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Environment and Social Impact Assessment Report

40 MW Operational Solar Power Project, Aurad, Karnataka

Hero Future Energies Private Limited

May 2019

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1. Introduction

1.1 Preface

M/s Clean Solar Power (Gulbarga) Private Limited (hereinafter referred to as 'CSPGPL'), a Special Purpose Vehicle of Hero Future Energies Pvt. Ltd. (hereinafter referred to as 'HFE') has developed a 40 MW Solar Power Project (hereinafter referred to as 'Project') spread across one Taluka/ Sub-District namely, Aurad in Bidar District of Karnataka, India.

As per the Power Purchase Agreement (PPA) signed between CSPGPL and Solar Energy Corporation of India Limited (hereinafter referred to as 'SECI') dated 2nd August 2016, the switchyard with capacity 33kV has been constructed by HFE at Jonnikere and Lingdahalli villages in Bidar District, Karnataka and has been connected to pooling substation at Santpur village to 110 kV.

1.2 Background and Rationale of the Study

AECOM India Pvt. Ltd. (hereinafter referred to as 'AECOM') understands that HFE intends to invest in the solar power project with financial assistance from international lenders/ multilaterals. In this context, the project requires evaluation of Environmental and Social risks associated with its operations. Evaluating such risks will help determining mitigation measures to avoid adverse impacts identified as part of the study.

As HFE is seeking project finance from international lenders, it is required to comply with the applicable International Finance Corporation (IFC) guidelines relating to Environment, Social issues and Occupational Health and Safety matters, in addition to regional and national laws and regulations.

HFE has commissioned AECOM to undertake an Environment and Social Impact Assessment (ESIA) in order to meet requirements of the following reference framework:

- Applicable national, state and local regulatory requirements;
- IFC Performance Standards (2012);
- IFC/World Bank EHS Guidelines for Electric Power Transmission and Distribution (2007).

1.3 Objective and Scope of Work

The scope of work for the ESIA broadly includes the following:

1.3.1.1 Defining the Project/Project Description

The project information includes providing project description with focus on understanding the environmental and social setting and sensitivities for the solar power project. This also includes any associated facilities that may be required (e.g., access roads, transmission lines, etc.). Also, description of the larger setting in which the project is located.

1.3.1.2 Outlining Policy, Legal, and Administrative Framework

Discussing the policy, legal, and administrative framework within which the assessment is carried out, including host country regulations, obligations under relevant international social and environmental treaties, agreements, and conventions, IFC Performance Standards and subsequently reviewing the Social and Environmental compliance requirements against afore mentioned requirements.

1.3.1.3 Generating Baseline Data

Collecting and generating relevant baseline social and environmental data (primary & secondary) relevant to decisions about project location, design, operation, or mitigation measures. The baseline data generation is specifically focused on issues around a) cumulative impact assessment due to operation of existing solar power projects in the vicinity of the project, b) traffic, c) water- its quality, availability and adequacy vis-à-vis the requirements during different operation phase of the project life cycle, d) land and land use e) ecology/

biodiversity, f) physical or cultural heritage (if any), g) other environmental sensitivities like wetlands, forests etc. Review of the land purchase process to assess any legacy or current/existing issues (like informal settlers, livelihood dependence, other usage etc.) on the purchased land is also assessed.

1.3.1.4 Consultation

Consultation with land sellers and representative of the local governing institution was carried out to review land procurement and compensation process and assess compliance to IFC PS 5 standards.

1.3.1.5 Assessing Social and Environmental Impacts and Mitigation Measures

Evaluating potential Environment and Social impacts of the Project and its components (including associated facilities like transmission line, access roads etc. as per the details available) and developing mitigation measures and plans to maximize project benefits in consultation with affected communities including, potential assessment of Cumulative impacts (linked to development or other solar projects), if relevant and as appropriate.

The impact assessment will identify mitigation measures for any residual negative impacts that may not be mitigated and also evaluate impacts and risks from associated facilities and other third party activities.

1.3.1.6 Analysing Alternatives

Comparing reasonable alternatives against proposed project site, technology, design, and operation in terms of their potential social and environmental impacts is to be undertaken. The feasibility of mitigating these impacts, capital and recurrent costs, suitability under local conditions, and institutional, training, and monitoring requirements also has been considered. The resultant alternative will state the basis for selecting a particular site and project design by justifying recommended approaches to pollution prevention and abatement.

1.3.1.7 Providing Management Program

The final step includes formulating management plan for mitigation of impacts as identified during assessment. This also entails developing Environmental and Social Management Plan (ESMP) based on the ESIA and procedures development for mitigation and monitoring of environment and social impacts on an ongoing basis and to identify any impacts/mitigation requirements that may occur subsequent to the completion of the ESIA.

