project

There are different types of solar panels available for accumulation of solar energy, the proposed project intends to utilize Crystalline Silicon 315Wp module of Trina Solar (the TallMax Module) technology. Thin film modules have less primary energy requirement per W than poly crystalline or mono-crystalline modules. Thin film materials include Copper Indium, Diselenide, Cadmium Telluride, and Gallium Arsenide, etc., typically a few μm or less in thickness is directly deposited on glass, stainless steel, ceramic or other compatible substrate materials. Some of these metals are considered hazardous metal as per Schedule II of the Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016.

PV technologies have, in general, fewer negative environmental impacts than traditional fossil fuel-based electricity production. PV systems emit no GHGs or air pollutants during normal operation. Small amounts of heavy metals and other chemicals such as cadmium and lead are used in the production of PV cells, and can arise from waste created by decommissioning, but PV modules can be an environmentally friendly means to sequester elemental cadmium, and it can be reclaimed and used again when PV modules are recycled. Water use and impacts on water quality in the life cycle of PV technologies are considered to be minimal. Although PV technologies can require a considerable amount of land (more for ground-mounted applications, less for rooftop), they can be located on marginal lands and brownfields or can be installed on higher-quality lands in conjunction with grazing livestock and crops. As module efficiency increases, land use will decrease, and when PV power plants are constructed using best management practices, they can provide a positive benefit to biodiversity. The increase in PV module manufacturing, and the eventual need for decommissioning and disposal, may create a new wave of e-waste, but recycling of spent PV modules has now begun and has shown potential to improve the environmental profile of PV technologies.

Figure 6-4: Comparison of GHG Emission from Different Sources



Source: UNEP (2016) Green Energy Choices: The benefits, risks, and trade-offs of low-carbon technologies for electricity production. Report of the International Resource Panel. E.G.Hertwich, J. Aloisi de Larderel, A. Arvesen, P. Bayer, J. Bergesen, E. Bouman, T. Gibon, G. Heath, C. Peña, P. Purohit, A. Ramirez, S. Suh.

PV technology life cycle assessments show that electricity generated from PV has substantially lower greenhouse gas emissions compared to fossil-fuel based electricity generation technologies and that thin film CdTe and CIGS modules have a lower environmental impact than crystalline silicon technologies in terms of greenhouse gas emissions, air pollutants, eco toxicity and energy use. Thin film PV technologies provide the industry’s ecologically leading solutions due to their low material consumption, efficient manufacturing processes and fast energy payback times. By using less electricity during production, thin film PV technologies generate the amount of energy required to produce them up to 3.5 times faster than crystalline silicon PV technologies.

The energy accumulated from the solar panels will be converted from DC to suitable AC power for feeding to the grid and subsequently to the Substation. This process is environmentally advanced than creating battery bank for storage of energy, which minimizes the hazards related to handling and disposal of batteries. A comparison of the characteristics of the most popular cell technologies have been presented in **Table 6-9**.

Table 6-9: Characteristics of some PV Technology Classes

Technology	Crystalline Silicon	Amorphous Silicon	Cd Te	Copper Indium Gallium Di-Selenide
Cost (USD/Wp)	1.6-1.75	1-1.3	1.4-1.5	1.4-1.6
Percentage of global installed capacity	82%		18%	
Current Commercial Efficiency	12-19%	5-7%	8-13%	8-12%
Temperature Co-efficient of Power (Typical)	-0.45%/°C	-0.21%/°C	-0.25%/°C	-0.36%/°C

Source: Detailed Project Report

6.5 Alternate Routes of Transmission Lines

Power from the solar PV plant is proposed to be evacuated to the 110/33/11 kV grid substation at Kurdi (owned by Karnataka Power Transmission Corporation Limited) which is located at a distance of about 6.8km from the site in South-East direction. The route for the transmission line has been selected based on the following factors:

1. Transmission line route has been planned to avoid any habitations along the route;
2. Only Right of way has been secured by providing adequate compensation to the land owners where transmission poles are proposed to be installed in Machnur, Kallur and Horkarani villages;
3. As per consultations held with transmission line Contractor M/s PVR Contractor, It was informed that no house or community structures are located under the route of transmission line. An area of 4mx4m or 15m x15m has been taken for installation of pole;
4. Areas requiring extensive clearing of vegetation have been avoided; and
5. Selection of the transmission route avoids any environmental sensitive site if identified.

The shortest possible route after considering the above factors has been selected for the transmission lines. Consideration of all the above factors has reduced the environmental and social footprint of the transmission line.

7 EVALUATION OF IMPACTS

7.1 Impact Assessment Methodology

This chapter describes various environmental and social impacts identified by accessing information gathered through primary and secondary sources. Impacts have been identified based on review of available project information; discussions conducted with the local community; representatives of the project and other sector specific professionals. Impacts during construction and operation phases have been included and are classified as per impact type.

Additionally, this section presents the identified impacts within a severity range to assess overall significance of impacts on environment, ecology, socio-economic resources, demographics, and livelihoods. Subsequently, mitigation measures have been suggested for impacts outlined in this section.

7.2 Impact Assessment Criteria

Identified impacts have been appraised through social and environmental components and have been presented in **Table 7-1** below. The appraisal criteria are classified according to spread, duration, intensity and nature of the impact. Severity levels have been sub classified under each criterion with specifics outlining the limits of each severity level.

Table 7-1: Impact Assessment Criteria

Criteria	Sub-Classification	Defining Limit	Remarks
Spread: Refers to area of direct influence from the impact of a particular project activity.	Insignificant/ local spread	impact is restricted within the foot prints of the Project boundary	except for ecology (which is defined as limited loss of vegetation only at site)
	Medium Spread	impact is spread up to 2 km around the project area	except for ecology (which is defined as loss of vegetation at site including large trees with limited disturbance to adjoining flora & fauna)
	High spread	impact is spread beyond 2 km from footprint boundary of the Project	except for ecology (which is defined as loss of vegetation at site and/ or damage to adjoining flora and fauna)
Duration: Based on duration of impact and time taken by an environmental aspect to recover to its original state	Insignificant / Short Duration	when impact is likely to be restricted for a duration less than 2 years	the anticipated recovery of the impacted environmental aspect is within 2 years
	Medium Duration	when impact extends up to five years	the anticipated recovery of the impacted environmental aspect is within 5 years
	Long Duration	when impact extends beyond five years	the anticipated recovery of the impacted environmental aspect is more than 5 years
Intensity: Defines the magnitude of impact	Insignificant intensity	when changes in the prevailing (baseline) environmental conditions does not exceed 10%	However, it shall be reconsidered where the baseline values are already high
	Low intensity	when changes in the prevailing (baseline) environmental conditions does not exceed 20%	for ecology it refers to minimal changes in the existing ecology in terms of their reproductive capacity, survival or habitat change
	Moderate intensity	when changes in the prevailing (baseline) environmental conditions does not exceed 30%	for ecology, it refers to changes that are potentially recoverable
	High intensity	when changes in the prevailing (baseline) environmental conditions exceeds 30%	While for ecology, high intensity refers to changes that result in serious destruction to species, productivity or critical habitat.
Nature: Refers to whether the effect is considered beneficial	Beneficial	-	Useful to Environment and Community

or adverse	Adverse	-	Harmful to Environment and Community
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A “significance assessment matrix” has been adopted in order to assess impacts appraised as per criteria mentioned in **Table 7-1**. The below **Table 7-2** provides the impact significance criteria adopted for assessment.

Table 7-2: Impact Significance Criteria

Spread	Duration	Intensity	Overall Significance	
			Adverse	Beneficial
Local	Short	Low	Insignificant	Insignificant
Local	Short	Moderate	Minor	Minor
	Medium	Low		
	Medium	Moderate		
Medium	Short	Low	Moderate	Moderate
Local	Long	Low		
Local	Short	High		
Local	Medium	High		
Local	Long	Moderate		
Medium	Short	Moderate		
Medium	Medium	Low		
Medium	Medium	Moderate		
Medium	Long	Low		
Medium	Long	Moderate		
High	Short	Low		
High	Short	Moderate		
High	Medium	Low		
High	Medium	Moderate		
High	Long	Low		
Local	Long	High	Major	Major
Medium	Short	High		
Medium	Long	High		
High	Short	High		
High	Medium	High		
High	Long	Moderate		
High	Low	Low		
High	Low	High		

7.3 Impact Identification

Based on the activities involved, an impact interaction matrix for construction and operation phases has been prepared for the project. Impacts have been categorized based on Environment and Social Aspects. The impact identification matrices are presented below in respective sections.

7.3.1 Impact identification Matrix

Table below presents the impact identification matrix for construction, operation and decommissioning phases of the project, based on environmental and occupational health and safety variables. Each of the impacts identified has been further discussed and corresponding mitigation measures have been proposed.

Table 7-3: Impact Identification Matrix – Construction and Operation Phase

Environment, Health & Safety impact assessment variables	Construction Phase	Operation and Maintenance Phase	Decommissioning Phase
Land Use and Visual Aesthetics			
Site Preparation and Grading	•		
Site/ Vegetation Clearance	•		•
Laying of Transmission Lines	•		

Ecology			
Site Preparation and vegetation Clearance	•		
Hazardous and Non- Hazardous Material and Waste Management	•	•	•
Power Transmission	•	•	
Water Resources and Water Quality			
Material Handling and Storage	•	•	•
Hazardous and Non- Hazardous Material and Waste Management	•	•	•
Washing of Solar Panels		•	
Water Requirement for workers	•	•	•
Ambient Air Quality/ Atmospheric Emissions			
Material Handling and Storage	•		•
Operation of construction equipment	•		
De-mobilization of construction equipments	•		•
Ambient Noise Quality			
Material Handling and Storage	•		
Repair and Maintenance Works of solar panels		•	•
Demobilization of construction equipments	•		
Traffic & Transport			
Material Handling and Storage	•		
Demobilization of construction equipment	•		
Soil Resources			
Site Preparation and vegetation clearance	•		
Demobilization of construction equipments	•		
Hazardous and Non- Hazardous Material and Waste Management	•	•	•
Material Handling and Storage	•	•	•
Occupational Health and Safety			
Employment of Workers	•	•	
Material Handling and Storage	•	•	•
Construction works	•		
Laying of transmission lines	•		
Electrical hazard during solar power generation		•	
Repair and Maintenance Works of solar panels		•	
Land Procurement			
Adequate Compensation	•		
Loss of Agricultural land	•		
Changing occupational opportunities	•		
Influx of migrant Workers			
Presence of an outside agency	•	•	
Conflicts Between Local Residents and Newcomers	•	•	
Income generating opportunities	•	•	
Increase in local employment	•	•	
Introduction of new Social classes	•		
Change in the commercial/industrial focus of the community	•	•	

Stress on local Infrastructure	•	
Loss of jobs		•
Community Infrastructure and property		
Change in community infrastructure		•
Land acquisition or disposal	•	
Initiation of community development activities	•	•
Effects on known cultural, historical and archaeological resources		

7.4 Environmental Impacts

7.4.1 Construction Phase

7.4.1.1 Land Use

The proposed project will be developed on 287.02 acres of land falling in Machnur and Singaddinni villages of Manvi Taluka, Raichur District. Based on the site surveys conducted, the land for the project comprises of privately owned agricultural land. Currently no agricultural activities are undertaken on the site and the project land is fallow. The land is purchased through a willing seller -buyer arrangement with the land sellers of both the villages. The surrounding land use is rain fed agriculture and mostly covered with black cotton soil.

The entire site can be classified as having a low potential for crop production, due to dependency upon rain for irrigation. Also, as per data collated from Karnataka State Natural Disaster Monitoring Centre, Raichur is a drought prone district and suffers from high agricultural drought frequency (greater than 40%). Consultations with land sellers revealed that the land is totally dependent upon rain for agriculture and the land sellers have voluntarily sold their land property for the proposed project in lieu of monetary payment.

With the development of the proposed Project, the land use of the site will alter to industrial land use. As the actively cultivated fields are precluded from the development layout, the overall impact of the PV power plant on the area's agricultural potential and production will be low.

Mitigation Measures

The project proponent has considered all aspects of siting and design prior to selection of the proposed site. The construction activities will be restricted within the boundary of the solar plant and will not alter the land use of the adjacent areas.

Significance of the Impact

Impact due to change of land use will have low intensity with a local spread for a long duration which will result in an overall minor impact without mitigation, which will remain a minor impact owing to permanent change in land use.

Table 7-4: Impact Significance – Land Use

Aspect	Scenario	Spread	Duration	Intensity	Overall
Land Use	Without Mitigation	Local	Long	Low	Minor
	With Mitigation	Local	Long	Low	Minor

7.4.1.2 Soil Quality

The project site comprises of flat land with gentle slope towards south-east. During construction works levelling activities will be undertaken. As the construction activities for the main plant units of project would be confined to the demarcated areas within project boundary; the impact on soil is expected to be minimal and confined. Cutting and filling is only required during excavation and foundation works. Further, the transport of materials, equipment, manpower will add to the movement of vehicles; construction machinery which may lead to some degree of compaction within the site premises.

Adverse impact on soil in the surrounding area is not anticipated. However, in order to minimize such impacts, appropriate soil erosion control measures would have to be undertaken by CSPGPL to reduce the chances of soil erosion.

The project will also involve use of paints for solar panels and switch yard structures during construction, which if not handled and used properly, may lead to contamination of soil. Improper disposal of hydraulic fluids, lubricating oils and other used oils can also result in contamination of soil. Improper storage of construction material can also result in unwanted dispersal of contaminants into adjoining areas.

Mitigation Measures

The topography of the project site is almost flat, therefore extensive levelling and backfilling will not be required. This will reduce the potential for compaction and disturbance to soil layers due to backfilling at site. The scale of construction being small, limited heavy machineries will be used at site and for small duration, which will further diminish the potential for compaction. Movement of trucks and other vehicles will be maintained along dedicated paths to avoid disturbance to land and soil. Completion of excavation and foundation work in limited time schedule would also reduce / minimize the chances of soil erosion. The other measures include:

- The removal of vegetation and soil cover will be restricted to only those areas necessary for the development;
- Soil conservation measures will be implemented such as stockpiling topsoil or gravel for the remediation of disturbed areas.
- Stockpiles will be vegetated or appropriately covered to reduce soil loss as a result of wind or water erosion.
- Work areas will be clearly defined and where necessary demarcated to avoid unnecessary disturbance of areas outside the development footprint.
- Fuel, lubricating oil and used oil storage areas will be contained in bunds of 110 percent capacity of the stored material.
- Spill containment and clean up kits will be available onsite and clean-up from any spill will be appropriately contained and disposed of.
- Construction vehicles and equipment will be serviced regularly and off site.
- Construction vehicles will remain on designated and prepared compacted gravel roads.

Significance of the Impact

The impact on soil will have moderate intensity with a local spread for a short duration which will result in an overall minor impact without mitigation. However with implementation of suggested mitigation measures the overall impact is expected to remain insignificant.

Table 7-5: Impact Significance – Soil Resource and Quality

Aspect	Scenario	Spread	Duration	Intensity	Overall
Soil Resources and Quality	Without Mitigation	Local	Short	Moderate	Minor
	With Mitigation	Local	Short	Low	Insignificant

7.4.1.3 Water Resources, Storage and Quality

Limited quantity of construction water will be required for piling and foundation work. It is estimated that about 80-85 kilo litres of water will be required for the entire construction phase (which includes water requirements for curing works, batching plant and domestic requirement of workers). It is to be ensured that pre-treatment is provided to ground water which will be utilized for drinking.

Currently, the site has a manmade pond and an extension of canal (water channel) in North West direction. However, both remains dry for most part of the year due to lack of rainfall in the area. There is potential of contamination of low lying areas due to sediment runoff from construction activities. Removal of the vegetation cover as well as increased run-off from the construction activities will reduce the rate of infiltration and groundwater recharge. Improper disposal of sewage and wastewater from labour camp and construction debris can contaminate the ground water resources in the area.

Mitigation Measures

- The natural slope of the site will be maintained to the extent possible in order to avoid any change in the drainage pattern;
- Open channel located in north of the site will not get disturbed due to construction activities in the site premises by ensuring that no waste is disposed;
- Storm water flow will be directed to the existing channel and pond with silt traps to avoid sedimentation;
- It is recommended that surface water quality of the water in the man-made pond within the project site is checked for basic drinking water parameters (pH and alkalinity as well) to ensure it is not contaminated due to surface run-off or other construction debris;
- Water for construction activities, flushing and washing purpose will be met from authorized water tankers from local areas. It is to be ensured that pre-treatment is provided to ground water (after taking pre-requisite approvals) if it is utilized for drinking;
- Portable toilets provided shall be self-contained and cleaned and disinfected on weekly basis by cleaners hired by construction contractor;

Significance of Impact

The impact on water resources will have moderate intensity with a medium spread for a short duration which will result in an overall moderate impact without mitigation. However with proper implementation of suggested mitigation the impact will be reduced to minor.

Table 7-6: Impact Significance – Water Resources

Aspect	Scenario	Spread	Duration	Intensity	Overall
Water Resources and Quality	Without Mitigation	Medium	Short	Moderate	Moderate
	With Mitigation	Local	Short	Moderate	Minor

7.4.1.4 Air Quality

The solar PV plant will not entail extensive construction activities for long duration; hence the impact during construction is expected to be minimal.

Fugitive Emissions due to vehicular movement and operation of Equipments

Dust will be generated mainly during excavation, back filling and hauling operations along with transportation activities. The main source of gaseous emission during the construction phase is movement of equipment and vehicles at site. Equipment deployed during the construction phase is also likely to result in marginal increase in the levels of SO₂, NO_x, and particulate matter.

Operation of DG Sets

The scale of construction being small will require only a limited number of construction machinery and DG sets and for limited duration, therefore emissions from DG sets are considered to be insignificant. The impact is reversible, marginal and temporary in nature.

Mitigation Measures

CSPGPL shall ensure minimization of dust from material handling sources by implementation of following measures:

- Sprinkling of water is being carried out to suppress dust from construction, stock piles and transport movement;
- It shall be ensured that all stock piles are covered and storage areas provided with enclosures to minimize dust from open area source;
- Stock piling and storage of construction material will be oriented after considering the predominant wind direction; Open burning of solid waste or packaging material will be strictly prohibited;
- Vehicles engaged for the project will be required to obtain "Pollution under Control" (PUC) certificates. Sufficient stack height needs to be provided to D.G. sets as per CPCB norms⁹.

⁹ <http://cpcb.nic.in/Industry-Specific-Standards/Emission/DieselGeneratorSets.pdf>

Significance of Impact

The impact on ambient air quality will have a local spread, moderate intensity and will last for a short duration primarily limited to construction related activities which will result in an overall minor impact without mitigation. However with proper implementation of suggested mitigation the impact will be reduced to insignificant.

Table 7-7: Impact Significance – Air Quality

Aspect	Scenario	Spread	Duration	Intensity	Overall
Air Quality	Without Mitigation	Local	Short	Moderate	Minor
	With Mitigation	Local	Short	Low	Insignificant

7.4.1.5 Ecology

The construction of the Project will result in disturbance at the site, in particular of the vegetation located within the PV Footprint. There will be a direct clearing of natural vegetation through cutting of small bushes and shrubs; the overall intensity of this impact is rated as *minor*, as the impact is not likely to be of wider significance. Reportedly, thirteen (13) ‘Neem Trees’ are present onsite which will not be removed and will be preserved. Drainage lines which are present onsite will not be disturbed and will remain intact. Installation of PV panels will be avoided around the drainage lines. The impacts envisaged on ecology during construction phase are enlisted below:

- Loss of vegetation and avian 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 fauna, including avifauna associated with noise and movement of construction equipment and personnel.

Destruction and Loss of Vegetation

Clearance of vegetation will be undertaken through shrub and grass cutting, which is required for the establishment of the PV power facility’s infrastructure including for the PV arrays, fencing, access roads and internal road network and storage and lay-down areas, resulting in permanent loss of vegetation within the Site.

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 (among the other objectives listed). Habitat fragmentation due to site clearing will result in limited disturbance to fauna. Noise from construction and frequent movement of vehicles can also disturb the avifauna of the area.

Mitigation Measures

Activities generating high noise will be restricted to day time and will be mitigated to minimize the noise level outside the site boundary. Recovery of vegetation under the PV panels and in other places that do not need to remain cleared should be encouraged.

Movement of construction and transport vehicles will be restricted to dedicated paths to minimize any harm to small mammals within the site. Transportation of construction material will be kept to day time hours in order to minimize noise and disturbance to fauna in the area.

Significance of Impact

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

Table 7-8: Impact Significance – Ecology

Aspect	Scenario	Spread	Duration	Intensity	Overall
Ecological Diversity	Without Mitigation	Local	Short	Moderate	Minor
	With Mitigation	Local	Short	Low	Insignificant

7.4.1.6 Noise Environment

Noise and vibration will be caused by the operation of earth moving and excavation equipment, concrete mixers, cranes and the transportation of equipment, materials and people. There is potential for disturbance to habitations in proximity of construction site. Movement of traffic during night hours can also disturb the local community. The operation of this equipment will generate noise ranges from 75 – 90 dB (A) which will remain within the site boundary. The noise level is substantially lower near the plant boundary due to attenuation caused over the distance. The nearest noise receptor is Singaddinni Village which is located at a distance of 2.4km in north-west direction. Overall, the impact of generated noise on the environment during construction period is insignificant, reversible and localized in nature.

Mitigation Measures

CSPGPL shall instruct its contractor to arrange for inherently quiet construction equipment and machines to maintain the noise level to minimum. Only limited construction activities shall be carried out during night-time. The hours of operation for specific pieces of equipment or operations, especially mobile sources operating through community areas should be limited. It is also to be ensured that village road connecting Machnur and Singaddinni village is not utilized for movement of equipments reducing project traffic through community areas.

All loud and sudden noises will be avoided wherever possible and fixed noise sources shall be located at least 50m away from the site boundary. Rubber padding/noise isolators will be used for construction equipment/machinery. Temporary noise barriers shall be provided surrounding the high noise generating construction equipment. The personnel involved in high noise generating activities shall be provided with personal protective devices to minimize their exposure to high noise levels. Construction vehicles and machinery will be well maintained and not kept idling when not in use.

Significance of Impact

The impact due to noise and vibration will have moderate intensity with a local spread for a short duration which will result in an overall minor impact without mitigation. However with proper implementation of suggested mitigation the impact will be reduced to insignificant.

Table 7-9: Impact Significance – Noise

Aspect	Scenario	Spread	Duration	Intensity	Overall
Noise	Without Mitigation	Local	Short	Moderate	Minor
	With Mitigation	Local	Short	Low	Insignificant

7.4.1.7 Traffic and Transport

Increase in traffic during construction phase is expected which involves transportation of construction materials, solar modules and mounting structures. It can lead to additional traffic and increased risk of traffic related accidents and injuries to community and to workers. However, the increase in traffic due to the project will remain marginal. Currently, the proposed project is accessible from National highway-167 (connecting Raichur to Mahbubnagar) which will be utilized for transportation of machines and solar modules. The traffic density along the National Highway and village road is low with peak traffic in morning and evening hours. The project proponent proposes to construct a 1.5km long access road towards the west of the site, connecting SH-20 and NH-167 with the site. The traffic density along the National Highway is low and has adequate carrying capacity to accommodate the additional traffic due to the construction activities.

Mitigation Measures

It is recommended that the proposed access road is constructed prior to site clearance activities. Only trained drivers with valid license shall be recruited by the construction contractor. Training programs shall be conducted for all the drivers for raising awareness about road safety and adopting best transport and traffic safety procedures before and during construction phase. Regular maintenance of vehicles and use of manufacturer approved parts should be adopted to minimize potentially serious accidents.

Significance of Impact

The impact due to traffic and transport will have moderate intensity with a medium spread for a short duration which will result in an overall moderate impact without mitigation. However with proper implementation of suggested mitigation the impact will be reduced to minor.

Table 7-10: Impact Significance – Traffic and Transport

Aspect	Scenario	Spread	Duration	Intensity	Overall
Traffic and Transport	Without Mitigation	Medium	Short	Moderate	Moderate
	With Mitigation	Local	Short	Moderate	Minor

7.4.1.8 Occupational Health and Safety Hazards

The construction activities include site preparation, infrastructure utilities installation, building structures. Therefore, there will be potential impacts on workers' health and safety due to exposure to risks through construction activities that lead to accidents causing injuries and death. The most frequent risks causes of accidental death and injury are:

Safety Risks:

- Tripping due to uneven surfaces, obstacles, trailing cables;
- Falling during working at height due to fall from fragile surfaces, roof edges and ladders;
- Fire due to hot works, smoking, failure in electrical installations;
- Mobile plant and vehicles;
- Electrical shocks

Health Risks

- Manual handling and musculoskeletal disorders: typical construction activities that can cause injury such as lifting, lowering, pushing, pulling and carrying
- Hand-arm vibration: people work with hand-held or hand-guided power-tools and machines, such as: concrete breakers, pokers and compactors, sanders, grinders and disc cutters, hammer drills, chipping hammers, chainsaws, scrabbles and needle guns.
- Temporary or permanent hearing loss which usually comes from noise generated from machinery used for excavation or piling work and from compressors and concrete mixers etc.
- Heat stress and working during high temperatures

Mitigation Measures

CSPGPL shall formulate a site specific Emergency Preparedness and Response Procedure. The On-Site emergency procedure shall provide details of the anticipated emergencies, the emergency organization, facilities, emergency procedures and roles and responsibilities. CSPGPL shall ensure that adequate training is provided to staff about raising awareness about use of Personal Protection Equipment (PPE) and emergency response measures.

CSPGPL shall introduce administrative controls into work processes such as job rotation, rest and stretch breaks etc to reduce overexertion. Work site layout will be well planned to avoid manual transfer of heavy loads. It shall also ensure good housekeeping at the construction site to avoid slips and falls. Excessive waste debris and liquid spills will be cleaned up regularly, while electrical cords and ropes will be placed along identified corridors marked for attention of everyone at site. Use of personal fall arrest system, such as full body harnesses as well as fall rescue procedures to deal with workers whose fall has been successfully arrested shall also be carried out. PPEs such as safety glasses with side shields, face shields, hard hats and safety shoes shall be mandatory at construction site. Ear plugs shall be provided for workers placed at high noise areas.

Significance of Impact

The health and safety impacts will have high intensity with a local spread for a short duration which will result in an overall moderate impact without mitigation. However with proper implementation of suggested mitigation the intensity can be reduced to minor.

Table 7-11: Impact Significance – Occupational Health and Safety

Aspect	Scenario	Spread	Duration	Intensity	Overall
Occupational Health & Safety	Without Mitigation	Local	Short	High	Moderate
	With Mitigation	Local	Short	Moderate	Minor

7.4.1.9 Solid Waste Generation

The construction activities such as site clearance, excavation works, setting up of labour camps, installation of modules will generate different types of solid and hazardous wastes. The construction demobilization which will entail removal of machinery, workers, campsite and other temporary structures will also result in generation of waste. The following types of wastes will be generated due to construction of the project:

- Domestic solid waste and sewage from labour colonies;
- Waste oil from generator and other construction machinery;
- Packaging waste such as gunny bags, plastics, etc.;
- Empty paint containers, metal scrap, etc.;
- Scraped building material;
- Excess concrete and cement;
- Rejected components and materials; and
- Construction debris.

Dust Emission due to Construction Debris

The construction debris generated due to the construction activities will have the potential for spread to areas outside the project boundary during construction. The dust particles from debris generated during construction activities can be carried along with the wind into nearby areas, thereby increasing the particulate matter in the area. However this will happen only for a temporary period as the construction activities will be for small duration only.

Disposal of waste from Labour Camps

Improper disposal of solid waste from the labour camps at site and lack of proper sanitation facility for labour can lead to unhygienic conditions due to open defecation and spread of diseases in the area. It can lead to discontent of local community and result in conflicts with the labour engaged at site.

Disposal of waste from site

Improper disposal of packaging materials, boxes, plastics, ropes etc. can lead to littering in the construction site and surrounding areas. Hazardous wastes such as waste oil, lubricants, hydraulic oil etc. can cause contamination of soil and water bodies if adequate precautions for management and handling are not undertaken. Use of chemicals such as paints, curing chemicals can lead to contamination of soil.

Mitigation Measures

Following mitigation measures will be implemented by CSPGPL for management of Solid Waste generation during construction phase:

- **Labour Camp:** The construction contractor shall ensure that the campsites provided at site have adequate waste disposal facilities.
 - Arrangements for collection of garbage in dustbins and daily disposal to the nearest dumpsite shall be made.

- Provision of separate toilets for male and female workers (if any) in the ratio of 1:15 and 1:10 (toilet to workers) respectively shall be made;
 - Washing and bathing areas will be provided with proper drainage system so that wastewater is not accumulated in the campsites;
 - Low lying areas prone to accumulation of water should be sprayed with mosquito repellents on regular basis to prevent health hazards to workers and community;
 - Disposal of sewage shall be made through a septic tank – soak pit arrangement.
- **Management of Hazardous Waste:**
 - Waste/used oil generated from generators and construction machinery and equipment will be stored on paved surface in a secure location at the project site. Appropriate secondary containment capable of containing the 110 percent of the largest tank to be provided;
 - The waste oil, which is characterized as hazardous according to Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016, will be sold to KSPCB approved vendors at frequent intervals;
 - Empty paint containers will also be stored at a secured area designated for scrap and sold to authorized vendors;
 - All packaging material will also be collected at the storage area and sold to scrap dealers.
 - Construction debris and excavated material will be stored in a confined area to prevent spread by wind or water.
 - The construction debris will be used for backfilling of excavated areas and for foundation works at site and excess soil will be given to the local villagers for filling up of low lying areas in the vicinity.
 - The scrap metal waste generated from erection of structures and related construction activities will be collected and stored separately in a stack yard and sold to local recyclers.

Significance of the Impact

The impact due to solid waste generation will be of moderate intensity, will have local spread for a short duration which will result in an overall minor impact without mitigation. However with proper implementation of suggested mitigation measures the overall impact will be insignificant.

Table 7-12: Impact Significance – Solid Waste Generation

Aspect	Scenario	Spread	Duration	Intensity	Overall
Solid Waste Generation	Without Mitigation	Local	Short	Moderate	Minor
	With Mitigation	Local	Short	Low	Insignificant

7.4.2 Operation Phase

7.4.2.1 Visual Impacts and Aesthetics

The presence of a large area of PV panels is not expected to constitute a risk for glare since it is situated far from airport, and residential dwellings, moreover, no potential visual disturbance to birds are expected given the fact that IBAs located are far from the project area, and as a result, there is no migratory bird flyway over the project area.

Therefore, it is not anticipated that visual impacts will be generated due to the PV system design, which is specifically designed to include dark, light-absorbing materials and covered with an anti-reflective coating (ARC) for glass surfaces, which reduces the reflectance from PV panels to 2.5%-2.6% while at the same time improving their efficiency.

Glare Assessment

A Desktop based glare assessment study has been carried out utilizing the Solar Glare Hazard Analysis Tool (SGHAT) developed by Sandia National Laboratory¹⁰ to assess potential glare utilizing latitude and longitudinal coordinates, elevation, sun position, and vector calculations. The PV module orientation, reflectance environment and ocular factors are also considered by the software. If potential glare is identified by the model, the tool

¹⁰ <https://share.sandia.gov/phlux/sghat/>

calculates the retinal irradiance and subtended angle (size/distance) of the glare source to predict potential ocular hazards according to the glare intensity categories.

Glare Intensity Categories

Glare refers to the human experience of reflected light. The potential hazard from solar glare is a function of retinal irradiance (power of electromagnetic radiation per unit area produced by the sun) and the subtended angle (size and distance) of the glare source.

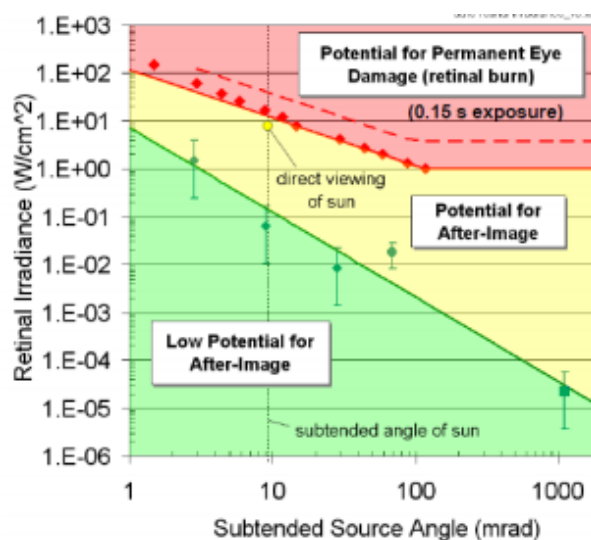
Glare can be broadly classified into three categories: low potential for after-image, potential for after-image, and potential for permanent eye damage, Figure below illustrates the glare intensity categories.

The amount of light reflected from a PV panel depends on the amount of sunlight hitting the surface, as well as the surface reflectivity. The amount of sunlight interacting with the solar panel will vary based on geographic location, time of year, cloud cover, and solar panel orientation.

The SGHAT does not take into consideration the following factors:

- Backtracking or the effect of shading in relation to the PV array tracking system
- Gaps between PV modules
- Topography and vegetation between the solar panels and the viewer (sensitive receptor)
- Atmospheric conditions

Figure 7-1: Glare Categories



Source: Solar Glare Hazard Analysis Tool (SGHAT) Presentation (2013)

SGHAT has been used extensively in the United States to assess the potential impact of solar arrays located in close proximity to airports. A limited analysis has been undertaken for the proposed project which can provide an overview of potential of glare effect caused, if any.

The baseline glare condition assessment takes into consideration the following:

- Characteristics of the environment that may affect the potential for glare;
- Land use and human modifications to the landscape such as roads, buildings and existing roads

The main elements of the Solar Farm with the potential to influence glare are the tilt, orientation, and optical properties of the PV modules in the solar array, and the rotational capabilities of the tracking system.

The proposed 50MW solar power project will be based on crystalline silicon (c-Si) Solar Photo Voltaic technology using Module Make Trina Solar, Model no-X06 1612 which is Poly Crystalline Silicon Module for power generation. The optimum tilt angle of tracking axis for proposed solar plant has been computed to be 45 degrees

and modules facing towards south i.e. the orientation of tracking axis would be 180 degrees, with maximum tracking angle to be 60 degrees.

Table 7-13: Glare Gauge Modelling Parameters

Modelling Parameters	Values
Time Zone	UTC+5
Axis Tracking	Single
Tilt of Tracking Axis	45
Orientation of tracking Axis	180
Offset Angle of Module	0
Module Surface Area	Smooth glass with Anti Reflective coating (ARC)
Maximum Tracking Angle	60
Height of panels above ground	5.5 ft* (Avg)
Slope Error	--
Reflectivity Varies with Incidence angle	Yes

Source: Forge Solar, Glare Gauge Analysis

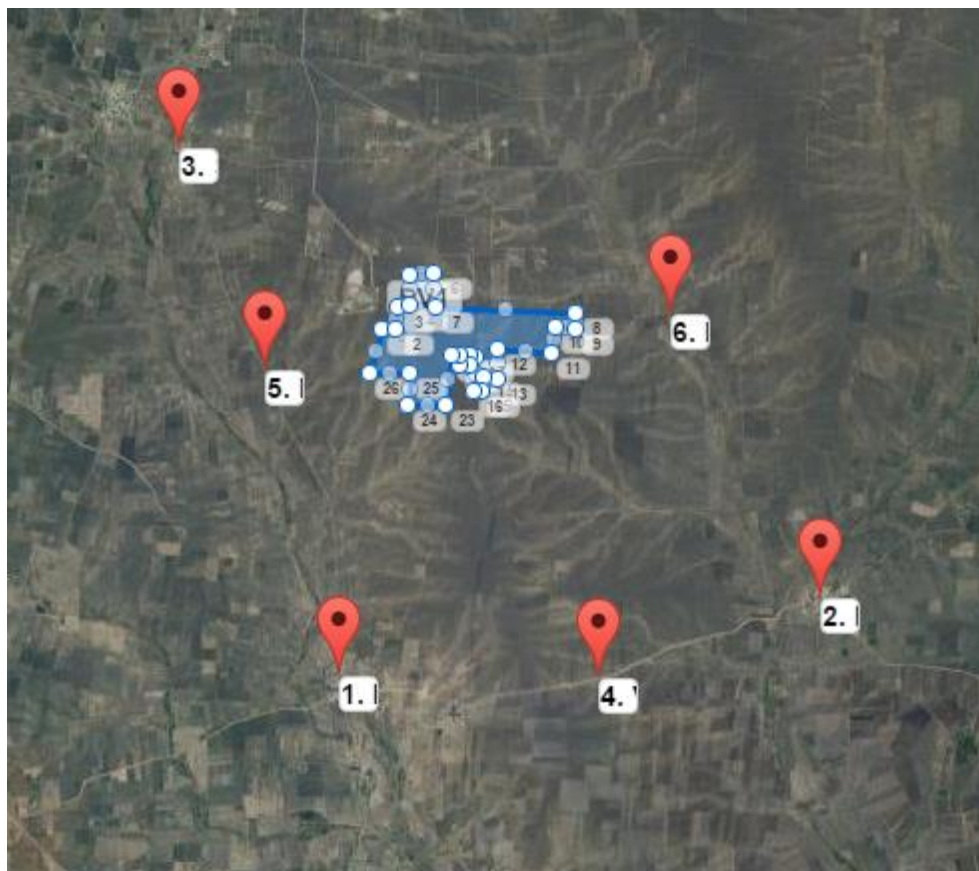
*Considering the height of solar panel 0.5 ft. more than with average eye level of a human being

The rectangular Photovoltaic has been considered for an area of 280 acres, the table gives the ground elevation with longitude and latitude of the site.

Table 7-14: Extreme Latitude and Longitude for the Proposed Solar Site

S.No	Latitude	Longitude	Ground Elevation (ft)	Height above ground (ft)	Total Elevation (ft)
1	16.13517	77.11829	1254.74	5.5	1273.55
2	16.13649	77.13499	1246.76	5.5	1251.26
3	16.12894	77.12387	1263.79	5.5	1268.29
4	16.13978	77.1228	1271.53	5.5	1276.03

Figure 7-2: Solar Site with Indicative Observation points



Total of six (06) observation points (OP) have been considered around the site. The observation points have been considered in a radius of 4 km from the site. One of the points is in a range of 1km from the site boundary and rest 5 (Six) fall in the radius of 4 km from the site. Three (3) villages are considered as they fall in the 4 km radius, Machnur village being in the South West of the site, Singaddinni is in the North West direction and Hokrani Village falls in the South East direction.

Table 7-15: Observation Points Details with Glare Gauge Results

S.No	Description	Distance from the Nearest Boundary	Latitude (Degrees)	Longitude (Degrees)	Ground Elevation (ft)	Eye Level height above ground elevation (ft)	Glare Potential
1	Machnur Village	2.51 km	16.10676	77.11462	1235.49	5	Green Glare Potential. No potential for Red or Yellow Glare.
2	Hokrani Village	3.68 km	16.11303	77.156	1222.77	5	Green Glare Potential. No potential for Red or Yellow Glare.
3	Singaddinni Village	3.11 km	16.15021	77.10091	1263.04	5	No Glare
4	Village Road Connecting Hokrani & Machnur Village	2.85 km	16.10656	77.13692	1237.19	5	Green Glare potential. No potential for Red or Yellow Glare
5	Road Connecting	1.07 km	16.13191	77.264357	1251.64	5	No Glare

S.No	Description	Distance from the Nearest Boundary	Latitude (Degrees)	Longitude (Degrees)	Ground Elevation (ft)	Eye Level height above ground elevation (ft)	Glare Potential
6	Point in the nearest plot	0.77 km	16.082805	77.250581	1207	5	No Glare

Source: Solar Glare Hazard Analysis Software

Table 7-16 below the glare analysis for the OPs considered.

Table 7-16: Findings for the Glare Assessment

Observation Points	Glare Occurrence			
	Potential	Intensity	Timings	Months of the Year
OP-1: Machnur Village	Low Potential for temporary After Image	Continuous	Between 12:00-14:30 Hrs	April, June, July, August, September
OP-2: Hokrani Village	Low Potential for temporary After Image	Scattered	Between 8:00-9:00 Hrs	April, May, August, September
OP-3: Singaddinni Village	No Potential	--	--	--
OP-4: Village Road Connecting Hokrani & Machnur Village	Low Potential for temporary After Image	Sparse	Between 8:00-11:30 Hrs	April, May, June, July & August
OP-5: Road Connecting Singaddinni & Machnur	No Potential	--	--	--
OP-6: Point in the nearest plot	No Potential	--	--	--

Source: Solar Glare Hazard Analysis Report.

The graphs below represent the annual occurrence of glare Potential for all OPs considered.