Where the client identifies measures and actions necessary for the project to comply with applicable laws and regulations and to meet the Performance Standards, the management program will include an Action Plan, which is subject to disclosure to the affected communities and ongoing reporting and updating.

1.4 Limitations

The ESIA study of the project is limited to project information made available by the client, discussion with HFE and other contractor staff, primary monitoring, secondary data collected, consultation with local community and observations made during site survey. Professional judgement and interpretation of facts has been applied for presenting inference from the collected information.

1.5 Layout of Report

The report structure is outlined in the following manner:

- Chapter 2 – outlines project description
- Chapter 3 – outlines Environmental and Social Regulatory Framework
- Chapter 4 – outlines Environmental and Socio-Economic Baseline
- Chapter 5 – outlines alternatives that may be considered for the project
- Chapter 6 – describes impacts associated with the project
- Chapter 7 – presents the Environmental Management Plan
- Chapter 8 – describes final recommendations and concluding remarks

2. Project Description

This section of the report provides a description of the site settings and project components along with associated facilities. This section also elaborates the project phases with its implementation mechanism and schedule.

2.1 Site Settings

The project site is spread across two villages, namely, Lingdahalli and Jonnikere in Aurad Taluka of Bidar District, Karnataka. The nearest highway to the site is the State Highway (SH) – 15 (also known as Bidar Road), which connects Raichur to Aurad, Santpur and Bidar, and is located at a distance of 2 km from the site towards the west direction. The site can be accessed through the village road of Jonnikere village leading to the site towards the west which further connects to SH 15 in the west direction. The site is located at a distance of 8 km from Aurad and 30 km from Bidar. Hyderabad airport is the nearest airport at a distance of 180 km from the site. There is no railway station within 10 km from the site; however, Kalgupur is the nearest railway station to the site, located at a distance of 37 km in west direction. ***Figure 2-1*** below presents the site location of the solar power project.