Figure 7-3: Glare Occurrence Plot for OP-1

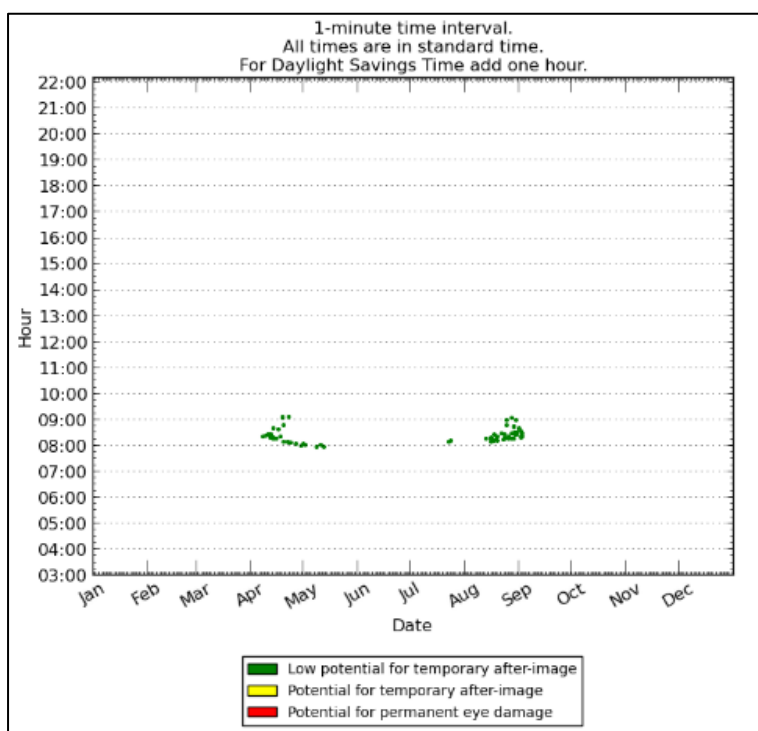


Figure 7-4: Glare Occurrence Plot for OP-2

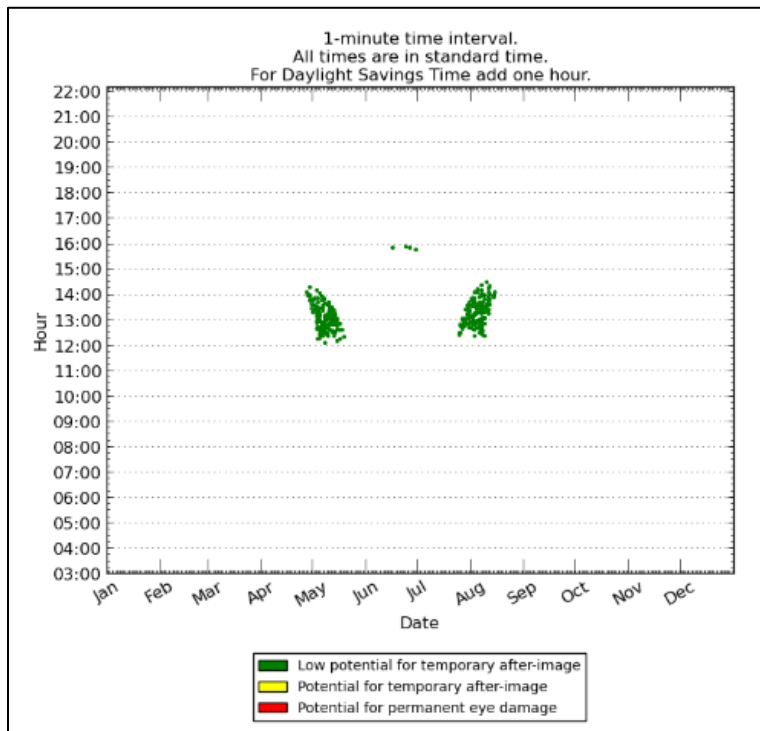
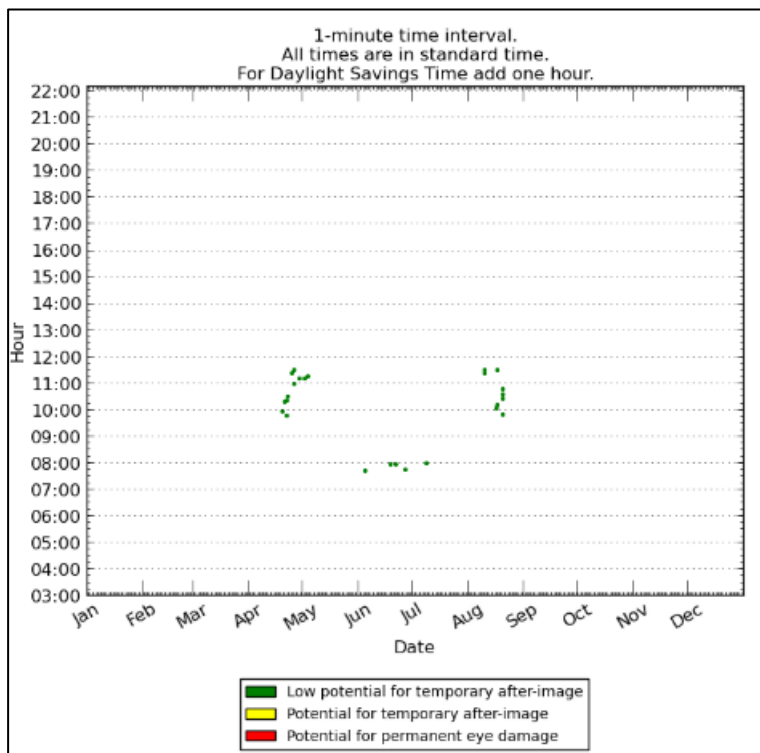


Figure 7-5: Glare Occurrence Plot for OP-3



Findings

Based on the assumptions and parameters considered for desktop assessment, the following results were inferred:

- No Glare Potential was identified in East, West and North Direction, so OP-3, OP-5 and OP-6 has no glare effect.
- The potential Glare hazard was identified for OP-2 which is Hokrani Village was in the 'Low Potential for temporary After-Image' category, between 8:00 to 9:00 for the summer months of April & May and for the south west monsoon months of August and September. The pattern of the glare observed is scattered.
- The potential glare hazard identified for OP-1 which is Machnur Village was in the 'Low Potential for temporary After-Image' category. The glare Occurrence was between 12:00-14:00 for the summer months of April, June, and July and for the south west monsoon months of August and September. The pattern of glare is observed to be almost Continuous.
- The potential glare hazard identified for OP-4 which is the Village Road Connecting Hokrani & Machnur Village was in the 'Low Potential for temporary After-Image' between 8:00 to 11:30 during the summer months of April, May, June, July and August. The Glare occurrence is sparse.

Mitigation Measures

The solar panels will be installed at a low height and will be kept closer to the ground so that it does not prop out of the general landscape of the area. The panels will be arranged in a systematic manner which will give an aesthetic sense to it. As per the assessment undertaken, reflections are envisaged only during morning and afternoon when the sun is low at OP1, 2 and 3.

Significance of the Impact

The impact on aesthetics and visual aspects will have low intensity with a local spread for a long duration which will result in an overall minor impact without mitigation.

Table 7-17: Impact Significance –Visual and Aesthetics

Aspect	Scenario	Spread	Duration	Intensity	Overall
Visual and Aesthetics	Without Mitigation	Local	Long	Low	Minor
	With Mitigation	Local	Short	low	Insignificant

7.4.2.2 Water Resource and Quality

During the operational phase, the water requirements for the plant will be predominantly for washing of solar PV modules with water periodically to remove bird droppings, dust and other dirt and domestic water consumption. Whereas, for domestic water consumption for the project will be restricted to man power engaged at project site.

The quantity of water consumption (domestic) for the project during operational phase is estimated to be 1.3-1.5 KLD. Assuming a minimum of 1 litres of water per module, the water requirement for cleaning the whole plant (i.e. 1, 98,415 modules) will be approximately 200 kilo litres, at one time. With a cleaning schedule of twice a month, it is estimated that approximately 400-450 kilo litres of water will be required for cleaning purpose on monthly basis and the requirements will be met through water tankers. A centralized water tank is also proposed to be constructed in south- eastern direction of the plant, which will be filled by the water received from water tankers during operation phase. The drinking water requirement will be met through packaged water bottles.

Availability of the water in the area

The study area is dotted with a man-made pond and a channel (extended canal) which were observed to be dry at the time of site visit. Manvi Taluka of Raichur District has categorized as 'Safe Area' for ground water abstraction as per categorization undertaken on March, 2009. As per the estimations provided by Central Ground Water Board for Manvi Taluka in July 2013, net annual ground water availability is 34285 hectare-meters (ham) and existing gross ground water draft for domestic and industrial water supply is 501 ham (which is 1% of the total available ground water). It is estimated that cleaning of the solar panels will require 450 m³ of water on monthly basis (considering frequency of cleaning twice a month. Hence, the water requirement on yearly basis is calculated to be 0.54 ha-m (0.045x 12 months) which is 0.11% of the existing ground water available for domestic and industrial water supply in Manvi Taluka.

Predominantly, agricultural activities in the area are predominantly rain-fed. Few locals in the area only depend upon surface water tanks and bore-wells as main source of irrigation. CGWB report also assesses existing gross ground water draft for irrigation which is 5861 ham which forms 17% of total net available ground water.

Rainwater Potential

Tapping of rain water can augment the ground water resources in the region. Net gain of rain water in form of storm water runoff considering average annual rainfall received by area of 600mm; with available area of 280 acres (1132880 square meters) of land and run off coefficient to be 0.1 comes out to be 67970 cubic meter/annum. The rainwater harvesting potential due to project is estimated to be 6.79 ha-m which can add to the existing ground water draft available for domestic and industrial supply in Manvi Taluk annually.

Mitigation Measures

The plant site will be provided with adequate drainage facility to drain off wash wastewater and prevent any water-logging at site or in the surroundings. Wastage of water during cleaning of panels shall be avoided. Various factors such as tilt angle, orientation and tracking are required to be monitored for efficient cleaning of modules. Ground water shall be extracted only after getting proper approvals from competent authority. It is to be ensured that water tankers required during operation phase are sourced from authorised vendor.

Rainwater harvesting system by making recharge pits shall be utilised to recharge the ground water. The water harvested will be directed to a recharge pit. CSPGPL should ensure that rain water collected from the project site will be utilized to recharge the ground water through onsite rain water harvesting tank/pits. Water use and harvesting/recharging in the project will be a key performance indicator that will be monitored through operation phase of the project.

Significance of Impact

The impact on water resources will have moderate intensity with a local spread for a long duration which will result in an overall moderate impact without mitigation.

Table 7-18: Impact Significance - Water Resources

Aspect	Scenario	Spread	Duration	Intensity	Overall
Water Resources and Quality	Without Mitigation	Local	Long	Moderate	Moderate
	With Mitigation	Local	Long	Low	Minor

7.4.2.3 Ecology

Operational phase impacts are likely to be restricted to maintenance activities within the site such as vegetation clearing through brush cutting from under PV arrays and from the internal road network. Solar photovoltaic power plant does not generate any significant noise or air emission during its operation to affect the faunal and floral population of the area. However there is potential for avian distraction due to glare/reflection from solar panels. The impact to flora from the operation will be limited to the routine clearance of vegetation near the solar plant to avoid shadows and hindrance to sunlight on solar panels. As such these impacts are considered to have a low intensity, and an overall minor significance.

Use of Herbicides

Herbicides are usually used throughout the operation phase to control the growth of plants which may cut off sunlight from the solar panelling. These herbicidal chemicals are toxic to most organisms and tend to accumulate in the subsoil layers. The toxic components are likely to enter into the operating food chains within the area through surface and ground water sources.

Use of Dust Settling Chemicals

In general practice, the dust-settling chemicals tend to be employed throughout the operation phase to prevent the dust and dirt accumulated on the coating surface of the solar panels. These dust settling chemicals may have toxic effects on organisms and may have tendency to bio-accumulate and could eventually contaminate the soil, surface and ground water and food chains in the area.

Spillage of Materials

Solar power generation projects often employ in their systems the chemicals such as heat transfer fluids belonging to chemical groups of nitrates, nitrites, sulphates and sulphites. Many of these chemicals are toxic to organisms involved in the respective ecosystem. Accidental or as a part of routine operations the spillage of these chemicals will likely to degrade the food chains and could result into the contamination of the natural resources in the area.

Mitigation Measures

Vegetation clearing through brush cutting for maintenance activities will be done manually wherever possible. Any cleared areas which do not have some vegetation cover to protect the soil will be revegetated with locally occurring species and monitored to ensure recovery is taking place. Vegetation that needs to be reduced in height will be mowed or brush-cut to an acceptable height, and not to ground level except where necessary. Solar panels will have an anti-reflective coating to minimize the light reflecting off of the panels. Thus there will be very less impact due to glare from the panels.

These hazardous impacts of herbicidal use on project site could be prevented by strictly prohibiting the use of herbicides in the facility and opting for manual weeding to control plant growth in the solar panel area.

Significance of the Impact

Assuming the above-mentioned mitigation measures are implemented, the operation phase impact significance is reduced to Minor.

Table 7-19: Impact Significance – Ecology

Aspect	Scenario	Spread	Duration	Intensity	Overall
Ecological Diversity	Without Mitigation	Local	Long	Low	Minor
	With Mitigation	Local	Long	Low	Minor

7.4.2.4 Soil Quality

Compaction of soils from increased levelling and grading of areas within the site will result in lower permeability and therefore, decreased infiltration and increased runoff. Without appropriate measures, runoff from PV panels, compacted areas and hard standing areas in addition to erosion by wind may increase erosion and increase the sediment load in run-off.

Operation of solar photovoltaic panels for power generation will not have any direct impact on soil. Once the plant is commissioned there will be limited disturbance to soil, however repair and maintenance of underground cables and associated utilities will lead to generation of hazardous wastes such as used transformer oil.

The defunct/damaged photo voltaic cells will also be generated and storage/disposal on unpaved ground can lead to contamination of soil. The defunct/damaged photo voltaic cells will also be generated and storage/disposal on unpaved ground can lead to contamination of soil being a hazardous waste. To avoid accumulation of waste from various blocks, RWEPL is required to take extra measures to keep a check on waste generated onsite and make proper storage area on impervious surface.

Mitigation Measures

Disturbance to soil from repair and maintenance activity will be limited and will ensure proper restoration of soil wherever excavation is undertaken. Project proponent shall explore the option of buyback agreements for defunct panels and for replacement and disposal of transformer oil by the supplier, otherwise will make arrangements for disposal of defunct panels and waste oil by Karnataka State pollution Control Board (KSPCB) authorised recyclers. Broken or damaged solar panels will immediately be shifted to a designated area in scrap yard to avoid land contamination. These broken cells once collected to a certain number will be sent back to the manufacturer with the photographs taken for proper and safe disposal.

Significance of Impact

The impact on soil will have moderate intensity with a local spread for a short duration (of activity) which will result in an overall minor impact without mitigation.

Table 7-20: Impact Significance- Soil Quality

Aspect	Scenario	Spread	Duration	Intensity	Overall
Soil Quality	Without Mitigation	Local	Short	Low	Minor
	With Mitigation	Local	Short	Low	Insignificant

7.4.2.5 Health and Safety

During the operation phase, the risks will be quite limited due to nature of operation activities; the activities will be limited to guarding and on call and/or onsite technical support (maintenance and cleaning). There will be potential impacts on personnel' health and safety during operation phase due to exposure to risks such as:

- Slipping and tripping;
- Falling during working at height;
- Exposure to hazards such as electric shock and thermal burn hazards;
- Exposure to chemicals, hazardous and flammable materials; and
- Maintenance activities are expected to be carried out in hot weather conditions, thus workers are exposed to dehydration, heat exhaustion and heat stroke.

Mitigation Measures

CSPGPL will implement the following measures:

- Regular electrical safety training to workers;
- Implement Lock out/ Tag Out (LOTO) system;
- Use work equipment or other methods to prevent a fall from occurring. Collective protection systems, such as edge protection or guardrails, should be implemented before resorting to individual fall arrest equipment. In addition, safety nets or airbags can be used to minimize the consequences of a fall should it occur.
- Personal Protective Equipment (PPEs) e.g., shock resistant rubber gloves, shoes, other protective gear etc. should be provided to workers handling electricity and related components;
- The transformer yard should be provided with fire extinguishers and sand buckets at all strategic locations to deal with any incident of fire;
- Employees involved in electrical works shall be trained in and familiar with the safety-related work practices, safety procedures and other safety requirements that pertain to their respective job assignments; and
- An accident reporting and monitoring record shall be maintained.

Significance of the Impact

The impact on health and safety will have moderate intensity with a local spread for a long duration which will result in an overall major impact without mitigation. However with proper health and safety measures the intensity of impact can be reduced to low resulting in an overall minor impact.

Table 7-21: Impact Significance – Health and Safety

Aspect	Scenario	Spread	Duration	Intensity	Overall
Health and Safety	Without Mitigation	Local	Long	Moderate	Moderate
	With Mitigation	Local	Long	Low	Minor

7.5 Socio-economic Impacts

7.5.1 Construction Phase

7.5.1.1 Land for project site

A total of 287.02 acres of private land falling in Machnur and Singaddinni villages has been procured from 26 land sellers on willing to sell and willing to buy arrangement and does not involve involuntary acquisition of land. The land parcels identified for the proposed project are currently fallow land. The past land use was agricultural land. However; due to lack of rainfall and limited access to irrigation facilities over the past 3-4 years, the land use has been changed to fallow land. CSPGPL has engaged a local land aggregator named 'Veerpaksha Godh' who assisted in land procurement from the land owners of both the villages. Process of land purchase normally involves a land sale deed between the seller and the buyer on a judicial stamp paper.

CSPGPL identified the land parcels for establishment of the proposed project and approached the land owners through the land aggregator for procurement of land. Subsequently, identified land parcels were sold by land owners on a negotiated and mutually agreed price. The negotiated price was higher than the prevailing market rate in the area. The transaction took place with the seller's informed consent and the land owners were provided with fair compensation based on prevailing market values.

There is no physical and economical displacement as a result of land procurement for development of proposed project. All the land sellers have executed Agreement to Sale with CSPGPL and have agreed to execute sale deed for the land parcels after getting conversion certificate for non-agricultural industrial purpose as required under Karnataka Land Reforms Act 1961. Consultation with the land sellers revealed that they will utilize the compensation received to purchase fertile land parcels in some other places to continue with the agricultural practices.

A total of 32 transmission poles are planned to be constructed for external transmission line connecting project site to Kurdi substation. The land for pole line footings Right of Way (ROW) will also be required. A relatively small area of 4mx4m or 15mx15m will be acquired by paying a one-time compensation to the land owner (which includes the compensation for crops in the Right of Way).

Considering the following factors, socio-economic impact due to proposed project is anticipated to be minor.

- There was no involuntary land acquisition due to willing to sell and willing to buy basis of land procurement from land owners;
- Adequate monetary and land compensation was provided by the project proponent to the land owners which was above the prevailing market rates;
- During consultation it was also verified that these land parcels were not being used for grazing purposes as there was minimum vegetation due to lack of rainfall.

Mitigation Measures

The land sellers have received payments more than prevailing market rate in lieu of land sold for the project. There has been no loss of livelihood for the project affected households as the land was not cultivated from last 3-4 years. With the payment received, the land sellers would have more purchasing power in hand to start up a new entrepreneurship venture of their own or invest in the purchase of land in some other area.

Significance of the Impact

The impact value for probable impacts during the construction phase pertaining to land procurement will be of local spread, medium duration and low intensity, predicting overall impact as minor.

Table 7-22: Land Procurement

Aspect	Scenario	Spread	Duration	Intensity	Overall impact
Land Procurement	Without mitigation	Local	Medium	High	Moderate
	With mitigation	Local	Medium	Low	Minor

7.5.1.2 Influx of Migrant Workers

The construction phase of the project is likely to last for around 5 - 6 months. Peak construction period is likely to last for 6 months wherein 300-350 construction workers will be deployed. It is estimated that most of the workers to be deployed will be skilled and will be largely migrant workers.

The respective sub-contractor will be responsible for the construction of temporary labour camps and provide workers with water supply electricity, sanitary facilities, medical aid and other basic amenities. CSPGPL has leased 4 acre of land from Singaddinni village for a year for construction of labour camps by the respective contractor. The influx of migrant workers in short to medium term is likely to have the following risks:

- Pressure on key local infrastructure such as water, healthcare, electricity;
- Spread of communicable diseases;
- Lack of hygiene and adequate sanitation facilities would create health ailments related to food poisoning or diseases like malaria, viral fever which could spread within the local community;
- Conflict amongst workers, and between workers and local community, based on cultural, religious or behavioural practices;
- Discontent amongst local community on engagement of outsiders.

After construction phase, the areas acquired by labour camp shall be reverted back similar to pre-construction stage. In spite of the risks from influx of migrant workers, there are also positive effects which are likely to benefit the local community in the immediate vicinity of the project area.

- Short term business opportunities targeted to the construction camps. Local businesses such as shops are likely to benefit from their proximity to labour camps that will be provided to accommodate migrant workers;
- There could be enhancement of local skills set through interaction of local unskilled or semi-skilled labourers with the skilled migrant workers.

Mitigation Measures

- The project proponent shall encourage the contractor to engage local population as workforce in the construction activity, as far as possible;
- The contractor should ensure that accommodation which is provided is not overcrowded and does not pose a risk to the health and safety of workers;
- It should be ensured that the labour camp should have basic amenities such as electricity, drinking water, health and sanitation facility, kitchen and rest room;
- The labour camp will be equipped with septic tank and soak pits and avoid presence of stagnant water is a factor of proliferation of potential disease vectors such as mosquitoes;
- The contractor should ensure that the disruption of local communities is minimum, in particular local communities' transport infrastructures and if required limit the workers movements in nearby areas;
- Security staff have a clear mandate and have received clear instruction about their duties and responsibilities, in particular, not to harass, intimidate, discipline or discriminate against workers;
- Where possible, an adequate transport system to surrounding communities will be provided. It is good practice to provide workers with free transportation to and from local communities.
- CSPGPL through the contractor agreement with the contractor shall ensure that the construction contractors commit and adhere to social obligations including community relations, handling complaints and grievances, adherence to labour laws and international commitments etc.
- The contractor shall provide adequate information to workers on expected social behaviour and hygiene practices to be followed at site.
- The contractor shall ensure that no child or forced labour is engaged by contractors and all wage payments are done without any discriminations or delays by the contractors;
- The contractor to ensure local contracting and vendor opportunities as far as possible;
- The contractor should undertake medical test of the contract workers prior to engagement to identify any communicable disease.

Significance of the Impact

The impact value for probable impacts during the construction phase pertaining to influx of migrant workers will be of local spread, medium duration and low intensity, predicting overall impact as minor.

Table 7-23: Migrant Labour Engagement

Aspect	Scenario	Spread	Duration	Intensity	Overall impact
Migrant Labor Engagement	Without mitigation	Medium	Short	Moderate	Moderate
	With mitigation	Medium	Short	Low	Minor

7.5.1.3 Archaeological, Historic and Cultural Aspects

A 'Babul Tree' is located on a parcel of land within the proposed project site which is being worshipped by the locals of the area once a year. Reportedly, it was mentioned by the Site Representative that the tree will not be cut and access will be provided to the community. Also, thirteen (13) Neem Trees present within the site premises and will not be removed. Apart from this there are no archaeological, historical or cultural important sites near the proposed site; hence no impact on these sites is envisaged.

Mitigation Measures

In the case of discovery of archaeological features during excavation / construction works, a chance find procedure¹¹ to notify relevant authorities will be put in place by CSPGPL. It will be ensured that continuous access is provided to the locals to worship the Babul Tree. It is recommended that a Memorandum of Understanding (MoU) with the Gram Panchayats in the study area is executed for the provision of continued access.

7.5.2 Operation Phase

7.5.2.1 Impacts on Local Economy

During the operational phase of the project, the impact on socio economic environment is likely to be positive as the project will lead to increase in local employment opportunities and increased demand for materials and services through local contracting. The power generated from the Project is being transmitted to the local grid and is likely to increase the power supply situation in the region.

7.5.2.2 Up-gradation of Local Infrastructure

Although the project is not likely to involve any creation of additional infrastructure, CSPGPL is likely to engage in community development activities like provision of drinking water, improvement of women in vocational courses and other such activities in coordination with the local Panchayat. This will lead to a beneficial impact on the upgrading of local infrastructure.

Significance of Impact

The Impact value for probable impacts during the Operation phase has been presented below:

Table 7-24: Impact Significance –Local Economy and up gradation of infrastructure

Aspect	Scenario	Spread	Duration	Intensity	Overall impact
Local Economy and up gradation of infrastructure	Without mitigation	Local	Long	Short	Minor
	With mitigation	Local	Short	Low	Positive

7.6 Impact Assessment – Decommissioning Phase

Typical activities during the solar energy facility decommissioning and site reclamation phase include facility removal, breaking up of concrete pads and foundations, removal of access roads that are not maintained for other uses, recontouring the surface, and revegetation.

¹¹ The chance find procedure is a project-specific procedure that outlines what will happen if previously unknown heritage resources, particularly archaeological resources, are encountered during project construction or operation.

Dismantling operation however will have impact on environment due to noise and dust arising out of it. During de-installation, a specific strategy shall be adopted in order to handle the each type of item to keep the impact during the actual activity low. The decommissioning will also have social impact. The impact due to decommissioning on power, social and environmental scenario will be guided by applicable laws and guidelines. The key issues associated with demobilization phase will include:

- Issue of loss of job when the workers will be asked to leave;
- Improper disposal of demolition waste and obsolete machineries will lead to contamination of soil and discontent of community;
- Demolition activity is anticipated to generate dust and exhaust emissions which can be carried downwind to habitations;
- Risks associated with health and safety issues such as trip and fall, electrical hazard etc.;
- The decommissioning activities of dismantling the solar power plant and removing the ancillary facilities can lead to increased noise levels;
- During the dismantling of the solar power plant, visual intrusions will be likely by removal of ancillary facilities but their consequence will be negligible due to fact that such impact would be temporary (over a short period);
- If any solar panel is damaged during dismantling of the facility, these toxins are likely to spill and leach into the soil and water of the area, posing threat to environmental and public health;
- If the solar panels are not handled or disposed of appropriately during the decommissioning phase, any toxic substances contained within them are likely to escape into the surrounding air, water or soil, creating serious environmental and public health risks.

Mitigation Measures

The mitigation measures for decommissioning shall include:

- The proponent shall inform the workers and local community about the duration of work;
- The workers shall be clearly informed about the expected schedule and completion of each activity;
- A transparent mechanism shall be prepared wherever choice is to be made between individuals of similar capability;
- All waste generated from decommissioning phase shall be collected and disposed off at the nearest municipal disposal site;
- All necessary Personal Protection Equipment (PPE) shall be used by the workers during demolition work;
- CSPGPL will be committed to ensure all health and safety measures are in place to prevent accidents and/or reduce the consequences of non-conformance events;
- Institution of suitable training modules for project-personnel and labour contractors involved in the dismantling process to ensure avoidance or minimization of solar panel damage as far as possible and adherence to appropriate decontamination protocols in the event of any unavoidable damage and adhere to proper safe disposal methods.

Significance of the Impact

Impact value for decommissioning is assessed to be moderate without mitigation and minor with preventive measures.

Table 7-25: Impact Significance – Decommissioning Phase

Aspect	Scenario	Spread	Duration	Intensity	Overall
Decommissioning	Without Mitigation	Medium	Short	Moderate	Moderate
	With Mitigation	Medium	Short	Low	Minor

8 ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

8.1 Introduction

This chapter addresses the requirement of IFC Performance Standard-1 which highlights the importance of managing the social and environmental performance throughout the life of the project. The purpose of an Environmental and Social Management Plan (hereinafter referred as ESMP) is to ensure that social and environmental impacts, risks and liabilities identified during the ESIA process are effectively managed during the construction, operation and closure of the proposed project. The ESMP specifies the mitigation and management measures to which the Proponent is committed and shows how the Project will mobilize organizational capacity and resources to implement these measures. The ESMP also shows how mitigation and management measures will be scheduled. The key objectives of the ESMP are to:

- Formalize and disclose the program for environmental and social management;
- Provide a framework for the implementation of environmental and social management initiatives.

The Environmental and Social Management Plan (ESMP) is specified in order to describe the mitigation measures for all the impacts associated with the project during its construction, operation and maintenance phase. The ESMP intends to delineate the monitoring and management measures to minimize such impacts by allocating management responsibility and suggesting skill requirement for implementation of these measures during the operational phase.

CSPGPL is committed to ensure compliance to all the commitments towards Environment, Social, Health and Safety Standards while executing all the project related activities to 50MW Solar Power Project. This ESMP is applicable to all the employees of CSPGPL, Mahindra Susten and the other sub-contractors if any, engaged during the project lifetime.

Mahindra Susten has formulated an Environment, Quality, Health and Safety policy which has been endorsed by CEO dated 17th August, 2015. Also, Mahindra is ISO 9001:2015, ISO 14001:2015 and OHSAS 18001:2007 certified company.

8.2 Organizational Structure (Environment, Social, Health and Safety)

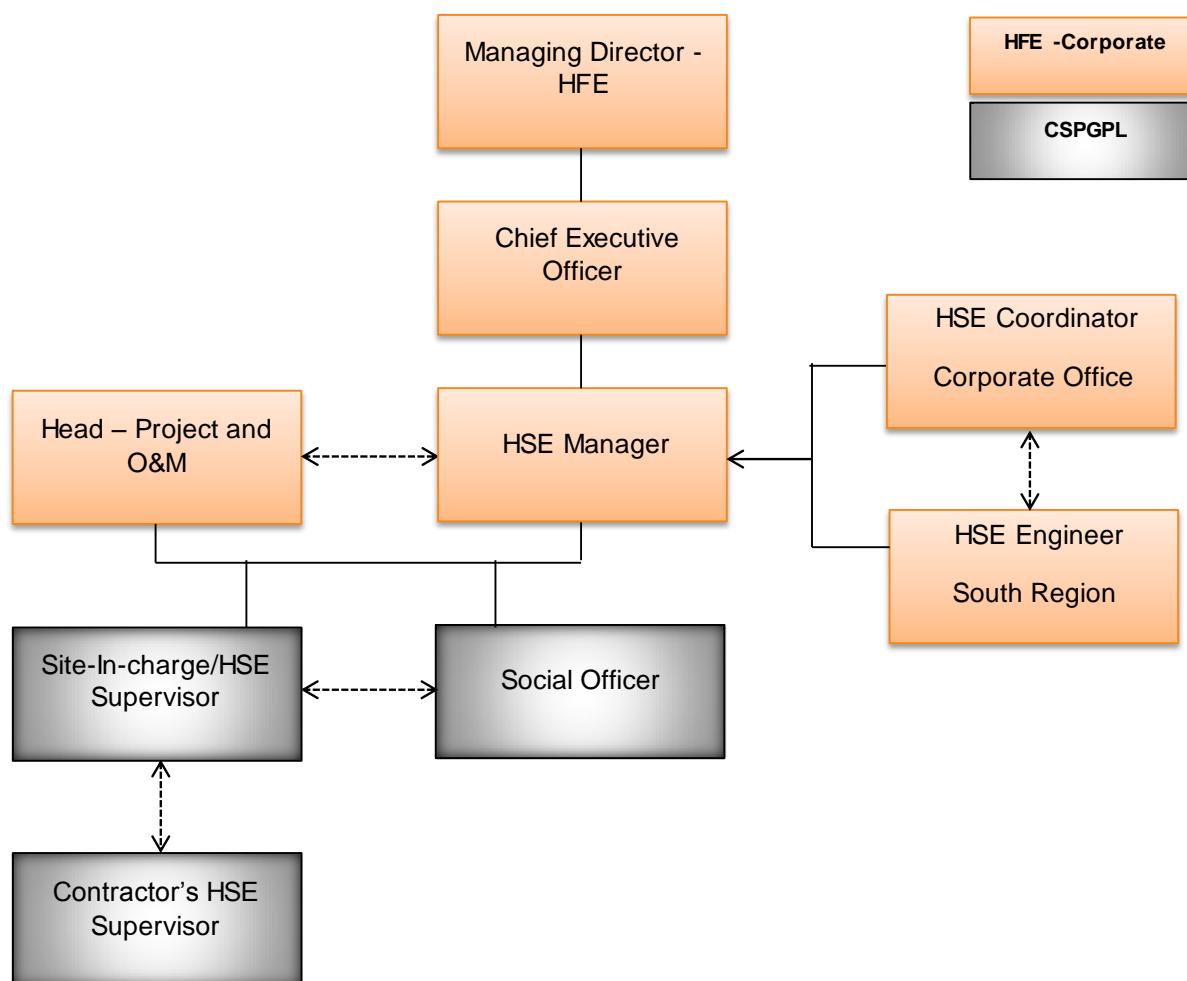
The enforcement and implementation of the project specific ESMP requires a robust manpower network working towards the common goal of ensuring compliance to the commitments towards ESHS standards for the project. The overall management and coordination of the project will be managed through the Managing Director of HFE. He is supported by and Chief Operating Officer (CEO) who in turn is supported by the Head of Projects and O&M.

Head of Projects and O&M will overview monitor and control the activities of HSE Manager who in-turn is the reporting manager of the HSE Engineer (based out of Bangalore for projects in the South India) and HSE – Coordinator (based out of Delhi, Corporate Office). The overall control of the site-in charge and contractor representative will be with the HSE Manager.

The project does not foresee any significant adverse social and environment impacts or risks as indicated in the previous sections. The project footprint area is limited to its immediate vicinity and a particular range of stakeholders. It is proposed that the CSPGPL provides professional HSE training to the site-in charge so that along with the technical project aspects he will be capable of supervising the environment, health and safety issues at the site. The HSE supervisor/site in-charge will work in coordination with the HSE staff of contractor.

It is proposed to appoint a social officer at project level, who will work in coordination with the contractors and stakeholders for managing the social (including 3rd party workers, staffs and neighbouring community) issues. The proposed organizational structure for project has been presented in Figure below:

Figure 8-1: Project organization structure



8.2.1 Roles and Responsibilities

This section describes the roles and responsibilities of the key persons responsible for management of onsite activities of the project:

Site In-charge

The Site In-charge of CSPGPL is responsible for overall management of the project and ESMP implementation on site during construction and operation phase of the project. The following tasks will fall within his/her responsibilities:

- Monitor site activities on weekly basis for compliance;
- Conduct internal audits of the construction site against the ESMP; and
- Confine the construction site to the demarcated area;
- Keeping a check on operation and maintenance services of WTGs required during operation phase;

Apart from the project related aspects, Site In-charge will also have additional responsibilities of community liaisoning such as:

- Managing all grievances of the project and their outcomes;
- Implementing, monitoring and updating the ESMP;
- Undertaking community development initiatives in the project villages in coordination with Mahindra Susten;
- Keep record of all the CSR activities being undertaken for the project;

- Keep the Regional EHS Manager informed on the progress of CSR activities undertaken at project site;
- Conduct periodic (formal and informal) meetings with local community for understanding their grievances and outcomes of the CSR activities; and
- Inform the local community about the Grievance Redressal Mechanism and ensure effective implementation.

HSE Engineer

The HSE Engineer will have the following responsibilities and will report to Site In-charge and the HSE Manager from HFE Corporate:

- Ensure availability of resources and appropriate institutional arrangements for implementation of ESMP;
- Compliance of legislative and IFC PS requirements;
- Carry out audits, and inspection of all the project activities with Project Manager;
- Conduct training programs and awareness activities on health and safety for site staff and community;
- Preparation of necessary documents and record keeping system; and
- Review and updating of ESMP for its effective implementation.
- He will have the authority to issue the work permit system for working at heights during O&M phase of the project;
- Arrangement of first aid and firefighting equipment at the site office;
- Maintenance of the records of near miss and incidents that can happen at site, if any;
- Maintenance of records of hazardous waste generated on site on monthly basis and ensuring its proper disposal to authorized vendors of KSPCB only.

EHS/ Safety Officer-Mahindra Susten (EPC Contractor)

The EHS/ Safety officer will be responsible for implementation of this ESMP and any other environmental requirements that may be identified by the Site In-charge during the course of the contract. The EHS officer will have received the basic EHS training either as part of the contract or previously. In addition to any other responsibilities, the general duties of the contractor's EHS officer shall be:

- Ensuring that all personnel (including sub-contractors) are duly informed of the requirements contained in this ESMP, and the associated responsibilities and implications of this ESMP;
- Ensuring that all records needed to demonstrate compliance with the ESMP requirements are obtained, filed and readily available for inspection by the Project Manager or the Proponent;
- Consulting with the CSPGPL's Regional HSE Engineer regarding interpretation of the ESMP and any other aspects of the contract that may impact significantly on the environment;
- Ensuring that all personnel demonstrate respect and care for the environment in which they are operating;
- Imparting of tool-box training and other health and safety trainings required during different phases of the project;
- Managing Sub-Contractors engaged by Mahindra Susten and ensure implementation of safety practices onsite.

Social Officer

The Social Officer will have the following responsibilities:

- i. Undertaking community development initiatives in the Project villages;
- ii. Planning, implementing and recording all the CSR activities being undertaken for the Project;
- iii. Managing all grievances of the Project and recording the actions taken;
- iv. Acting as a point of contact for local residents and community members;
- v. Providing training and guidance to the employees and workers on how to behave with the community to avoid conflicts;
- vi. Develop a Grievance Redressal Mechanism in lines with informing the local community about the Grievance Redressal Mechanism and ensuring effective implementation; and
- vii. Conducting periodic meetings with local community for understanding their grievances and outcomes of the CSR activities;

8.3 Monitoring and Audit

The ESMP will have to be monitored on a regular basis in order to ensure effective implementation. The EHS team of HFE/CSPGPL, along with Mahindra, will undertake inspection and monitoring of the environmental and social impacts of construction and operation phase activities in order to ensure the effectiveness of suggested mitigation measures.

- CSPGPL will ensure that Mahindra complies with the requirements of conditions for all applicable permits and guidelines;
- The ESMP will be monitored on a regular basis, quarterly or half yearly all outcomes would need to be audited in accordance with EHS commitments of HFE/CSPGPL.
- The monitoring process will cover all stakeholders including the local community impacted by the project activities and associated facilities.
- The inspections and audits will be undertaken by a trained team of external agencies/experts or from HFE/CSPGPL.
- The inspection and audit findings will be implemented by Mahindra in the areas of concern.
- The entire process of inspections and audits will be documented.

Sub-Contractors will be required to fully comply with the reporting requirements in terms of timely report submission with acceptable level of details. Reporting will be done in the form of environmental, health, safety and social check list, incident record register, environmental, health, safety and social performance reports (weekly, monthly, quarterly, half yearly, yearly etc.).

8.4 Document and Record Keeping

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

8.5 Training

The training and competence of personnel working remotely and the readiness of all necessary safety equipment in the location is needed to be assessed. Hence, HFE/CSPGPL shall ensure that the job specific training and EHS Induction Training needs are identified based on the specific requirements of ESMS and project personnel (including the Contractors and Sub-contractors) to undertake the required actions and monitoring activities. Mahindra is responsible for ensuring that their workers are provided HSE training as stipulated. In addition to formal training, the contractor should undertake tool-box talks. A training register should be kept on site for all training conducted onsite.

An environmental 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 environmental aspects of the project.

A basic occupational training program and specialty 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.

Table 8-1: Training Requirements for the project

Topic	Training Content	Targeted Audience
General Project Awareness	<ul style="list-style-type: none"> • Benefits of the Project • Type of land required for the project • Possible employment Opportunities 	Local Communities
Environmental and Social Management training	<ul style="list-style-type: none"> • 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; and • Understanding of the potential risks from the project activities; 	Site Level Officers of Mahindra and HFE/CSPGPL and Contract Workers
Occupational Health & Safety Training	<ul style="list-style-type: none"> • The importance of conforming with all HSE policies; • The HSE impacts of the proposed activities; • HSE benefits of improved personal performance; • Worker roles and responsibilities in achieving conformance with the client's HSE policy, procedures and this EMP including associated procedures and emergency preparedness and response requirements; • Mitigation measures required to be implemented when carrying out their work activities. • Use of PPE; <ul style="list-style-type: none"> – Job Safety analysis – First aid trainings and awareness regarding medicines; – Fire drills and usage of fire extinguishers at the time of emergency; – Maintaining accident and incident investigation reports 	Site Level Officers of Mahindra and HFE/CSPGPL and Contract Workers First Aiders and Fire Fighters

8.6 Management Plans and Procedure

8.6.1 Introduction

HFE, the parent company is committed to ensuring compliance to the national and state level regulatory requirements and mitigating potential adverse environmental impacts resulting from the project activities. It has formally developed a corporate level Environment and Social Management System (ESMS) to ensure smooth functioning of its proposed projects. The ESMS is applicable for all the holding companies of HFE including this project SPV (CSPGPL).