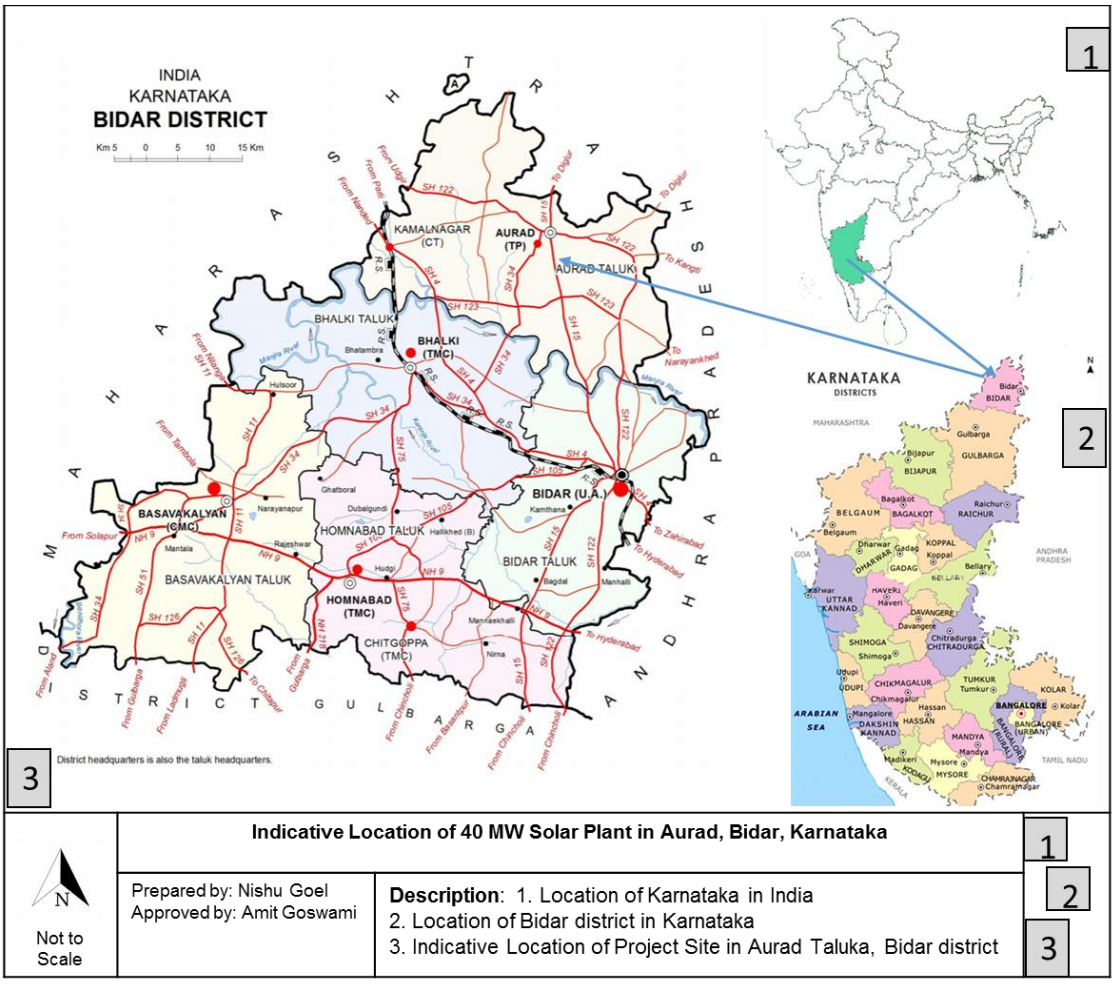


Figure 2-1: Indicative Location of 40 MW Solar Project in Aurad, Bidar in Karnataka

The site selected for the project comprises of private agricultural land from Lingdahalli and Jonnikere villages of Aurad 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/m^2 to 2050 kWh/m^2. This irradiance is generally suitable for reasonably good energy generation.

The land for the site area as informed during discussions held with the landowners was used in undertaking rainfed agricultural activities and characterised by mainly black cotton soil. Over 5 years, because of the gradual decline in rainfall, the agricultural activities ceased, and the land became fallow and unusable. The project site is slightly undulating and has an average elevation of about 610 metres above mean sea level. As informed by the site management and through consultations undertaken with land sellers, the site area was previously used for rain-fed agriculture. The site comprises of scanty vegetation in form of shrubs and grasses. The site entry is through the west side of the village road followed by a 3.5 m wide internal road to the site. The project site has been divided into three (03) zones viz. Zone 1, 2 and 3. A small rain-fed waterbody is present at a distance of 1 km in north-west direction of the site in Jonnikere village and is used for agricultural and domestic purpose by villagers. Jonnikere village is the nearest habitation located at a distance of about 500 m from site in the north direction. The physical features located near the Project site are represented in ***Figure 2-2.***