Corporate ESMS of HFE comprises of the following policies and plans:

- i. Environment and Social Policy
- ii. Occupational Health and Safety Policy
- iii. Labour Management Plan
- iv. Occupational Health and safety Plan
- v. Stakeholder Engagement Plan
- vi. Construction Waste Management Plan
- vii. Grievance Redressal Mechanism
- viii. Resettlement Action Plan
- ix. Livelihood Restoration Plan

As mentioned above, CSPGPL will adopt all of these while implementing the project specific plans at this project site along with the mitigation measures suggested for each of the potential impacts.

8.6.2 Stakeholder Engagement

Stakeholders are persons or groups who are directly or indirectly affected by a project, as well as those who may have interests in a project and/or the ability to influence its outcome, either positively or negatively. They can comprise individuals, communities, social groups, organizations etc. It is often observed that the poor and the marginalized are often ignored either due to the fact that they are unaware or do not have a forum to voice their opinion.

The purpose of the Stakeholder Engagement Plan (SEP) is to ensure that the direct and indirect impacted stakeholders of the project are regularly apprised of the project activities. The plan has been developed in order to draw out an outline wherein the communication process associated with the activities of the project cycle is to be undertaken.

The stakeholders in the project were identified based on their level of interest and influence over the project activities. The stakeholders were primarily divided into direct and indirect and further regrouped as internal and external. In the table below, the types of stakeholders as per their level of interest and influence have been provided.

Table 8-2: Types of Stakeholder as per their interest and influence

S. No.	Types of Stakeholders	Description	Groups + Individuals
1	Direct Internal Stakeholders	Direct internal stakeholders comprise the parent company or the project proponent and the employees of the company that are directly controlled by the parent company.	<ul style="list-style-type: none"> • HFE (Project Owner) • Mahindra Susten(EPC Contractor)
2	Direct External Stakeholders	Direct external stakeholders comprise the project affected people/families, contractors, supply chain and financial intermediary who are directly affected by the project activities but are not directly controlled by the project proponent.	<ul style="list-style-type: none"> • Project Affected Persons/Families (Land Owners) • Karnataka State Power Department • Karnataka Power Transmission Corporation Limited (KPTCL) • Financial Intermediary • Contractors • Vendors
3	Indirect Internal Stakeholders	Indirect internal stakeholders consist of the secondary stakeholders who would have a	<ul style="list-style-type: none"> • Families of Direct Employees

S. No.	Types of Stakeholders	Description	Groups + Individuals
		more indirect interest but within the direct influence of the project.	
4	Indirect External Stakeholders	Indirect external stakeholders comprise of those stakeholders who might be not be involved directly in the day to day operation of the project but have an interest in the activities of the project.	<ul style="list-style-type: none"> Local Community residing within the two villages (Machnur and Singaddinni) Opinion Leaders of local communities residing within the 8 villages of the project area Local Government Institutions Karnataka Pollution Control Board Karnataka Renewable Energy Development Limited (KREDL) Local Media

8.6.2.1 Stakeholder Analysis

Stakeholder analysis takes a more comprehensive view of the stakeholder’s group interests, how they would be affected and to what extent and influence they could have on the project. These aspects cumulatively provide the basis for constructing the stakeholder engagement strategy. The key stakeholders identified in the previous section have been categorised into four major groups: Government Agencies, Positively Influenced Stakeholders, Critical to Engage and Donors. The categorisation list of key stakeholders has been provided in the following table.

Table 8-3: Categorization List of Key Stakeholders

Categorization	Key Stakeholders
Government Agencies	<ul style="list-style-type: none"> Karnataka State Power Department Karnataka Power Transmission Corporation Limited (KPTCL) Karnataka State Pollution Control Board Centre for Wind Energy Technology Karnataka Renewable Energy Development Limited (KREDL)
Positively Influenced Stakeholders	<ul style="list-style-type: none"> Project Affected Persons/Families (Land Owners) Families of Direct Employees HFE (Project Owner) Mahindra Susten (EPC Contractor) Local Community residing within the 8 villages of the project area Contractors Vendors
Critical to Engage	<ul style="list-style-type: none"> Opinion Leaders of local communities Local Government Institutions Local Media
Lenders	<ul style="list-style-type: none"> Financial Intermediary

In order to map the interest/influence of the stakeholders on the project activities, a matrix showcasing the stakeholders and their interest/influence has been developed. This step is to assess the interest/influence into high, medium and low levels. In the table below, the interest matrix has been provided.

Table 8-4: Interest Matrix of Stakeholders

Categorisation	Key Stakeholders	Influence Power to facilitate or impede project	Interest in the Project
Government Agencies	Karnataka State Power Department	High	High
	Karnataka Power Transmission Corporation Limited (KPTCL)	High	High
	Karnataka State Pollution Control Board	High	High

Categorisation	Key Stakeholders	Influence Power to facilitate or impede project	Interest in the Project
	New & Renewable Energy Department	High	High
	Karnataka Renewable Energy Development Limited (KREDL)	Low	High
Positively Influenced Stakeholders	Project Affected Persons/Families (Land Owners)	Low	High
	Families of Direct Employees	Low	Low
	Direct Employees of HFE (Project Owner)	Low	High
	Direct Employees of Mahindra (EPC Contractor)	Low	High
	Local Community	Low	Medium
	Contractors	Low	High
	Vendors	Low	High
Critical to Engage	Opinion Leaders	Low	High
	Local Government Institutions	Low	High
	Local Media	Low	Medium
Lenders	Financial Intermediary	High	High

8.6.2.2 Communicative Method

Stakeholder engagement becomes a successful exercise when proper and participatory communicative methods are used. This ensures that the stakeholders are kept engaged and well informed of the project development at every stage. A combination of communicative methods is usually used to engage with the stakeholders. To determine which option is best suited to the various stakeholders, a benefit analysis of each option has been carried out. The communicative methods are:

- General Information consisting of the project’s various activities, the operation stage and impacts that might arise shall be made available:
 - on information board of the Gram Panchayat’s office within the project area
 - on information board of site office
 - on HFE’s website
 - in local newspaper
- Detailed information including documents like ESIA report; Environment, Health & Safety and Social Policy, Environment Management Plan, Social Management Plan including environmental decisions shall be in hard copies and disseminated to:
 - Site office
 - Electronic version of these documents will be made available at HFE’s website.
- In addition to this, a host of tools and techniques can be adopted to engage with the stakeholders in a transparent and accountable manner. Below a list of the tools and techniques which can be adopted are mentioned:
 - **Public Meeting:** This tool can be used to disclose information on a large scale involving the stakeholders of a particular village. A schedule of the meeting can be circulated well in advance and discussions can involve feedback session from the stakeholders. The meeting can be conducted in the premise of the village school for proximity and familiarity purposes. Once the meeting concludes, minutes of the same should be kept as a record with the site office and a copy given to the village

head. Schedules of future meetings should be discussed and finalised so that the stakeholders can gauge the seriousness of the project proponent in continuing the engagement process.

- Focus Group Discussion (FGDs): FGDs are important when gauging with a particular group of stakeholder on issues related to the project activities. It can be used to understand the needs, perceptions and concerns of the group. The discussion will give space for the members to voice their concerns and suggestions. The moderator of the discussion should be impartial in his/ her view and should encourage everyone present to participate in the discussion. Records of the FGDs should be maintained and updated regularly.
- Participatory Workshops: Participatory workshops are meetings which enable local people to analyse, share and enhance their knowledge to plan, manage and evaluate development projects and programmes. Visual aids – such as mapping, videos, illustrations, timelines, card sorting and ranking, Venn diagrams, seasonal calendar diagramming and body maps are often used in participatory workshops to engage participants and capture knowledge. They are often an effective means of getting participants to reflect on issues and their own personal experiences. These workshops also pay particular attention to group dynamics and breaking down distinctions between ‘uppers’ – those with power, standing, influence etc. within a community – and ‘lowers’ – those with less power, influence and standing within a community. To initiate such a workshop, an expert familiar with participatory tools and conducting such workshops shall be engaged.
- Participatory Rural Appraisal (PRA) Techniques: PRA techniques are usually adopted to emphasize local knowledge by enabling local people to make their own appraisal, analysis and plan. PRA uses group animation and exercises to facilitate information sharing, analysis and action among stakeholders. This process can be useful when the project proponent initiates any developmental activities in the area and uses the local knowledge to plan and strategize so that they feel responsible for delivery of the objectives.

8.6.2.3 Stakeholder Engagement Program

The consultation with the stakeholders will be conducted by the Admin Officer and Site-In-Charge of CSPGPL, Regional HSE Engineer with representative from Mahindra/ Any grievances from the community relating to any issues that might arise from the project activities will be managed by the nominated Grievance Officer based at the Site Office. The Admin/ Liaison Officer is required to report directly to the Project Manager based at the Site level.

Consultations with the government agencies will be conducted as per the schedule that will be created with the Community Liaison Officer and Project Manager. These stakeholders will be informed in advance of the planned project activities. The development of the facilities will be based on the ESIA procedures and mitigation issues once an ESIA study has been completed.

Consultations with the direct internal stakeholders will involve meetings, information boards announcements to apprise the direct employees of CSPGPL and Mahindra regarding the procedures of emergency response system, incident/accident reporting, grievance redressal mechanism, HR Policies and Procedures, welfare measures etc. In addition, communication of general employment conditions, company's code of conduct for work site, EHS concerns, use of PPEs, information and awareness about the requirements of labour laws and minimum wages, working hours, grievance redressal, retrenchment process etc. should be also be conducted with workers engaged with contractors.

Project related information will be posted on the informational boards at the site office as well as at the Corporate Level. Information on the project milestones will be published in advance on the company's website to be available for the public and non-governmental organizations in the area to comprehend the attitude of the external stakeholders. In addition, the company will publish information on the project in the local newspapers.

In turn, if any issues are raised by the stakeholders, the project proponent management comprising of the Grievance Redressal Committee at the Site Level will respond accordingly in the shortest possible time. Details of which have been provided in the Grievance Redressal Mechanism section of the report.

The responsibility for the SEP implementation will be held by the Staff present at the project site. He will be supported by the Project Manager (CSPGPL), Social/CSR Officer, Site In-charge (Mahindra) and nominated Grievance Officer at the site level.

A summary of the consultation activities that the project proponent shall undertake as part of the Engagement Plan pertaining to the villages around the project area and other stakeholders have been provided below:

Table 8-5: Summary of Consultation Activities

Stakeholder	Objective and Consultation Method	Proposed Timeline	Responsibility
Local Community, Opinion Leaders, Local Media at Project Site	<ul style="list-style-type: none"> Disclosure of the project at village level and progress of the work to be displayed at the Information Board of Gram Panchayats office within the project area. Website of the Company 	Before the commissioning of the Project	Community Liaison Officer from the Company and Panchayat Members.
Government Authorities	<ul style="list-style-type: none"> Information meetings and consultations 	On-going on a permanent basis (every six monthly)	Company: Head-Projects (HFE), Project Manager / HSE Supervisor (CSPGPL), EHS Officer (Mahindra)
Direct Employees	<ul style="list-style-type: none"> Internal meetings of direct employees and managers Day to day contact 	<ul style="list-style-type: none"> On-going process on a permanent basis: monthly On-going on a permanent basis 	<ul style="list-style-type: none"> Company: Project Manager/ EHS Officer & Community Liaison Officer EHS Officer
Contractors (Third Party)	<ul style="list-style-type: none"> Meetings with contractors and their respective managers 	On-going on a permanent basis: monthly basis	EHS Officer, Project Manager and Community Liaison Officer
Lenders	<ul style="list-style-type: none"> Information on project status Submission of annual reports, information on any project-related events that could potentially create an increased risk of the project 	On-going process on a permanent basis	Company: Project Manager; designated person from HFE, EHS Officer and Community Liaison Officer.

The stakeholder engagement process should be carried out at two levels, namely, local community and local governing bodies. A summary of the proposed plans that is to be initiated by CSPGPL have been described below:

Table 8-6: Summary of Proposed Plan of Activities

Sl. No.	Key Stakeholders	Proposed Plan of Activities
1	Positively Influenced Stakeholders/ Local Communities	<ul style="list-style-type: none"> Announcement of vacancies (skilled/unskilled) at proposed site Announcement of contract work for small scale work associated with the proposed project CSR Activities to be initiated by Project Proponent Consultation with village panchayats about movement of heavy vehicles Information on route and timing of vehicle movement to be provided to village administrations Set up a grievance redress mechanism and inform the community about the procedure Discuss the management plan with the community and incorporate the comments
2	Local Governing Bodies	<ul style="list-style-type: none"> Compliance with legal requirements Involvement of various CSR Activities
3	Lenders	<ul style="list-style-type: none"> Compliance with International Guidelines (IFC Sustainability Framework & other national and local legal requirements) Regular Reporting

It is to be noted that the proposed plan of activities relating to the stakeholder engagement can change as per the future planning of activities by CSPGPL.

8.6.2.4 Monitoring and Evaluation

Monitoring: Monitoring of project activities is necessary to cater to the stakeholder's concerns by ensuring transparency in guaranteeing the project proponent's commitment in implementing the mitigation measures that addresses the environmental and social impacts arising from the project.

Through this information flow, the local stakeholders feel the sense of responsibility for the environment and welfare in relation to the project and feel empowered to act on issues that might affect their lives.

Internal monitoring of project related activities as well as associated activities involving the local communities should be contemplated upon on a regular yearly basis (by identified staff from the Corporate level) to bring in openness in the company's commitment. In addition, external monitoring of a company's environmental and social commitments can strengthen stakeholder engagement processes by increasing transparency and promoting trust between the project and its key stakeholders.

CSPGPL should undertake a commitment in undertaking internal audits every once in a year. All related information shall be readily maintained at the site office and produced at the time of the audits.

Audit reports shall be accordingly created after every yearly audit and submitted to Head-Projects. All records of these reports shall be maintained at the site office as well as the Corporate Office. In addition, an external auditor shall be engaged every six monthly to assess the activities of the project and its mitigation measures. The auditor shall accordingly submit a report to the company for review and this should be forwarded to the lender financing the project as well.

Reporting: Performance of CSPGPL will be reviewed yearly against the Stakeholder Engagement Plan. The report will include, but not be limited to, the following:

- Informative materials disseminated, its types, frequency, and location
- Place and time of formal engagement events and level of participation
- Activities of community welfare undertaken
- Feedback on CSR initiatives
- Other interactions with the community; and
- Numbers and types of grievances (both from the community and workers) and the nature and timing of their resolution.

8.6.3 Grievance Redressal Mechanism

Grievance Redressal Mechanisms assist in reducing and mitigating the anticipated risks that may arise with the project development. An effective grievance mechanism would be one which is transparent and approachable process and would address the concerns promptly in a culturally appropriate manner. The grievance mechanism should be able to inform and complement the existing stakeholder engagement process.

Importance of Grievance Redressal Mechanism

For successful construction and operation of developmental projects, Grievance redressal mechanism is an important tool. The primary objective of a Grievance redressal mechanism is to develop and promote practices which would ensure creation and sustenance of healthy stakeholder relationships and redressal and expeditious settlement of genuine grievances of the workers and the management staff. Its aim is to be gender inclusive, social class inclusive and a continuous and transparent stakeholder engagement process. Grievance redressal mechanism is developed with the prime intention of being a primary apparatus for identification of complaints, its subsequent assessment and thereafter the resolution of the complaints.

Stages of Grievance Redressal Mechanism

As the Grievance Redressal Mechanism for is currently not in place the following section will provide certain recommendations which should be considered while developing a Grievance Redressal Mechanism:

- i. **Development of Procedures:** HFE/CSPGPL should ensure that there is a procedure in place at the site level to lodge and register complaints. Identification of a community liaison officer is the foremost step to develop a grievance redressal mechanism. It should be followed by the procedure of receiving complaints, assessment of complaints, procedure to identify the appropriate resolution path and

decision making on the final resolution process. These procedures are to be given appropriate time frames to ensure effective and suitable redressal.

- ii. **Development of Responses and Suitable Options:** The second step would be to develop appropriate responses for the received/anticipated grievances. Procedures to reach an appropriate resolution should be in place. It could include formal or informal procedures to reach a resolution such as discussions and negotiations. Resolutions can be reached through mediation with the intervention of a third-party generally a community leader or prominent member of the community.
- iii. **Publicise the Grievance Redressal Mechanism:** There is a requirement to publicise the grievance redressal mechanism as when there is awareness creation of the mechanism there will be increased involvement of the stakeholders. Information dissemination to the local community comprises of the next step. The publicising of the GRM can be done through stakeholder engagement activities such as focus group discussions, local community meetings, and development of communicative methods such as printing of pamphlets with the telephone number of the Grievance officer, installation of grievance boxes at suitable locations, updating of websites etc. The GRM should be documented both in the native language (Kannada) and English for wider outreach.
- iv. **Training on Grievance Redressal Mechanism:** As the GRM is now in place, it is a prerequisite that the community members and the workers are informed on the procedures involved in the mechanism. For the workers, at the time of recruitment and formal induction programme they can also be trained on the workings of the GRM. During these trainings the whole process of the GRM should be discussed. It includes the identification and appointment of a local point of contact, process of registering a grievance, timelines for redressal of the complaints and information on the personnel involved in the redressal process.
- v. **Recording of Grievances:** After the dissemination of the provision of the Grievance redressal Mechanism, it is a prerequisite that HFE/CSPGPL should start receiving and addressing the grievances. Required grievances boxes, record books and tracking form should be in order to address and record the grievances.
- vi. **Resolution and Follow up Action:** On receiving the complaints and grievances, the corrective action to be taken should be discussed and implemented within stipulated time frames in each level. Record of follow up action in the form of photographs, agreements between the project proponent and the complainant should be documented for reference purposes.
- vii. **Appeals:** On account of the complainant not being satisfied with the follow up action, the individual should be offered an appeal process. Involvement of the HFE in the appeal process is encouraged to maintain transparency and accountability.

Proposed Grievance Redressal Mechanism

- i. **Formation of a Grievance Redressal Committee:** For the purpose of the successful implementation of the GRM, it is a prerequisite that a Grievance Redressal Committee is formed. The formation of the GRC would provide a stipulated framework for the receipt and redressal of grievances. Representatives in the Grievance Redressal Committee should comprise of:

Figure 8-2: Grievance Redressal Committee



- ii. Community Liaison Officer can be designated as the point of contact at the site level. The functions of the Grievance Redressal Committee are:
 - To record grievances brought up by the community members and the workers/management staff.
 - To assess and prioritize the grievances and redressal of the grievances within a stipulated time-frame.
 - To inform the aggrieved community members and workers/management staff on the progress of the grievance redressal and the outcome or decisions taken by the committee.
 - Grievance Redressal Committee at the site level should inform the concerned at the corporate level at the event of escalation.
 - Grievance Redressal Committee should proactively analyse the received grievance and accordingly act towards redressing it.
 - To continually review the existent Grievance Redressal Mechanism and its applicability on the basis of local customary tradition and culture. Thereafter should initiate systemic reforms/modifications if required for better connectivity and implementation of the GRM.
- iii. **Formation of Criteria for Classification of Grievances:** HFE can formulate a table for classification of the grievances. A sample of which can be found below:

Table 8-7: Classification of Grievances

Code No	Criteria
01	Human Resources Related
02	Community Related Grievances

Stages of Grievance Redressal Mechanism

As Grievance Redressal would involve a multitude of individuals, information and action responses, it is imperative to develop a structure which would assist in effective information gathering, recording and Addressal of the grievances received. The steps for developing a Grievance Redressal process have been provided below:

Receive and Register a Complaint

- i. Installation of secured Grievance boxes at relevant sites (such as site office, substation) within the project area.
- ii. Dissemination of the mobile-phone number of the Community Liaison Officer as a point of contact for grievances to community members/workers through display at strategic locations in the site.
- iii. A stakeholder with a concern/grievance regarding the onsite safety, community health and safety, compensation related grievance may register a written complaint to the appointed grievance officer and drop the written complaint at the grievance boxes installed at different locations.
- iv. The complainant may have the option of lodging complaints verbally as many may not have the ability to write.

- v. The complainant should have the option to remain anonymous while registering the complaint.
- vi. Once received, a database in the form of a Grievance Register or computerised database should be maintained.

Assessment and Addressal of the Complaint

- i. The Community Liaison Officer is advised to check and open the grievance boxes every fifteen (15) days.
- ii. The grievances will be assessed by the grievance officer in a stipulated time frame of two (02) working days to determine if the issues raised by the complainant falls within the mandate of the grievance mechanism or not.
- iii. During the assessment phase, the Grievance Redressal Committee (Level I) team will assess the complaints and discuss the key issues and methods to address the issue. The complainant should be made aware of the results within fifteen (15) working days.
- iv. If the grievance of cannot be resolved at Site (Level I), then the case will be referred/forwarded to the (Level II) for redressal.
- v. The solution for the grievance shall be devised in five (05) working days by the committee at Level II.
- vi. On the event of no resolution at Level II, the complainant will have the option to approach the appropriate court of law for redressal.
- vii. The complainant will have the opportunity to present and discuss the grievance at all levels of the GRC.

Documentation and Reporting

Documentation and Reporting are important components of Grievance Redressal Mechanism. They help to keep track of the grievances and can be used as a databank for future responses/mitigation measures to similar grievances.

- i. **Grievance Tracking Form:** A Grievance Tracking Form should be prepared. It will enable the GRC to trace the grievances and present similar responses.
- ii. **Grievances Record Book:** GRC will maintain a record book containing all the received complaints and the actions taken. The record book should include the following details:
 - a. The Name of Complainant (optional in case anonymity is asked to be maintained);
 - b. Date of the complaint;
 - c. Nature of the complaint;
 - d. Follow-up Action/Redressal of the complaint;
 - e. Date of communication to the complainant of the final result;
 - f. Implementation of the decision;
 - g. Appeals to higher levels (if any).
- iii. **Maintenance of Minutes of Meetings:** The Community Liaison Officer shall be responsible for maintaining the minutes of Meetings with stakeholders, complainants and grievance redressal committee.

Engagement of Third Party

To maintain ultimate transparency and accountability for the grievance mechanism process third parties such as NGOs, local community etc. can at times be involved in the grievance redressal process. These parties can serve as process organisers, mediums through which a complaint can be passed on to the company or they can act as facilitators, witnesses, advisors or mediators. Third parties can assist in enhancing trust level amongst communities as well as assist in overcoming limitation of project level mechanism. The engagement of the third party can thereby be contemplated upon by the company.

Monitoring and Reporting

Monitoring and Reporting are requisite tools for measuring the effectiveness of the grievance mechanism. The implementation and execution of the grievance mechanism is to be regularly monitored and reviewed in order to increase its effectiveness. The efficient use of resources, determining broad trends and acknowledging recurring problems before they reach a higher level of contention. They also create a base level of information that can be used by the project proponent to report back to the stakeholders.

Monitoring: Depending on the extent of project impacts and the volume of grievances, monitoring measures like internal (identified corporate level staff) and external audits (third party consultants) based on the complexity of the grievances received can be adopted by HFE. The frequency of the audits can be decided upon by the corporate level. Through the review and analysis of each grievance and its analysis of its effectiveness and efficiency HFE can draw on the complaints to evaluate systemic deficiencies. In addition monitoring of the grievance mechanism helps ensure that the design and implementation of the mechanism is adequately responding to stakeholders grievances in a cost effective manner.

Reporting: The grievances that have been received and registered are required to be recorded and regularly updated. A sample of grievance record register has been provided as **Appendix C**. The Community Liaison officer at the site level is responsible for discharging his responsibility of recording and updating the grievances and at the time of their audit should be able to present these documents on account of an audit. Minutes of meetings with all stakeholders, complainants and the Grievance Redressal Committee should be documented for reference purposes. In addition to the monitoring and the reporting thereafter it ensures continual improvement on the company's operation is guaranteed. The monitoring reports are also used as a system to report back to the community members on the action/resolution taken in relation to the grievances and the modification/changes proposed to make it more user-friendly.

8.6.4 Waste Management Plan

8.6.4.1 Scope & Purpose of the Plan

This Waste Management Plan (WMP) identifies the wastes that are likely to be generated during the construction and operation of the proposed Plant and documents waste management practices to be employed for their collection, storage, treatment and/or disposal.

Specifically, the waste covered by this WMP includes the following sources:

- Construction and commissioning of plant and the associated facilities
- Operation of plant and the associated facilities throughout the project life-cycle.
- Temporary accommodation during construction phase for the workers.
- Other operations like equipment maintenance, road construction, site preparation etc.
- Operation and maintenance of infrastructures both during construction and operation phase.

WMP is intended to serve as a guideline for the project proponent & the contractor(s) to manage wastes effectively during construction and operation phase. The contractor(s) should prepare their own WMP in compliance with this WMP and implement the same during the construction phase. CSPGPL should implement the WMP throughout the operational phase.

The WMP describes how wastes will be managed during the construction and operation phase of the project and how the project will:

- Minimize the potential to cause harm to human health and the environment.
- Comply with IFC's PS and with Indian Environmental Regulations.
- Reduce operational costs and 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 the associated facilities will be managed effectively.

8.6.4.2 Waste Characterization

Construction Phase

The waste will generate from construction activities like site clearing, levelling etc. Other categories of waste will be produced daily and comprise of the following:

- Scrap metal;
- Soil waste;
- Food waste from kitchen premises of labour camps;
- Construction debris; and
- Sewage from temporary toilets;

The construction and decommissioning phases will require the use of hazardous materials such as diesel or petrol to cater the fuel equipment and vehicles and maintain equipment. The following hazardous wastes will also be produced from construction activities.

- Oily rags;
- Used oil and oil filters - from generators or vehicle maintenance; and
- Scrap and packaging material.

Operational Phase

Operations and maintenance of the PV power facility is not expected to generate any significant amount of waste. PV panels, array enclosures and inverter/transformer enclosures will not produce waste during operation except the following:

- Defunct solar panels;
- Broken solar panels generated during cleaning and other maintenance activities;
- Fuel requirements like greasing, transformer oil etc.
- Used oil; and
- Oily rags

8.6.4.3 Waste Handling, Management and Disposal

Construction Phase

All wastes produced from the project activities on site will be temporarily stored in designated waste storage areas. All wastes that cannot be reused or recycled will be collected by approved waste contractors and transferred to an appropriately licensed waste management facility for treatment and disposal. Following steps will be taken to manage the waste generation during construction phase:

- Fuel will be stored on site in temporary aboveground storage tanks and will be stored in a locked container within a fenced and secure temporary staging area;
- Trucks and construction vehicles will be serviced off site;
- All concrete mixing be undertaken on impermeable plastic lining to prevent contamination of the soils and surrounding areas;
- Food waste and other refuse are to be adequately deposited in sealable containers and removed from the kitchen frequently to avoid accumulation;
- The use, storage, transport and disposal of hazardous materials used for the project will be carried out in accordance with all applicable regulations;
- All hazardous waste to be disposed of to KSCCB approved vendors;
- Material Safety Data Sheets for all applicable materials present on site will be readily available to on-site personnel;
- All construction debris will be placed in appropriate on-site storage containers and periodically disposed of by a licensed waste contractor;
- The construction contractor will remove refuse collected from the designated waste storage areas at the site at least once a week;
- It is proposed that the Module Developer will supply the required temporary ablution facilities and be responsible for the removal and treatment thereof; and
- Empty fuel containers will also be stored at a secured area designated for scrap and sold to authorized vendors. All packaging material will also be collected at the storage area and sold to scrap dealers.

Operation Phase

Damaged panels would need to be characterized and managed as hazardous waste. Following measures to be taken for management of waste:

- Module Developers need to have buy back agreements for defunct solar panels;
- A designated area needs to be demarcated within the module premises for storage of defunct and broken solar panels with restricted access and on impervious surface;
- All fuel storage should be equipped with secondary containment and spillage trays;
- It is to be ensured that authorization for hazardous waste storage and generation has been taken from KSPCB;
- All used oil is required to send off to KSPCB approved vendors and recyclers; and
- Transportation of defunct solar panels is required to be undertaken as per the procedures specified by the Manufacture of Solar Panels.
- Handling of Broken Solar Modules generated due to cleaning and other maintenance activities

- Broken or damaged solar panels are required to be shifted to a designated area in scrap yard to avoid any type of land contamination;
- The designated area should be isolated and to be established on an impervious surface;
- Proper PPE are provided to the workers handling the broken solar panels;
- The workers at site are also on regular basis appraised about the potential health risks associated with handling of solar panels.

8.6.5 Environment and Social Management Plan

The ESMP aims at ensuring the implementation of proposed mitigation and monitoring measures along with the responsible entity for implementation. Although the ESIA process does not reveal any significantly high adverse impacts due to the project, the following Table provides mitigation measures that further reduce the severity of identified adverse impacts on land and environment due to the project activities.

Table 8-8: Proposed Environment and Social Management Plan

S. No	Potential Impact/ Activity	Proposed Mitigation Measures	Monitoring Requirement	Responsibility
Site Preparation and Construction Phase				
1	Soil Quality	<ul style="list-style-type: none"> • Removal of vegetation and soil cover will be restricted to only those areas necessary for the development; • Stockpiles will be covered to reduce soil loss as a result of wind or water erosion. • Work areas will be clearly defined. • Fuel, lubricating oil and used oil storage areas will be contained in bunds of 110 percent capacity of the stored material. • Spill containment and clean up kits will be available onsite and clean-up from any spill will be appropriately contained and disposed. • Construction vehicles and equipment will be serviced regularly and off site. • Construction vehicles will remain on designated and prepared compacted gravel roads. 	<p>Visual inspection of storage material.</p> <p>Storage location of fuel, lubricating and used oil.</p>	CSPGPL to ensure compliance by construction contractors and sub-contractors
2	Water Resource, Storage and Quality	<ul style="list-style-type: none"> • The natural slope of the site will be maintained to the extent possible in order to avoid any change in the drainage pattern. • Open channel located in north of the site will not get disturbed due to construction activities in the site premises by ensuring that no waste is disposed. • Storm water flow will be directed to the existing channel and pond with silt traps to avoid sedimentation; • It is recommended that surface water quality of the water in the man-made pond within the project site is checked for basic drinking water parameters (pH and alkalinity as well) to ensure it is not contaminated due to surface run-off or other construction debris; • It is to be ensured that pre-treatment is provided to ground water (after taking pre-requisite approvals) if it is utilized for drinking; • Portable toilets provided shall be self-contained and cleaned and disinfected on weekly basis by cleaners hired by construction contractor; 	<p>Testing of ground water quality for drinking water standards.</p> <p>Visual inspection of natural drainage lines to check contamination or flow of sediments</p> <p>Testing of water in man-made pond</p>	CSPGPL to ensure compliance by construction contractors and sub-contractors
3	Air Quality	<ul style="list-style-type: none"> • Sprinkling of water is being carried out to suppress dust from construction, stock piles and transport movement; • All stock piles are covered and storage areas provided with enclosures to minimize dust from 	Undertake ambient air quality monitoring at construction locations and at	CSPGPL to ensure compliance by construction contractors and sub-contractors

S. No	Potential Impact/ Activity	Proposed Mitigation Measures	Monitoring Requirement	Responsibility
		<p>open area source;</p> <ul style="list-style-type: none"> Open burning of solid waste or packaging material will be strictly prohibited; Vehicles engaged for the project will be required to obtain "Pollution under Control" (PUC) certificates. Sufficient stack height needs to be provided to D.G. sets as per CPCB norms. 	labour camp (PM ₁₀ , PM _{2.5} NOx and SOx)	
4	Ecology	<ul style="list-style-type: none"> Activities generating high noise will be restricted to day time and will be mitigated to minimize the noise level outside the site boundary. Recovery of vegetation under the PV panels and in other places that do not need to remain cleared should be encouraged. Movement of construction and transport vehicles will be restricted to dedicated paths to minimize any harm to small mammals within the site. Transportation of construction material will be kept to day time hours in order to minimize noise and disturbance to fauna in the area. 	The entire workforce shall be sensitized (by the construction contractor) to possible adverse ecological impacts during the construction phase by conducting awareness programs.	CSPGPL to ensure compliance by construction contractors and sub-contractors
5	Generation of Noise	<ul style="list-style-type: none"> Instruct its contractor to arrange for inherently quiet construction equipment and machines to maintain the noise level to minimum. Only limited construction activities shall be carried out during night-time. The hours of operation for specific pieces of equipment or operations, especially mobile sources operating through community areas should be limited. It is also to be ensured that village road connecting Machnur and Singaddinni village is not utilized for movement of equipments reducing project traffic through community areas. All loud and sudden noises will be avoided wherever possible and fixed noise sources shall be located at least 50m away from the site boundary. Rubber padding/noise isolators will be used for construction equipment/machinery. Temporary noise barriers shall be provided surrounding the high noise generating construction equipment. PPEs will be provided. Construction vehicles and machinery will be well maintained and not kept idling when not in use. 	<p>Installation of Temporary noise barriers</p> <p>Usage of PPEs in high noise areas.</p>	CSPGPL to ensure compliance by construction contractors and sub-contractors
6	Traffic and Transport	<ul style="list-style-type: none"> It is recommended that the proposed access road is constructed prior to site clearance activities. Only trained drivers with valid license shall be recruited by the construction contractor. Training programs shall be conducted for all the drivers for raising awareness about road safety. Regular maintenance of vehicles and use of manufacturer approved parts should be adopted to minimize potentially serious accidents. 	Monitor Vehicles PUC certificates; Training Records of Drivers Engaged to be maintained	CSPGPL to ensure compliance by construction contractors and sub-contractors
7	Occupational Health and Safety	<ul style="list-style-type: none"> CSPGPL shall formulate a site specific Emergency Preparedness and Response 	Records and details of PPE usage, Work	CSPGPL to ensure

S. No	Potential Impact/ Activity	Proposed Mitigation Measures	Monitoring Requirement	Responsibility
		<p>Procedure.</p> <ul style="list-style-type: none"> CSPGPL shall ensure that adequate training is provided to staff about raising awareness about use of Personal Protection Equipment (PPE) and emergency response measures. CSPGPL shall introduce administrative controls into work processes such as job rotation, rest and stretch breaks etc to reduce overexertion. Work site layout will be well planned to avoid manual transfer of heavy loads. It shall also ensure good housekeeping at the construction site to avoid slips and falls. Excessive waste debris and liquid spills will be cleaned up regularly. PPEs such as safety glasses with side shields, face shields, hard hats and safety shoes shall be mandatory at construction site. Ear plugs shall be provided for workers placed at high noise areas. 	<p>permits, First Aid and regulatory compliances should be maintained.</p> <p>Accident/ Incident reporting and corrective actions taken</p>	<p>compliance by construction contractors and sub-contractors</p>
8	Solid Waste Generation	<ul style="list-style-type: none"> Arrangements for collection of garbage in dustbins and daily disposal to the nearest dumpsite shall be made. Provision of separate toilets for male and female workers (if any) in the ratio of 1:15 and 1:10 (toilet to workers) respectively shall be made; Washing and bathing areas will be provided with proper drainage system so that wastewater is not accumulated in the campsites; Waste/used oil generated from generators and construction machinery and equipment will be stored on paved surface in a secure location at the project site. Appropriate secondary containment capable of containing the 110 percent of the largest tank to be provided; The waste oil, which is characterized as hazardous according to Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016, will be sold to KSPCB approved vendors at frequent intervals; Empty paint containers will also be stored at a secured area designated for scrap and sold to authorized vendors; All packaging material will also be collected at the storage area and sold to scrap dealers. Construction debris and excavated material will be stored in a confined area to prevent spread by wind or water. The construction debris will be used for backfilling of excavated areas and for foundation works at site and excess soil will be given to the local villagers for filling up of low lying areas in the vicinity. The scrap metal waste generated from erection of structures and related construction activities will be collected and stored separately in a stack yard and sold to local recyclers. 	<p>Visual Inspection of storage areas of hazardous waste.</p> <p>Weekly labour camp inspection.</p>	<p>CSPGPL to ensure compliance by construction contractors and sub-contractors</p>
9	Procurement of Land	<ul style="list-style-type: none"> The land sellers would receive payments more than prevailing market rate in the area as a negotiated settlement will offer adequate and fair price for land and/or other assets. There has been no loss of livelihood for the project affected households as the land was not 	<p>Maintenance of all sale deeds</p>	<p>CSPGPL to ensure compliance by construction contractors and sub-contractors</p>

S. No	Potential Impact/ Activity	Proposed Mitigation Measures	Monitoring Requirement	Responsibility
		cultivated from many years.		
	Influx of Migrant Labours	<ul style="list-style-type: none"> Engage local population as workforce in the construction activity, as far as possible; It should be ensured that the labour camp should have basic amenities such as electricity, drinking water, health and sanitation facility, kitchen and rest room; The labour camp will be equipped with septic tank and soak pits and avoid presence of stagnant water is a factor of proliferation of potential disease vectors such as mosquitoes; Security staff have a clear mandate and have received clear instruction about their duties and responsibilities; Where possible, an adequate transport system to surrounding communities will be provided. CSPGPL through the contractor agreement with the contractor shall ensure that the construction contractors commit and adhere to social obligations including community relations, handling complaints and grievances, adherence to labour laws and international commitments etc. The contractor shall provide adequate information to workers on expected social behaviour and hygiene practices to be followed at site. The contractor shall ensure that no child or forced labour is engaged by contractors and all wage payments are done without any discriminations or delays by the contractors; The contractor to ensure local contracting and vendor opportunities as far as possible; The contractor should undertake medical test of the contract workers prior to engagement to identify any communicable disease. 	<p>Records related to wages, age, leave etc. to be maintained;</p> <p>HSE training sessions for all workmen/staffs</p>	CSPGPL to ensure compliance by construction contractors and sub-contractors
10	Archaeological, Historic and Cultural Aspects	<ul style="list-style-type: none"> Also, thirteen (13) Neem Trees present within the site premises and will not be removed. It will be ensured that continuous access is provided to the locals to worship the Babul Tree. It is recommended that a Memorandum of Understanding (MoU) with the Gram Panchayats in the study area is executed for the provision of continued access. 	Provision of clear access all the time	CSPGPL to ensure compliance by construction contractors and sub-contractors
Operation Phase				
1	Visual Aesthetics	<ul style="list-style-type: none"> The solar panels will be installed at a low height and will be kept closer to the ground so that it does not prop out of the general landscape of the area. The panels will be arranged in a systematic manner which will give an aesthetic sense to it. 	Records of grievances received pertaining to visual conflicts.	CSPGPL
2	Water resource and quality	<ul style="list-style-type: none"> The plant site will be provided with adequate drainage facility to drain off wash wastewater and prevent any water-logging at site or in the surroundings. Wastage of water during cleaning of panels shall be avoided. Various factors such as tilt angle, orientation and tracking are required to be monitored for efficient cleaning of modules. Ground water shall be extracted only after getting proper approvals from competent 	<p>Ground water sample testing at the project site location.</p> <p>Details of rain water harvesting</p>	CSPGPL

S. No	Potential Impact/ Activity	Proposed Mitigation Measures	Monitoring Requirement	Responsibility
		<p>authority.</p> <ul style="list-style-type: none"> It is to be ensured that water tankers required during operation phase are sourced from authorised vendor. Rainwater harvesting system by making recharge pits shall be utilised to recharge the ground water. The water harvested will be directed to a recharge pit. CSPGPL should ensure that rain water collected from the project site will be utilized to recharge the ground water through onsite rain water harvesting tank/pits. Water use and harvesting/recharging in the project will be a key performance indicator that will be monitored through operation phase of the project. 		
3	Ecology	<ul style="list-style-type: none"> Vegetation clearing through brush cutting for maintenance activities will be done manually wherever possible. Any cleared areas which do not have some vegetation cover to protect the soil will be revegetated with locally occurring species and monitored to ensure recovery is taking place. Vegetation that needs to be reduced in height will be mowed or brush-cut to an acceptable height, and not to ground level except where necessary. Solar panels will have an anti-reflective coating to minimize the light reflecting off of the panels. 	Training the vegetation controlling and cleaning manpower on long term issues of herbicide usage.	CSPGPL
4	Soil Quality	<ul style="list-style-type: none"> Ensure proper restoration of soil wherever excavation is undertaken. Explore the option of buyback agreements for defunct panels and for replacement and disposal of transformer oil by the supplier, otherwise will make arrangements for disposal of defunct panels and waste oil by Karnataka State pollution Control Board (KSPCB) authorised recyclers. Broken or damaged solar panels will immediately be shifted to a designated area in scrap yard to avoid land contamination. These broken cells once collected to a certain number will be sent back to the manufacturer with the photographs taken for proper and safe disposal. 	<p>Awareness and training about the procedure for proper storage and disposal waste oil and how to act in case of accidental oil spillage;</p> <p>Buy Back agreements for defunct solar panels</p>	CSPGPL
5	Health and Safety	<ul style="list-style-type: none"> Regular electrical safety training to workers; Implement Lock out/ Tag Out (LOTO) system; Use work equipment or other methods to prevent a fall from occurring. Personal Protective Equipment (PPEs). should be provided to workers handling electricity and related components; The transformer yard should be provided with fire extinguishers and sand buckets Employees involved in electrical works shall be trained in and familiar with the safety-related work practices, safety procedures and other safety requirements that pertain to their respective job assignments; and An accident reporting and monitoring record shall be maintained. 	<p>Workers to be trained for use of Personal Protection Equipment and its importance.</p> <p>All safety related incidents will be recorded and monitored.</p> <p>Training to be provided to the workers regarding health and safety procedures.</p>	CSPGPL
6	Impacts on economy	<ul style="list-style-type: none"> Details of community development activities 	Undertaking	CSPGPL

S. No	Potential Impact/ Activity	Proposed Mitigation Measures	Monitoring Requirement	Responsibility
	Upgradation of local Infrastructure	should be shared with the Panchayat of the village.	Community Development Activities according to the plan Stakeholder Engagement and Grievances received	

Decommissioning Phase

1	Impact on Air, Soil, Noise, Ecology and Socio-Economic Aspects	<ul style="list-style-type: none"> The proponent shall inform the workers and local community about the duration of work; The workers shall be clearly informed about the expected schedule and completion of each activity; A transparent mechanism shall be prepared wherever choice is to be made between individuals of similar capability; All waste generated from decommissioning phase shall be collected and disposed off at the nearest municipal disposal site; All necessary Personal Protection Equipment (PPE) shall be used by the workers during demolition work; CSPGPL will be committed to ensure all health and safety measures are in place to prevent accidents and/or reduce the consequences of non-conformance events; Institution of suitable training modules for project-personnel and labour contractors involved in the dismantling process to ensure avoidance or minimization of solar panel damage as far as possible and adherence to appropriate decontamination protocols in the event of any unavoidable damage and adhere to proper safe disposal methods. 	Information to workers/staffs of close down; Training on safe handling of bulk hazardous wastes generated at site	CSPGPL
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8.6.6 Environment Monitoring Programme

Regular monitoring of environmental aspects is important to assess the status of environment during the operation phase of the project. The monitored data can serve as an indicator for any change in environmental quality due to the project with respect to baseline environmental conditions; so that suitable mitigation could be taken in time to safeguard the environment.