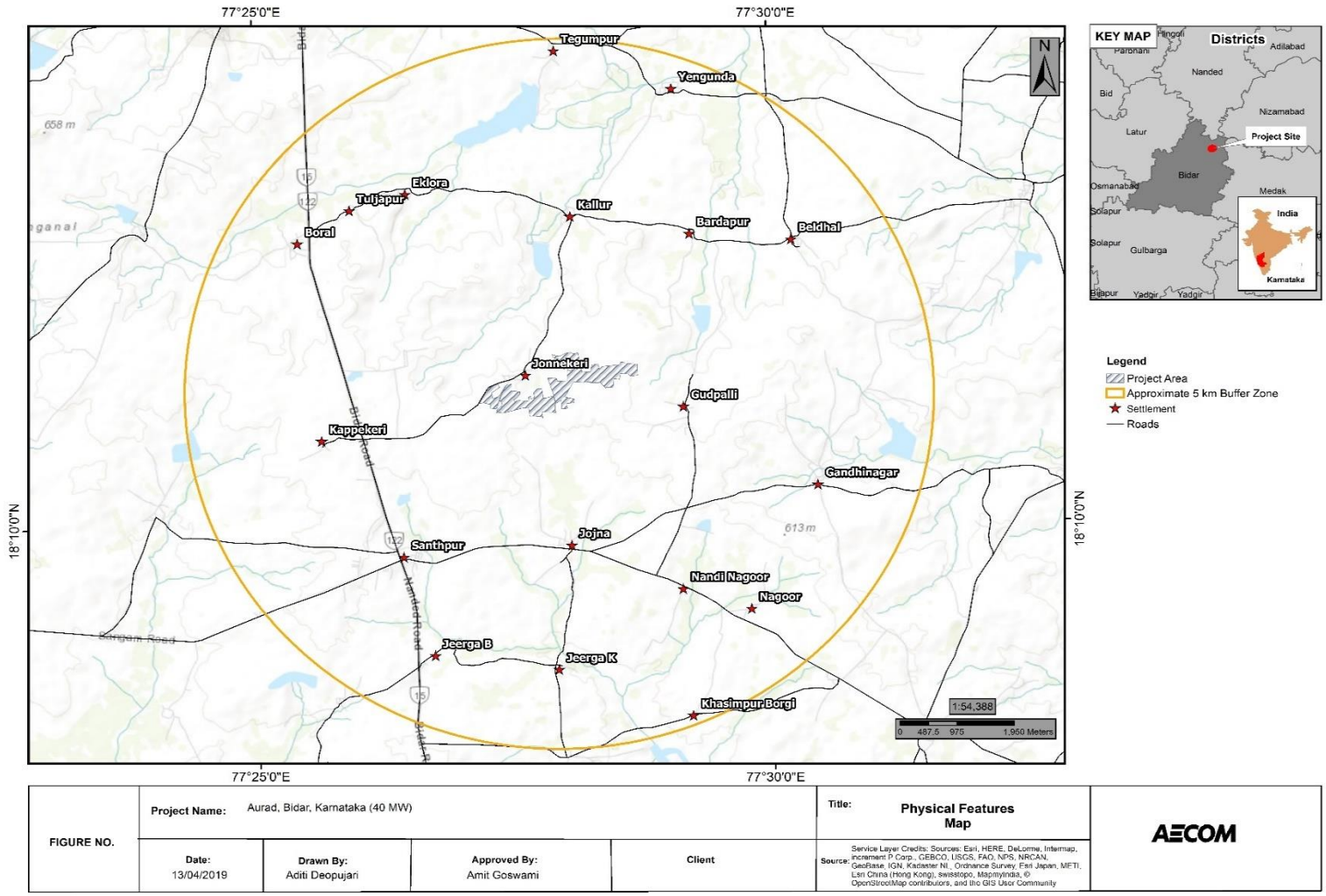


Figure 2-2. Physical Features of Project Area

2.2 Project Schedule

CSPGPL has conducted site assessment based on solar radiation data available, identification of land and land procurement for the project. After hand over of land, CSPGPL had performed site clearing works and soil testing works to monitor the soil quality of the project site. CSPGPL had engaged M/s L&T Construction as EPC (Erection, Procurement and Construction) contractor on turnkey basis for provision of construction works pertaining to the project. The works comprised of carrying out geotechnical investigations, foundation works, installation of switch yard, array yard installation, SCADA system, inverter modules and equipment installation. CSPGPL had also engaged M/s Sri Vinayaka Surveyors to undertake survey of transmission line, assessment of land required for construction of transmission poles and execution of works of installation of one (01) number of 110 kV bay at 110/ 33 kV Santpur Grid Sub- Station. The Construction work for the project commenced in July 2017 and the project was commissioned in March 2018.

CSPGPL has entered into a Separate Operations and Maintenance (O&M) Agreement with M/s Ritis Meera Infra Energy LLP for O&M of the project. The project is to be handed over to the O&M contractor by the EPC Contractor by June 2019.

2.3 Current Status of Project

The 40 MW solar plant is spread across 240.2 acres (97.2 hectares) of land and divided into three (03) zones. The project was observed to be in the Operational Phase on the day of the site visit undertaken by AECOM in 27th and 28th February 2019 with construction work for the project at ~85% completed. The construction of internal roads, site boundary and street light installation was noted to be under progress at site and was envisaged to be completed by April 2019. It was informed by the site personnel, that the drainage work is yet to be initiated at the site and will be undertaken before the onset of monsoon (June-July).

The power plant is divided into ten (10) blocks with four (04) invertors of capacity 4.4 MW in each block. The power generated from the plant is being evacuated at Santpur substation of Gulbarga Electricity Supply Company Limited (GESCOM). Twelve (12) employees of M/s Ritis Meera Infra Energy LLP has been engaged at the site for O&M phase of the project which include nine (09) Site technicians, one (01) Safety In charge, one (01) Site In charge and one (01) Site Engineer for management and maintenance of the project. Additionally, one (01) Site In charge of HFE has also been deployed at the site for overall management of the project. At present, ten (10) employees of the EPC contractor have been engaged at the site for completion of remaining construction works and thirty-two (32) security guards including one (01) armed guard have been deployed by the EPC contractor at the site.

One (01) site office has been constructed at site for operation and management of the plant with Main Control Room (MCR), SCADA system and a meeting room. The Site office has also been provided with one (01) pantry and two (02) washrooms. It was reported that the Site Management has an agreement with the nearest Private Clinic in Aurad for any medical emergency, including emergency situations. One (01) anti-venom vial has been provided at site in case of instances of snake bite.

	
Cleaning of Solar Panels at the site	*Control room and sub-station at site*
	
Boundary work undergoing at site	*Solid waste dumped at the site*
	
Access road leading to SH 15 (Bidar road)	*A view of Jonnikere Village*

2.4 Project Components

The 40MW (AC) solar power project is based on crystalline silicon (c-Si) Solar Photo Voltaic technology using Module Make Hareon Solar (320Wp and 325Wp) Model no- HR-325P-24/Ba and Trina Solar (320Wp and 325

Wp) Model no- TSM-320PD-14 which are Poly Crystalline Silicon Modules with 72 cells each for power generation. The energy generated is being evacuated at the 110 KV utility substation of GESCOM located at Santpur Village. The length of the110KV Single circuit (SC) transmission line between power plant and utility substation is ~ 5km. The plant is expected to generate energy about 76 KWh in the first year of operation. The salient features of the project components have been presented in ***Table 2-1*** below and the details have been provided in subsequent sections. The array layout of the facility has been presented in ***Figure 2-3.***