Monitoring indicators have been developed for each of the activity considering the mitigation measures proposed. Monitoring results would be documented, analysed and reported internally. Monitoring requirements (including monitoring frequency) have been presented in **Table 8-9**.

Table 8-9: Environmental Performance Monitoring

S. No	Environment Performance Indicator (EPI)	Monitoring Parameter	Period & Frequency
A Construction Phase			
1	Dust generated from site clearance/ levelling	<ul style="list-style-type: none"> Visual observation of dust generation 	Daily during site preparation
2	Noise emissions from vehicles and machineries	<ul style="list-style-type: none"> Noise pressure level in dB(A) Compliance with CPCB noise limits specified for DG sets Check for valid certificates of Type Approval and also valid certificates of Conformity of Production for 	Quarterly during site Preparation Daily during construction phase

S. No	Environment Performance Indicator (EPI)	Monitoring Parameter	Period & Frequency
		equipment particularly DG sets • Volume of water sourced and consumed	
3	Fugitive emissions from handling and storage of raw materials	• Visual observation	Daily during construction phase
4	Community health and safety	• Complaints registered by the local communities • No. of. Accidents	Monthly during Construction phase
5	Occupational health and safety	• Health surveillance of workers • Sanitation status of labour camps and canteen • Potable nature of drinking water viz. coliform, pH, TSS, Residual chlorine • Usage of proper PPEs • Safety performance indicators viz. LTIs. Near misses, fatalities etc.	Monthly during construction phase Daily during construction phase
6	Disposal of sewage	• Visual observation of leaks, Overflows etc. • Odour	Daily during construction phase
7	Surface run-off Discharge Domestic waste generation, storage, handling and disposal	• Visual observation of water logging due to drainage disruption • CPCB Inland Water Discharge Parameters • Quantity of waste generated and recycled • Visual observation of waste segregation and storage conditions viz. usage of labelled and covered bins, insect repellents etc. • Awareness level of onsite workers • Monitoring of water collected in man- made pond	Weekly during construction phase Twice during construction phase (middle and end of the construction)
8	Hazardous chemicals and waste storage, handling and disposal	• Visual observation of chemical storage conditions viz. presence of spill kits, drip trays, fire extinguisher and display of MSDS etc. • Quantity of waste oil and other hazardous waste generated and recycled to registered recyclers • Awareness level of onsite workers	Weekly during construction phase
9	Labour Camp Inspection	• Visual inspection of labour camp for accommodation facilities, provision of toilets, housekeeping etc	Weekly during construction phase
B Operation Phase			
1	Fugitive emissions	• Visual observation of dust generated • Water sprinkling details viz. frequency and quantity	Daily during operational phase
2	Community health and safety	• Complaints registered by the local communities • No. of. Accidents	Monthly during operational phase
3	Occupational health and safety	• Health surveillance of staffs and other workers • Sanitation status of onsite office building and canteen • Potable nature of drinking water viz. coliform, pH, TSS, residual chlorine • Usage of proper PPEs • Safety performance indicators viz. Near misses, fatalities etc.	Monthly during operational phase Daily during operational phase

9 CONCLUSION AND RECOMMENDATIONS

The Environmental and Social Assessment study for the proposed 50 MW solar power project in Raichur District of Karnataka has been undertaken in accordance with IFC's Performance Standards and World Bank's Environment Health and Safety (EHS) Guidelines.

The ESIA study aimed to identify and evaluate potential environmental impacts associated with all aspects of the proposed project. The conclusion and recommendations of this study are result of on-site inspections, the evaluation of impacts identified by specialists, and the process of stakeholder consultation. The impacts due to the project is site specific and reversible owing to the construction activities and availability of land with is suitable for establishing the proposed project due to land use and lack of rainfall.

The project is assessed to generate limited environmental and social impacts owing to construction related activity which will not extend beyond Solar PV Foot Prints, procurement of private land based on 'willing buyer-willing seller' for project development. Mitigation measures for potential impacts on various environmental and socio-economics have been specified through:

- Follow up of best practice of compensation, stakeholder engagement, and grievance management;
- Planning & designing of Solar Power plant, site preparation and access route, construction, drainage, traffic movement etc.;
- Application of standards for Health and Safety; and
- Clearances and permits required for each sub activity

The proposed Environmental and Social Management Plan describe implementation mechanism for recommended mitigation measures together with monitoring to verify overall project performance. The implementation of the mitigation measures including monitoring schedule will provide a basis for ensuring that the potential positive and negative impacts associated with the establishment of the Power Plant are taken care off. This ESIA study together with mitigation measures and follow up of recommendations on management actions will help CSPGPL and the EPC contractor in complying with the environmental standards and meet the IFC performance standards.

The Project is a renewable energy project which uses solar energy for power generation. Renewable energy projects are considered to be cleaner compared to fossil fuel based energy projects. In accordance to the screening criteria of IFC, AECOM has categorized Project as '**Category B**', which specifies that the project can cause potential and limited adverse social or environmental impacts which are generally site-specific, largely reversible and readily addressed through mitigation measures. The rationale for categorisation being:

- The potential environmental impacts on surface and groundwater due to a change in drainage network on the site and potential spills of contaminants is assessed to be of negligible significance;
- Land procurement was based on 'willing buyer-willing seller' with compensation more than prevailing market rates;
- The site is not located in an ecologically sensitive area or forest land;
- There are no issues of resettlement and rehabilitation;
- The project will bring positive impacts through the creation of direct employment and training opportunities which will induce economic benefits;
- The duration and extent of construction activities will also limited; thereby resulting in minimal environmental and social impacts;
- Village road will not be used for movement of project components and access to the roads will not be restricted during construction and operation phase of the project; and
- Any adverse environmental and social impacts may be readily addressed through mitigation measures as outlined in the Environmental and Social Management Plan (ESMP).

Appendix A : List of Land Sellers for the Proposed Project

SI No	Survey No	Land Owner Name	Land Extent	
			Acres	Guntas
1	110	Vaishali	17	35
2	111	Dodda Sharanappa	10	3
3	112	Chennamma	19	29
4	113	D.Sharanappa	16	33
5	114	Madhumathi	11	38
6	115/A	Vaishali	7	30
7	116/1	Jayappa	7	39
8	116/2	Linganagowda	7	39
9	117	Mruthyunjaya	16	25
10	118	Ajay	17	8
11	119	Shailaja	20	5
12	132	Vishwanath	18	5
13	133	Dr Shivappa Malipatil	13	7
14	130/VU	Pampanna	4	27
15	122/	Chandrashekarappa Eshwarappa	15	9
16	121/A	Virupakshappa	5	7
17	121/AA	Basanna	5	7
18	120/E	Basamma	4	25
19	120/2	Basanna	4	20
20	120/3	Veerendra Patil	4	20
21	115/EE	Venkatesh	6	20
22	115/AA	Jayalakshmi	6	0
23	120/4	Sugappa	4	29
24	121/EE	Mallikarjun	5	9
25	121/E	Shanthamma	5	7
26	66/AA	Virupakshi	8	26
27	130/A	Vaishali	3	4
28	108	Amarnath	13	26
29	134/2	Dr Shivappa Mali Patil	4	8
	115/E	Sushila	0	0.22
		Total	273	540.22
		Total Extent in Acres	287.02 Acres	

Appendix B :List of Fauna in the Study Area

Table 1: Mammals of the Study Area

Sr. No.	Scientific Name	Common Name	IUCN Status*	WPA Schedule**
1	<i>Macaca radiata</i>	Bonnet Macaque	LC	II
2	<i>Semnopithecus dussumieri</i>	Southern Plains Grey Langur	LC	II
3	<i>Muntiacus muntjak</i>	Indian Muntjac	LC	III
4	<i>Boselaphus tragocamelus</i>	Blue Bull	LC	III
5	<i>Tetracerus quadricornis</i>	Four-horned Antelope	VU	I
6	<i>Antilope cervicapra</i>	Blackbuck	NT	I
7	<i>Sus scrofa</i>	Indian Wild Pig	LC	III
8	<i>Panthera pardus</i>	Common Leopard	VU	I
9	<i>Felis chaus</i>	Jungle Cat	LC	II
10	<i>Prionailurus rubiginosus</i>	Rusty Spotted Cat	NT	I
11	<i>Paradoxurus hermaphroditus</i>	Common Palm Civet	LC	II
12	<i>Viverricula indica</i>	Small Indian Civet	LC	II
13	<i>Herpestes edwardsii</i>	Grey Mongoose	LC	II
14	<i>Herpestes smithii</i>	Ruddy Mongoose	LC	II
15	<i>Hyaena hyaena</i>	Striped Hyaena	NT	III
16	<i>Canis lupus</i>	Grey Wolf	LC	I
17	<i>Canis aureus</i>	Golden Jackal	LC	II
18	<i>Vulpes benghalensis</i>	Indian Fox	LC	II
19	<i>Mellivora capensis</i>	Honey Badger	LC	I
20	<i>Aonyx cinerea</i>	Asian Small-clawed Otter	VU	I
21	<i>Lepus nigricollis</i>	Indian Hare	LC	IV
22	<i>Manis crassicaudata</i>	Indian Pangolin	EN	I
23	<i>Anathana ellioti</i>	Southern Tree Shrew	LC	-
24	<i>Suncus murinus</i>	House Shrew	LC	-
25	<i>Suncus etruscus</i>	Pygmy White-toothed Shrew	LC	-
26	<i>Hystrix indica</i>	Indian Crested Porcupine	LC	IV
27	<i>Funambulus palmarum</i>	Three-striped Palm Squirrel	LC	IV
28	<i>Tatera indica</i>	Indian Gerbil	LC	V
29	<i>Vandeleuria oleracea</i>	Indian Long-tailed Tree Mouse	LC	V
30	<i>Mus musculus</i>	House Mouse	LC	V
31	<i>Mus booduga</i>	Little Indian Field Mouse	LC	V
32	<i>Millardia meltada</i>	Soft-furred Field Rat	LC	V
33	<i>Madromys blanfordi</i>	White-tailed Wood Rat	LC	V
34	<i>Golunda ellioti</i>	Indian Bush Rat	LC	V
35	<i>Bandicota indica</i>	Large Bandicoot Rat	LC	V
36	<i>Bandicota bengalensis</i>	Lesser Bandicoot Rat	LC	V
37	<i>Rattus rattus</i>	House Rat	LC	V
38	<i>Megaderma lyra</i>	Greater False Vampire Bat	LC	-
39	<i>Hipposideros lankadiva</i>	Kelaart's Leaf-nosed Bat	LC	-

*Status assigned by the International Union for Conservation of Nature and Natural Resources, where EN – Endangered; NT – Near Threatened; VU – Vulnerable; LC – Least Concern; DD – Data Deficient

**Schedules I to VI: Indian Wildlife (Protection) Act, 1972.

Sources: Vivek Menon (2014), *Indian Mammals: A Field Guide*. Hachette Book Publishing India Pvt. Ltd., Gurgaon, India, pp 1-522; IUCN (2017). *The IUCN Red List of Threatened Species. Version 2017-1*.

Table 2: Resident Birds of the Study Area

Sr. No.	Scientific Name	Common Name	IUCN Status*	WPA Schedule**
1	<i>Fringilla pictus</i>	Painted Francolin	LC	IV
2	<i>Fringilla pondicerianus</i>	Grey Francolin	LC	IV
3	<i>Coturnix chinensis</i>	King Quail	LC	IV
4	<i>Perdula asiatica</i>	Jungle Bush Quail	LC	IV

5	<i>Perdicula argoondah</i>	Rock Bush Quail	LC	IV
6	<i>Galloperdix spadicea</i>	Red Spurfowl	LC	IV
7	<i>Galloperdix lunulata</i>	Painted Spurfowl	LC	IV
8	<i>Pavo cristatus</i>	Indian Peafowl	LC	I
9	<i>Dendrocygna javanica</i>	Lesser Whistling Duck	LC	IV
10	<i>Sarkidiornis melanotos</i>	Knob-billed Duck	LC	IV
11	<i>Nettapus coromandelianus</i>	Cotton Pygmy Goose	LC	IV
12	<i>Anas poecilorhyncha</i>	Indian Spot-billed Duck	LC	IV
13	<i>Tachybaptus ruficollis</i>	Little Grebe	LC	IV
14	<i>Mycteria leucocephala</i>	Painted Stork	NT	IV
15	<i>Ciconia episcopus</i>	Woolly-headed Stork	VU	IV
16	<i>Threskiornis melanocephalus</i>	Black-headed Ibis	NT	IV
17	<i>Pseudibis papillosa</i>	Red-naped Ibis	LC	IV
18	<i>Platalea leucorodia</i>	Eurasian Spoonbill	LC	I
19	<i>Butorides striata</i>	Striated Heron	LC	IV
20	<i>Nycticorax nycticorax</i>	Black-crowned Night Heron	LC	IV
21	<i>Ardeola grayii</i>	Indian Pond Heron	LC	IV
22	<i>Ardea purpurea</i>	Purple Heron	LC	IV
23	<i>Bubulcus ibis</i>	Cattle Egret	LC	IV
24	<i>Casmerodius albus</i>	Great Egret	LC	IV
25	<i>Mesophoyx intermedia</i>	Intermediate Egret	LC	IV
26	<i>Egretta garzetta</i>	Little Egret	LC	IV
27	<i>Falco jugger</i>	Laggar Falcon	LC	I
28	<i>Elanus caeruleus</i>	Black-winged Kite	LC	IV
29	<i>Milvus migrans</i>	Black Kite	LC	IV
30	<i>Haliastur indus</i>	Brahminy Kite	LC	IV
31	<i>Pernis ptilorhynchus</i>	Oriental Honey Buzzard	LC	IV
32	<i>Neophron percnopterus</i>	Egyptian Vulture	EN	IV
33	<i>Gyps bengalensis</i>	White-rumped Vulture	CR	I
34	<i>Gyps indicus</i>	Indian Vulture	CR	I
35	<i>Sarcogyps calvus</i>	Red-headed Vulture	CR	IV
36	<i>Circaetus gallicus</i>	Short-toed Snake Eagle	LC	IV
37	<i>Spilornis cheela</i>	Crested Serpent Eagle	LC	IV
38	<i>Accipiter badius</i>	Shikra	LC	I
39	<i>Butastur teesa</i>	White-eyed Buzzard	LC	IV
40	<i>Aquila rapax</i>	Tawny Eagle	LC	IV
41	<i>Aquila fasciata</i>	Bonelli's Eagle	LC	IV
42	<i>Nisaetus cirrhatu</i>	Crested Hawk Eagle	LC	IV
43	<i>Ardiotis nigriceps</i>	Great Indian Bustard	CR	I
44	<i>Sypheotides indicus</i>	Lesser Florican	EN	I
45	<i>Amauornis phoenicurus</i>	White-breasted Waterhen	LC	IV
46	<i>Amauornis akool</i>	Brown Crake	LC	IV
47	<i>Turnix sylvaticus</i>	Small Buttonquail	LC	IV
48	<i>Turnix suscitator</i>	Barred Buttonquail	LC	IV
49	<i>Porphyrio porphyrio</i>	Purple Swamphen	LC	IV
50	<i>Gallinula chloropus</i>	Common Moorhen	LC	IV
51	<i>Fulica atra</i>	Eurasian Coot	LC	IV
52	<i>Burhinus (oedicnemus) indicus</i>	Indian Thick-knee	LC	-
53	<i>Esacus recurvirostris</i>	Great Thick-knee	LC	-
54	<i>Hydrophasianus chirurgus</i>	Pheasant-tailed Jacana	LC	IV
55	<i>Metopidius indicus</i>	Bronze-winged Jacana	LC	IV
56	<i>Vanellus malabaricus</i>	Yellow-wattled Lapwing	LC	IV
57	<i>Vanellus indicus</i>	Red-wattled Lapwing	LC	IV
58	<i>Charadrius dubius</i>	Little Ringed Plover	LC	IV
59	<i>Rostratula benghalensis</i>	Greater Painted Snipe	LC	IV
60	<i>Cursorius coromandelicus</i>	Indian Courser	LC	-
61	<i>Glareola lactea</i>	Small Pratincole	LC	-

62	<i>Sterna aurantia</i>	River Tern	LC	-
63	<i>Chlidonias hybrid</i>	Whiskered Tern	LC	-
64	<i>Pterocles exustus</i>	Chestnut-bellied Sandgrouse	LC	IV
65	<i>Pterocles indicus</i>	Painted Sandgrouse	LC	IV
66	<i>Columba livia</i>	Common Pigeon	LC	-
67	<i>Streptopelia orientalis</i>	Oriental Turtle Dove	LC	IV
68	<i>Streptopelia decaocto</i>	Eurasian Collared Dove	LC	IV
69	<i>Streptopelia tranquebarica</i>	Red-collared Dove	LC	IV
70	<i>Stigmatopelia chinensis</i>	Spotted Dove	LC	IV
71	<i>Stigmatopelia senegalensis</i>	Laughing Dove	LC	IV
72	<i>Treron phoenicopterus</i>	Yellow-footed Green Pigeon	LC	IV
73	<i>Psittacula krameri</i>	Rose-ringed Parakeet	LC	IV
74	<i>Psittacula cyanocephala</i>	Plum-headed Parakeet	LC	IV
75	<i>Hieracoccyx varius</i>	Common Hawk Cuckoo	LC	IV
76	<i>Coccyzus passerines</i>	Grey-bellied Cuckoo	LC	IV
77	<i>Eudynamis scolopaceus</i>	Asian Koel	LC	IV
78	<i>Rhopodytes viridirostris</i>	Blue-faced Malkoha	LC	IV
79	<i>Taccocua leschenaultia</i>	Sirkeer Malkoha	LC	IV
80	<i>Centropus (sinensis) parroti</i>	Southern Coucal	LC	IV
81	<i>Tyto alba</i>	Barn Owl	LC	IV
82	<i>Glaucidium radiatum</i>	Jungle Owlet	LC	IV
83	<i>Athene brama</i>	Spotted Owlet	LC	IV
84	<i>Bubo bubo</i>	Eurasian Eagle Owl	LC	IV
85	<i>Ketupa zeylonensis</i>	Brown Fish Owl	LC	IV
86	<i>Strix ocellata</i>	Mottled Wood Owl	LC	IV
87	<i>Caprimulgus asiaticus</i>	Indian Nightjar	LC	IV
88	<i>Caprimulgus affinis</i>	Savannah Nightjar	LC	IV
89	<i>Cypsiurus balasiensis</i>	Asian Palm Swift	LC	-
90	<i>Hemiprocne coronata</i>	Crested Tree Swift	LC	-
91	<i>Apus affinis</i>	Little Swift	LC	-
92	<i>Upupa epops</i>	Common Hoopoe	LC	IV
93	<i>Coracias bengalensis</i>	Indian Roller	LC	IV
94	<i>Halcyon smyrnensis</i>	White-throated Kingfisher	LC	IV
95	<i>Alcedo atthis</i>	Common Kingfisher	LC	IV
96	<i>Ceryle rudis</i>	Pied Kingfisher	LC	IV
97	<i>Merops orientalis</i>	Green Bee-eater	LC	-
98	<i>Ocyrceros birostris</i>	Indian Grey Hornbill	LC	-
99	<i>Megalaima zeylanica</i>	Brown-headed Barbet	LC	IV
100	<i>Megalaima haemacephala</i>	Coppersmith Barbet	LC	IV
101	<i>Dendrocopos nanus</i>	Brown-capped Pygmy Woodpecker	LC	IV
102	<i>Dendrocopos mahattensis</i>	Yellow-crowned Woodpecker	LC	IV
103	<i>Dinopium benghalense</i>	Lesser Goldenback	LC	IV
104	<i>Tephrodornis pondicerianus</i>	Common Woodshrike	LC	IV
105	<i>Artamus fuscus</i>	Ashy Woodswallow	LC	IV
106	<i>Coracina macei</i>	Large Cuckooshrike	LC	IV
107	<i>Aegithina tiphia</i>	Common Iora	LC	IV
108	<i>Pericrocotus cinnamomeus</i>	Small Minivet	LC	IV
109	<i>Lanius vittatus</i>	Bay-backed Shrike	LC	-
110	<i>Lanius schach</i>	Long-tailed Shrike	LC	-
111	<i>Lanius meridionalis</i>	Southern Grey Shrike	LC	-
112	<i>Dicrurus macrocercus</i>	Black Drongo	LC	IV
113	<i>Dicrurus caerulescens</i>	White-bellied Drongo	LC	IV
114	<i>Oriolus xanthornus</i>	Black-hooded Oriole	LC	IV
115	<i>Rhipidura aureola</i>	White-browed Fantail	LC	-
116	<i>Dendrocitta vagabunda</i>	Rufous Treepie	LC	IV
117	<i>Corvus (macrorhynchus) culminatus</i>	Indian Jungle Crow	LC	IV
118	<i>Corvus splendens</i>	House Crow	LC	V