Table 2-1: Technical Details of PV Power Plant

Parameter	Make
Solar PV Modules -320/325 Wp	Trina/Haeron (136724/136836)
Module mounting structure	HFE Design
Grid interactive inverter	SMA Sunny Central 1000CP XT
String Combiner Box (SCB)	Statcon (281 number)
Cables as per design DC	KEC
Cables as per design AC	KEC
Invertors Capacity AC/DC	1100/1122
Number of Blocks	10
Number of Invertor	40
Invertor Transformer Make	Toshiba (4.4 MVA)
Invertor Block	Capacity: 4.4 MW 4 Invertor/Block
Substation: Transformer, CTs, Pts, isolators, circuit breakers, surge arrestors	Siemens
Outdoor HT Panel make and Rating	Siemens (12 KV/565 A)
Lightning arrestor	Jef/Sabo/equivalent (53 number)
Earthing pit	Jef/Sabo/equivalent (220 number)
Tracker	L&T Single Axis (100 Kilonewton)

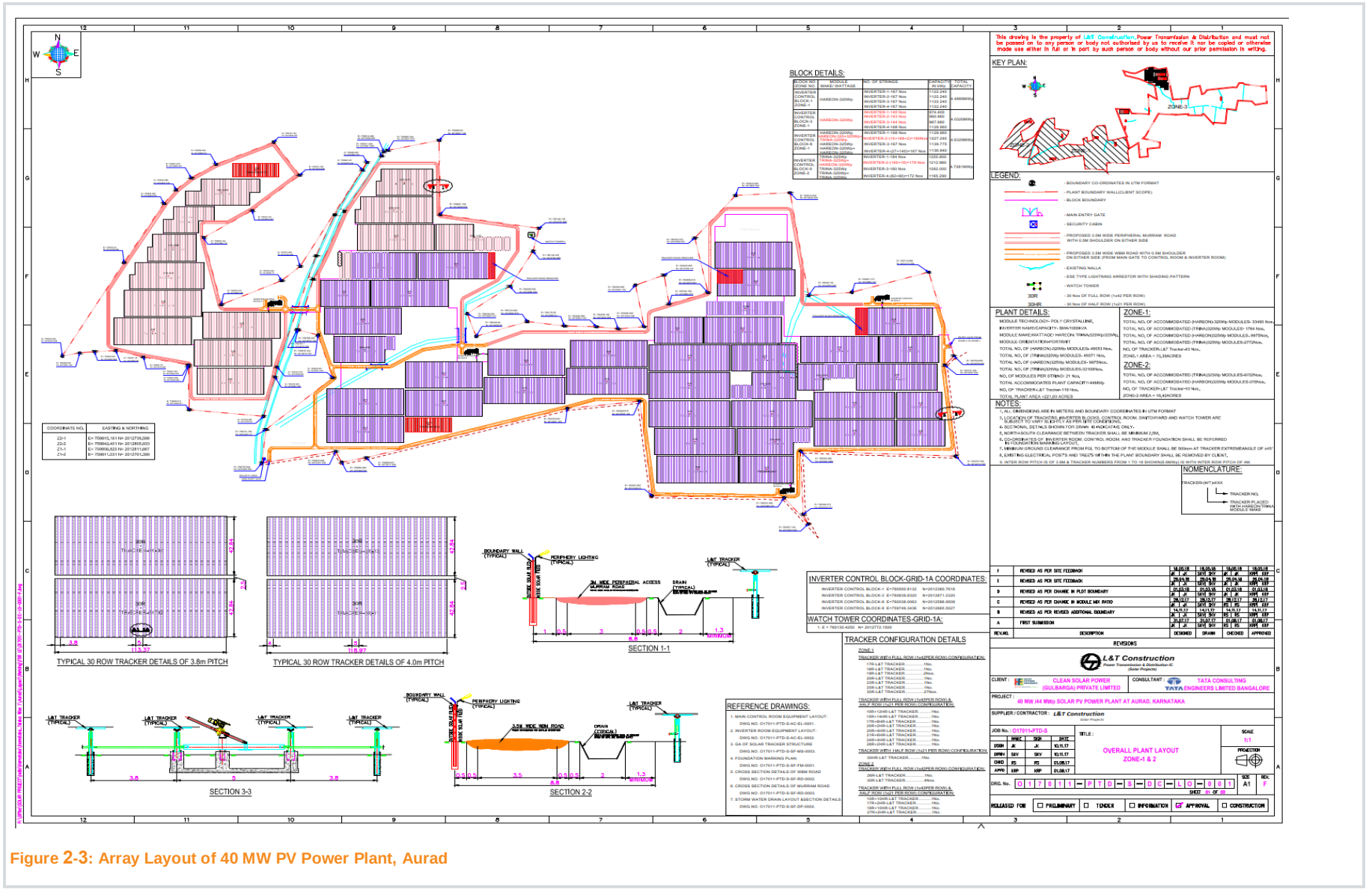


Figure 2-3: Array Layout of 40 MW PV Power Plant, Aurad

2.4.1 Technical Details of the PV Modules

2.4.1.1 DC Components

PV Module

All solar PV modules mandatorily have to adhere to International Electrotechnical Commission (IEC) specifications given in IEC 61215 for Crystalline Silicon modules. The solar PV modules for the project must be tested and certified by an independent international testing laboratory. For optimum energy generation Crystalline Silicon 320 Wp and 325 Wp modules of Hareon Solar and 320 Wp and 325 Wp of Trina Solar have been selected for this project.

Module Mounting Structure

Single axis tracking ground mounted structures have been used for this project. Each of this structure can support 21 modules. The structure is made of galvanized steel profiles and is inclined (-45 to +45) degree to horizontal. PV modules are directly mounted on the module support members. The aluminum frame of each solar module is galvanically isolated from the steel supporting beam to prevent localized corrosion and high-quality stainless-steel fixings are used throughout.

The mounting structure is designed for holding the designated number of modules in series. The frames and leg assemblies of the array structures are made of structural steel sections. The composition of steel conforms to IS 2062, suitable for welding purposes.

The structure has been designed to allow easy replacement of any module. It support solar PV modules at a given orientation, absorbs and transfers the mechanical loads to the ground properly. The legs of the structures with appropriate strength are fixed in the foundation columns as per design based on site soil condition.

Inverters

Inverters/ Power Conditioning Units (PCU) act as the interface between the PV array and the Grid. As the PV array output varies with the solar radiation, the inverter has to effectively interface with the grid to remain synchronized. Main functions of Inverters are:

- Convert the incoming DC received from PV modules into AC with suitable power quality.
- The inverter also has to act as a protective device of the system. It needs to trip if the voltage, current or frequency goes outside acceptable ranges

For the project, a 1100/1122 kW AC/DC SMA Sunny Central make inverter (three phases with compact and weatherproof enclosures for indoor use) has been selected.

2.4.1.2 AC Components

The AC subsystem commences from the output of the inverters and comprises of the transformers, the associated switchgear, metering and protection circuits and terminates at the two-pole structure from where the transmission lines would start.

Transformer

Each Inverter transformer will be 3 phase of 4.4 MVA capacity. The transformer steps up the inverter transformer output of 365 V to 465 V.

Cables

The cables used for this connection will be cross-linked polyethylene insulated and as per standards IS-7098-part I.

HT Panel

The HT panel is an interface between the transformers and grid providing the protection required for the system. HT panel consist of VCB and the associated C & R Panel for each PV quadrant. VCB conforms to IEC-62271-100. The switchgear contains all equipment viz. Circuit breakers, CTs, PTs, relays and associated equipment.

Metering

The metering arrangement is compatible with the Availability-Based-Tariff (ABT) mechanism along with a check meter with Modbus arrangement and facility to provide remote monitoring. The meter has web communication facility and is visible at the State Load Dispatch Centre (SLDC).

AC Auxiliary System

The AC auxiliary supply of single/three phase is required for periphery lighting, security cabin and control room lighting etc.

2.4.1.3 Civil Structures

Inverter room and Control Room

The inverter rooms are pre-fabricated FRP structures and control room is the standard RCC framed structures.

Boundary Wall

The complete plant boundary covering module yard, control room, switchgear room and switch-yard, security cabin, etc. is provided with a compound wall made of pre-cast slabs.

Security Cabin

The security cabin made of FRP (Fiber-reinforced plastic) is provided near the site entry gate.

Transformer Foundation

The power transformer has been placed on gravel filled foundation and placed on the ground/ raised foundation.

Pile Foundation

Pile foundation design has depended upon soil conditions, geographical condition, regional wind speed, bearing capacity, slope stability, etc.

Internal Roads

Internal roads of 11.5 km have been developed for the project site which is approximately 3 m in width. Peripheral roads around the boundary are Water Bound Macadam (WBM) road as per IRC 37 with at least 3 m width.

2.4.1.4 Earthing

There is dedicated earthing stations for transformer, MV switch boards and high voltage panels. Maintenance free earthing stations are considered preferable for the design due to long-term trouble-free performance in comparison to conventional pipe earthing. All the modules have been appropriately earthed in accordance to the NEC (National Electrical Code). Grounding of the modules has been done as recommended by the manufacturer. A total of 220 earth pits have been provided at the site in order to limit the grid resistance to below 1 ohm.

2.4.1.5 Lighting and Over Voltage Protection

The MV stations comprising of transformers, inverters, etc. have been provided with adequate lightning protection. Similarly, the entire main control room building and four pole structure arrangement has been protected as per IS standards.