119	<i>Ptyonoprogne concolor</i>	Dusky Crag Martin	LC	-
120	<i>Petrochelidon fluvicola</i>	Streak-throated Swallow	LC	-
121	<i>Hirundo smithii</i>	Wire-tailed Swallow	LC	-
122	<i>Ammomanes phoenicura</i>	Rufous-tailed Lark	LC	IV
123	<i>Eremopterix griseus</i>	Ashy-crowned Sparrow Lark	LC	IV
124	<i>Galerida deva</i>	Sykes's Lark	LC	IV
125	<i>Alauda gulgula</i>	Oriental Skylark	LC	IV
126	<i>Pycnonotus cafer</i>	Red-vented Bulbul	LC	IV
127	<i>Pycnonotus luteolus</i>	White-browed Bulbul	LC	IV
128	<i>Prinia hodgsonii</i>	Grey-breasted Prinia	LC	-
129	<i>Prinia sylvatica</i>	Jungle Prinia	LC	-
130	<i>Prinia socialis</i>	Ashy Prinia	LC	-
131	<i>Prinia inornata</i>	Plain Prinia	LC	-
132	<i>Cisticola juncidis</i>	Zitting Cisticola	LC	-
133	<i>Orthotomus sutorius</i>	Common Tailorbird	LC	-
134	<i>Dumetia hyperythra</i>	Tawny-bellied Babbler	LC	IV
135	<i>Turdoides caudata</i>	Common Babbler	LC	IV
136	<i>Turdoides malcolmi</i>	Large Grey Babbler	LC	IV
137	<i>Turdoides striata</i>	Jungle Babbler	LC	IV
138	<i>Turdoides affinis</i>	Yellow-billed Babbler	LC	IV
139	<i>Chrysomma sinense</i>	Yellow-eyed Babbler	LC	IV
140	<i>Zosterops palpebrosus</i>	Oriental White-eye	LC	IV
141	<i>Acridotheres tristis</i>	Common Myna	LC	IV
142	<i>Sturnia pagodarum</i>	Brahminy Starling	LC	IV
143	<i>Zoothera citrina</i>	Orange-headed Thrush	LC	-
144	<i>Copsychus saularis</i>	Oriental Magpie Robin	LC	IV
145	<i>Saxicoloides fulcatus</i>	Indian Robin	LC	IV
146	<i>Saxicola caprata</i>	Pied Bushchat	LC	IV
147	<i>Cyornis tickelliae</i>	Tickell's Blue Flycatcher	LC	IV
148	<i>Chloropsis jerdoni</i>	Jerdon's Leafbird	LC	IV
149	<i>Dicaeum agile</i>	Thick-billed Flowerpecker	LC	IV
150	<i>Dicaeum erythrorhynchos</i>	Pale-billed Flowerpecker	LC	IV
151	<i>Leptocoma zeylonica</i>	Purple-rumped Sunbird	LC	IV
152	<i>Cinnyris asiaticus</i>	Purple Sunbird	LC	IV
153	<i>Passer domesticus</i>	House Sparrow	LC	-
154	<i>Gymnoris xanthocollis</i>	Chestnut-shouldered Petronia	LC	-
155	<i>Ploceus philippinus</i>	Baya Weaver	LC	IV
156	<i>Euodice malabarica</i>	Indian Silverbill	LC	IV
157	<i>Lonchura Malacca</i>	Black-headed Munia	LC	IV
158	<i>Motacilla maderaspatensis</i>	White-browed Wagtail	LC	IV
159	<i>Anthus rufulus</i>	Paddyfield Pipit	LC	IV

*Status assigned by the International Union for Conservation of Nature and Natural Resources, where – CR – Critically Endangered; EN – Endangered; NT – Near Threatened; LC – Least Concern; NA – Not Assessed. **Schedules I to VI: Indian Wildlife (Protection) Act, 1972.

Sources: R. Grimmett, C. Inskipp & T. Inskipp (2011). *Birds of the Indian Subcontinent*. Oxford University Press, pp 1-528; Salim Ali (2012) reprinted. *The Book of Indian Birds*. Oxford University Press, pp 1-326; IUCN (2017). *The IUCN Red List of Threatened Species. Version 2017-1; Schedules I to VI: Indian Wildlife (Protection) Act, 1972.*

Table 3: Reptiles of the Study Area

Sr. No.	Scientific Name	Common Name	IUCN Status*	WPA Schedule**
1	<i>Ramphotyphlops braminus</i>	Brahminy Worm Snake	NA	IV
2	<i>Grypotyphlops acutus</i>	Beaked Worm Snake	NA	IV
3	<i>Python molurus molurus</i>	Indian Rock Python	NA	I
4	<i>Gongylophis conicus</i>	Common Sand Boa	NA	IV
5	<i>Eryx johnii</i>	Red Sand Boa	NA	IV
6	<i>Coelognathus helena helena</i>	Common Trinket Snake	NA	IV

7	<i>Ptyas mucosa</i>	Indian Rat Snake	NA	II
8	<i>Argyrogena fasciolata</i>	Banded Racer	NA	IV
9	<i>Oligodon taeniolatus</i>	Russell's Kukri Snake	LC	IV
10	<i>Oligodon arnensis</i>	Common Kukri Snake	NA	IV
11	<i>Dendrelaphis tristis</i>	Common Bronzeback Tree Snake	NA	IV
12	<i>Lycodon striatus</i>	Barred Wolf Snake	NA	IV
13	<i>Lycodon aulicus</i>	Common Wolf Snake	LC	IV
14	<i>Sibynophis subpunctatus</i>	Dumeril's Black-headed Snake	NA	IV
15	<i>Xenochrophis piscator</i>	Checkered Keelback	NA	II
16	<i>Amphiesma stolatum</i>	Striped Keelback	NA	IV
17	<i>Macropisthodon plumbicolor</i>	Green Keelback	NA	IV
18	<i>Atretium schistosum</i>	Olive Keelback	NA	IV
19	<i>Boiga trigonata</i>	Common Cat Snake	LC	IV
20	<i>Ahaetulla nasuta</i>	Common Vine Snake	NA	IV
21	<i>Bungarus caeruleus</i>	Common Krait	NA	IV
22	<i>Calliophis melanurus</i>	Slender Coral Snake	NA	IV
23	<i>Naja naja</i>	Spectacled Cobra	NA	II
24	<i>Daboia russelii</i>	Russell's Viper	LC	II
25	<i>Echis carinatus</i>	Saw-scaled Viper	NA	IV
26	<i>Calotes calotes</i>	Green Forest Lizard	NA	-
27	<i>Calotes versicolor</i>	Indian Garden Lizard	NA	-
28	<i>Sitana ponticeriana</i>	Fan-throated Lizard	LC	-
29	<i>Chamaeleo zeylanicus</i>	South Asian Chamaeleon	LC	II
30	<i>Eublepharis fuscus</i>	Western Indian Leopard Gecko	NA	-
31	<i>Calodactylodes aureus</i>	Indian Golden Gecko	NA	-
32	<i>Geckoella kollegalensis</i>	Kollegal Ground Gecko	NA	-
33	<i>Hemidactylus frenatus</i>	Asian House Gecko	LC	-
34	<i>Hemidactylus reticulatus</i>	Reticulated Gecko	LC	-
35	<i>Ophisops leschenaultii</i>	Leschenault's Lacerta	NA	-
36	<i>Lygosoma punctata</i>	Spotted Supple Skink	NA	-
37	<i>Mabuya carinata</i>	Keeled Grass Skink	LC	-
38	<i>Mabuya macularia</i>	Bronze Grass Skink	NA	-
39	<i>Sphenomorphus dussumieri</i>	Dussumier's Litter Skink	LC	-
40	<i>Varanus bengalensis</i>	Bengal Monitor	LC	II
41	<i>Melanochelys trijuga</i>	Indian Black Turtle	NT	-
42	<i>Geochelone elegans</i>	Indian Star Tortoise	VU	IV
43	<i>Lissemys punctata</i>	Indian Flapshell Turtle	LC	I

*Status assigned by the International Union for Conservation of Nature and Natural Resources, where VU – Vulnerable; LC – Least Concern; NA – Not Assessed and NT – Near Threatened. **Schedules I to VI: Indian Wildlife (Protection) Act, 1972.

Sources: Indraneil Das (2002). Snakes & other Reptiles of India. New Holland Publishers (UK) Ltd pp. 1-144; Romulus Whitaker & Ashok Captain (2006). Snakes of India; Dreko Books, Chennai, pp 1-146; WWF-India, (2013). IUCN (2017). The IUCN Red List of Threatened Species. Version 2017-1; Schedules I to VI: Indian Wildlife (Protection) Act, 1972.

Table 4: Amphibians of the Study Area

Sr. No.	Scientific Name	Common Name	IUCN Status*	WPA Schedule**
1	<i>Duttaphrynus melanostictus</i>	Common Indian Toad	LC	-
2	<i>Duttaphrynus scaber</i>	Ferguson's Toad	LC	-
3	<i>Duttaphrynus stomaticus</i>	Marbled Toad	LC	-
4	<i>Uperodon taprobanicus</i>	Indian Painted Frog	LC	-
5	<i>Microhyla ornate</i>	Ornate Microhylid	LC	-
6	<i>Microhyla rubra</i>	Red Microhylid	LC	-
7	<i>Uperodon variegatus</i>	Eluru Dot Frog	LC	-
8	<i>Uperodon globulosus</i>	Greater Balloon Frog	LC	-
9	<i>Uperodon systoma</i>	Lesser Balloon Frog	LC	-
10	<i>Polypedates maculatus</i>	Common Tree Frog	LC	-
11	<i>Euphlyctis cyanophlyctis</i>	Skittering Frog	LC	-

12	<i>Hoplobatrachus crassus</i>	Jerdon's Bullfrog	LC	-
13	<i>Hoplobatrachus tigerinus</i>	Indian Bullfrog	LC	-
14	<i>Fejervarya limnocharis</i>	Asian Grass Frog	LC	-
15	<i>Tomopterna breviceps</i>	Indian Burrowing Frog	NA	-

*Status assigned by the International Union for Conservation of Nature and Natural Resources, where LC – Least Concern and NA – Not Assessed. **Schedules I to VI: Indian Wildlife (Protection) Act, 1972.

Sources: R. J. Ranjit Daniels, (2005). *Amphibians of Peninsular India*. Indian Academy of Sciences, University Press, pp 1-258; IUCN (2017). *The IUCN Red List of Threatened Species. Version 2017-1; Schedules I to VI: Indian Wildlife (Protection) Act, 1972.*

Table 5: Fishes of the Study Area

Sr. No.	Scientific Name	Common Name	IUCN Status*	WPA Schedule**
1	<i>Catla catla</i>	Catla	NA	-
2	<i>Cirrhinus mrigala</i>	Mrigal	LC	-
3	<i>Cirrhinus reba</i>	Reba Carp	LC	-
4	<i>Gonoproktopteres kolus</i>	Kolus Barb	VU	-
5	<i>Puntius dorsalis</i>	Long-snouted Barb	LC	-
6	<i>Puntius sarana subnasutus</i>	Peninsular Olive Barb	NA	-
7	<i>Puntius sophore</i>	Spotfin Barb	LC	-
8	<i>Puntius ticto</i>	Ticto Barb	LC	-
9	<i>Puntius vittatus</i>	Kooli Barb	LC	-
10	<i>Tor khudree</i>	Yellow Mahseer	EN	-
11	<i>Esomus danrica</i>	Flying Barb	LC	-
12	<i>Parluciosoma daniconius</i>	Blackline Rasbora	LC	-
13	<i>Nemacheilus denisoni</i>	Day's Loach	LC	-
14	<i>Lepidocephalus thermalis</i>	Malabar Loach	LC	-

*Status assigned by the International Union for Conservation of Nature and Natural Resources, where – EN – Endangered;; LC – Least Concern; NA – Not Assessed; and VU – Vulnerable.

**Schedules I to VI: Indian Wildlife (Protection) Act, 1972.

Sources: R. J. Ranjit Daniels, (2002). *Freshwater Fishes of Peninsular India*, Indian Academy of Sciences, University Press, pp 1-282; IUCN (2017). *The IUCN Red List of Threatened Species. Version 2017-1; Schedules I to VI: Indian Wildlife (Protection) Act, 1972.*

Table 6: Migratory Birds of the Study Area

Sr. No.	Scientific Name	Common Name	IUCN Status*	WPA Schedule
1	<i>Coturnix coturnix</i>	Common Quail	LC	IV
2	<i>Coturnix coromandelica</i>	Rain Quail	LC	IV
3	<i>Tadorna ferruginea</i>	Ruddy Shelduck	LC	IV
4	<i>Anas strepera</i>	Gadwall	LC	IV
5	<i>Anas clypeata</i>	Northern Shoveler	LC	IV
6	<i>Anas acuta</i>	Northern Pintail	LC	IV
7	<i>Anas querquedula</i>	Garganey	LC	IV
8	<i>Anas crecca</i>	Common Teal	LC	IV
9	<i>Aythya farina</i>	Common Pochard	VU	IV
10	<i>Anastomus oscitans</i>	Asian Openbill	LC	IV
11	<i>Plegadis falcinella</i>	Glossy Ibis	LC	IV
12	<i>Ardea cinerea</i>	Grey Heron	LC	IV
13	<i>Anhinga melanogaster</i>	Darter	NT	IV
14	<i>Phalacrocorax niger</i>	Little Cormorant	LC	IV
15	<i>Phalacrocorax fuscicollis</i>	Indian Cormorant	LC	IV
16	<i>Phalacrocorax carbo</i>	Great Cormorant	LC	IV
17	<i>Falco tinnunculus</i>	Common Kestrel	LC	IV
18	<i>Falco peregrinus</i>	Peregrine Falcon	LC	IV
19	<i>Pandion haliaetus</i>	Osprey	LC	I

20	<i>Circus aeruginosus</i>	Eurasian Marsh Harrier	LC	IV
21	<i>Circus macrourus</i>	Pallid Harrier	NT	IV
22	<i>Circus pygargus</i>	Montagu's Harrier	LC	IV
23	<i>Hieraaetus pennatus</i>	Booted Eagle	LC	IV
24	<i>Porzana pusilla</i>	Baillon's Crake	LC	IV
25	<i>Turnix tanki</i>	Yellow-legged Buttonquail	LC	-
26	<i>Himantopus himantopus</i>	Black-winged Stilt	LC	IV
27	<i>Philomachus pugnax</i>	Ruff	LC	IV
28	<i>Gallinago stenura</i>	Pin-tailed Snipe	LC	IV
29	<i>Gallinago gallinago</i>	Common Snipe	LC	IV
30	<i>Limosa limosa</i>	Black-tailed Godwit	NT	IV
31	<i>Numenius arquata</i>	Eurasian Curlew	NT	IV
32	<i>Tringa erythropus</i>	Spotted Redshank	LC	IV
33	<i>Tringa tetanus</i>	Common Redshank	LC	IV
34	<i>Tringa stagnatilis</i>	Marsh Sandpiper	LC	IV
35	<i>Tringa nebularia</i>	Common Greenshank	LC	IV
36	<i>Tringa ochropus</i>	Green Sandpiper	LC	IV
37	<i>Tringa glareola</i>	Wood Sandpiper	LC	IV
38	<i>Actitis hypoleucos</i>	Common Sandpiper	LC	IV
39	<i>Calidris minuta</i>	Little Stint	LC	IV
40	<i>Calidris temminckii</i>	Temminck's Stint	LC	IV
41	<i>Clamator jacobinus</i>	Jacobin Cuckoo	LC	IV
42	<i>Asio flammeus</i>	Short-eared Owl	LC	IV
43	<i>Merops philippinus</i>	Blue-tailed Bee-eater	LC	-
44	<i>Jynx torquilla</i>	Eurasian Wryneck	LC	IV
45	<i>Coracina melanoptera</i>	Black-headed Cuckooshrike	LC	IV
46	<i>Lanius cristatus</i>	Brown Shrike	LC	-
47	<i>Dicrurus leucophaeus</i>	Ashy Drongo	LC	IV
48	<i>Oriolus (oriolus) kundoo</i>	Indian Golden Oriole	LC	IV
49	<i>Terpsiphone paradise</i>	Asian Paradise Flycatcher	LC	IV
50	<i>Hirundo rustica</i>	Barn Swallow	LC	IV
51	<i>Cecropis daurica</i>	Red-rumped Swallow	LC	IV
52	<i>Acrocephalus dumetorum</i>	Blyth's Reed Warbler	LC	-
53	<i>Phylloscopus humei</i>	Hume's Leaf Warbler	LC	-
54	<i>Phylloscopus trochiloides</i>	Greenish Warbler	LC	-
55	<i>Sylvia curruca</i>	Lesser Whitethroat	LC	-
56	<i>Sylvia althaea</i>	Hume's Whitethroat	LC	-
57	<i>Sturnia malabarica</i>	Chestnut-tailed Starling	LC	IV
58	<i>Luscinia svecica</i>	Bluethroat	LC	IV
59	<i>Phoenicurus ochruros</i>	Black Redstart	LC	IV
60	<i>Saxicola torquatus</i>	Common Stonechat	LC	IV
61	<i>Monticola solitarius</i>	Blue Rock Thrush	LC	IV
62	<i>Muscicapa daurica</i>	Asian Brown Flycatcher	LC	IV
63	<i>Ficedula superciliaris</i>	Ultramarine Flycatcher	LC	IV
64	<i>Motacilla flava</i>	Yellow Wagtail	LC	IV
65	<i>Motacilla cinerea</i>	Grey Wagtail	LC	IV
66	<i>Motacilla alba</i>	White Wagtail	LC	IV
67	<i>Anthus godlewskii</i>	Blyth's Pipit	LC	IV
68	<i>Anthus trivialis</i>	Tree Pipit	LC	IV
69	<i>Anthus hodgsoni</i>	Olive-backed Pipit	LC	IV

*Status assigned by the International Union for Conservation of Nature and Natural Resources, where – LC – Least Concern; NT – Near Threatened; and VU – Vulnerable;.

**Schedules I to VI: Indian Wildlife (Protection) Act, 1972.

Source: R. Grimmett, C. Inskipp & T. Inskipp (2011). *Birds of the Indian Subcontinent*. Oxford University Press, pp 1-528; IUCN (2015). *The IUCN Red List of Threatened Species*. Version 2017-1; Schedules I to VI: Indian Wildlife (Protection) Act, 1972.