Necessary concrete foundation for holding the lightning conductor in position has been made after giving due consideration to the maximum wind speed and maintenance requirement at site in future. Each lightning conductor is fitted with individual separate earth pit as per required Standards including accessories and provided with iron cover plate having a lock arrangement, watering pipe using charcoal or coke and salt as per required provisions of Indian Standards (IS). A total of 53 Lightning Arrestors have been provided at the site.

2.4.1.6 Supervisory Control and Data Acquisition (SCADA) System

The entire solar PV power plant has been integrated with Supervisory Control and Data Acquisition (SCADA) system which communicates with all the inverters and monitoring boxes (SMB) for displaying parameters

mentioned below. The integrated SCADA has the feature to be used either locally via a local computer or also remotely via the Web using either a standard modem or a GSM / WIFI modem and broadband. SCADA have provision of tracking the status of breakers and relays. Following parameters are shown in the SCADA system:

- Data from weather station;
- PV module back surface temp;
- Line and phase currents;
- Cumulative energy exported;
- Power at 110 kV terminal;
- AC and DC side power of each inverter;
- Voltage of the HT Side; and
- Current and voltage of each sub-array/string.

2.4.2 Access Roads

No new approach road has been constructed for the project. The existing village road connecting Jonnikere to Jojna village is used to enter the site. An internal road of 11.5 km has been developed inside the project site.

2.4.3 Power Evacuation

Power from the solar PV plant is being evacuated to the 110/33/11 kV grid substation at Santpur with terminal bay along with the required matching control equipment at both ends of the lines as per the technical specifications and layout has been approved by GESCOM. The Santpur sub-station is located at a distance of about 5 km from the site. CSPGPL has already received approval dated 4th January 2017 for construction of 110 kV line of ~5 km length with Lynx ACSR Conductor from project site to 110/33/11 kV substation of GESCOM. According to the approval obtained, CSPGPL was required to purchase land adjacent to Santpur Sub-Station of GESCOM under KPTCL for construction of 110 kV TB and connect it for metering and has handed over the land along with 110kV TB to GESCOM for maintenance.

The metering required for power purchase is done at the utility substation end. The Power Purchase Agreement is signed for 25 years.

2.5 Resource Requirement

2.5.1 Manpower

2.5.1.1 Construction Phase

Through documents reviewed and discussions held with the EPC representatives during the site visit, it was noted that there were ~120 skilled and unskilled labours during peak time period required for the construction phase works. The EPC, L&T sourced labour from M/s Centurion Company wherein approximately 40% of labour was sourced locally and 60% of labour was sourced from outside the State. A labour accommodation was provided to the labourers comprising of five (05) blocks and 40 rooms. On the day of the site visit, the labour accommodation was in the process of being dismantled.

2.5.1.2 Operation Phase

Twelve (12) employees of M/s Ritis Meera Infra Energy LLP has been engaged at the site for O&M phase of the project which include nine (09) Site technicians, one (01) Safety In charge, one (01) Site In charge and one (01) Site Engineer for management and maintenance of the project. Additionally, one (01) Site In charge of HFE has also been deployed at the site for overall management of the project. Security related aspects as informed by the site management will be undertaken by the O&M Contractor and outsourced to a Security Agency once the EPC demobilises from site.

2.5.2 Water Requirement

2.5.2.1 Construction Phase

Water for construction phase (including water for construction activity and domestic and drinking water requirement for workers) was provided by the EPC contractor. Water tankers were sourced through authorized vendors to meet the water demand for the project. Additionally, water was sourced from two (02) bore wells present at the site. As informed, the bore wells have dried and now become non-operational and will be closed.

2.5.2.2 Operation Phase

The water requirements for the plant during operation phase 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. 2, 73, 560 modules) will be approximately 300 kilo litres, at one time. With a cleaning schedule of once a month, it is estimated that approximately 300-350 kilo litres of water will be required for cleaning purpose on monthly basis and the requirements will be met through water tankers. The water tankers will be supplied by the contractor engaged for module cleaning. Two (02) tanks of capacity 5,000 L each have also been constructed at the site, which will be filled by the water received from water tankers for module cleaning. A Reverse Osmosis (RO) plant will be installed at site for treatment of tanker water for module cleaning. Water for domestic purpose such as toilets and cleaning in the site office will also be supplied by the water tankers. Drinking water requirement at the site for operation phase is ~40L/day and is sourced through a RO plant in Santpur.

2.5.3 Power Requirement

During the construction phase, power was sourced through 3-4 Diesel Generator (DG) sets of capacity ~30 KVA. The DG sets were provided and maintained regularly on the site by the EPC contractor.

For operation phase, power requirement will be met through the power generated by the PV power plant. For backup purpose, a UPS of capacity 1000 KVA has been installed at site.

2.6 Land Requirement

A total land of 240.2 acres (97.2 hectares) of private land has been purchased by CSPGPL through a broker, Mr. Raju Gowda based in Gulbarga from 56 landowners for settling up of the solar power plant and its associated facilities such as internal roads, office buildings, switch yard etc. No Objection Certificate (NOC) has been obtained by CSPGPL from Jojna Gram Panchayat on 11th September 2017 for 30% of land coming under Lingdahalli village and from Santpur Gram Panchayat on 24th July 2017 for 70% of land under Jonnikere village. For the external transmission line up to the Grid Sub Station of ~5.7 km comprising of 26 towers, ~500-700 sq. ft. has been used and a one-time compensation paid to the respective landowners.

2.7 Waste Generation

2.7.1 Waste Water

During construction phase, waste water was generated from the labour camp at the site. Adequate number of portable toilets was provided by the EPC contractor at site and a septic tank with soak pit was also provided for disposal of domestic waste water generated. Waste water from construction activity was limited to cleaning and washing activities.

During the operation phase, waste water will be limited to domestic waste water discharged from the site office. Two (02) toilets have been provided with a septic tank and soak pit of capacity ~8m^3 for handling and disposal of waste water at the site.

2.7.2 Hazardous Waste

During construction phase, hazardous waste such as used oil from DG sets, oil-soaked cotton, oil lined containers, paints etc. were generated at the site. The Hazardous waste was disposed through a KSPCB authorized hazardous waste vendor, M/s KarRecycle Centre LLP within 90 days of generation.

During operation phase, no DG set has been installed at site and thus, the hazardous waste generation will be limited to used oil from transformer. The oil will be reused after filtration and the waste oil will be disposed through a KSPCB approved Hazardous waste vendor.

2.7.3 Solid Waste

Solid waste generation during the construction phase consisted primarily of scrapped building materials, excess concrete and cement, rejected components and materials, packing and shipping materials (pallets, crates, Styrofoam, plastics etc.) and domestic waste from the labour camp. The waste was disposed by the EPC contractor by following designated solid waste management practices.

During operation phase, the waste generated is limited to paper, plastic waste and food waste from the site office. The waste is collected in designated bins at site and disposed at a regular interval through municipal vehicle.

2.8 Operation 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.

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.

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.

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.

2.8.1 EPC Contractors and Subcontractors

M/s L&T Construction was engaged for EPC (Erection, Procurement and Construction) contractor on turnkey basis for provision of construction works pertaining to the project. The works comprised of carrying out geotechnical investigations, foundation works, installation of switch yard, array yard installation, SCADA system, inverters modules and equipment installation. Approximately, 120 workers were engaged at site during peak construction phase. M/s The Centurion Company was engaged as a sub-contractor at the site for supply of labour during construction phase.

2.8.2 Monitoring and Reporting

It was informed by the site personnel that Site In charge of O&M contractor is responsible for overall management of the project. Site technicians, Safety In charge, and Site engineer deployed at the site through O&M contractor report to the Site In charge. The O&M Site In charge reports to HFE Site In charge deployed at the site. HFE Site In charge was informed to be responsible of the Health and Safety (H&S) aspects at the site and reports to the Head Chief Engineer at the Corporate O&M level of HFE as well as regional HSE Engineer at Bangalore. The Head Chief Engineer reports to the Project Head (Vice President) of HFE at Corporate Level.

For the operation phase of the Project, the following records are being maintained by O&M team at the site office;

- Data logging records for power generation, Solar Irradiation data, grid availability, machine availability, Machine breakdown, etc.;
- Daily and Monthly performance reports;
- Monthly meter reading for State Electricity Board;
- Record of accidents/incidents;
- Record of work permits;
- Records pertaining to Lock-out Tag-out of turbines/ transformers under maintenance;
- Records pertaining to EHS training of the staffs at site and training calendar for a year; and
- Quality check records of personal protective equipment (PPEs) at the site office.

3. Environment and Social Regulatory Framework

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

3.1 National and Regional Enforcement Authorities

In India, Ministry of New and Renewable Energy (MNRE) is the nodal agency to manage the upcoming solar power projects and the environmental aspects are governed by Ministry of Environment, Forests and Climate Change (MoEF&CC), 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 (MoEF&CC)	Nodal Agency for planning, promotion, co-ordination and overseeing the implementation of environmental and forestry policies and programmes	• 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	• 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; 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) Rules, 2016, etc.	• 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 and is under the administrative control of minister of cabinet rank for Forest, Ecology & Environment.	Responsible for the enforcement of various environment related Acts, Rules, Notifications etc., including; • 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 and 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.	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 as stated on its website.
6.	Karnataka Renewable Energy Development Limited (KREDL)	Agency under the purview of Energy Department, Government of Karnataka. Devoted to promoting projects for harnessing energy from wind, small-hydro, biomass, solar energy and energy recovery from wastes through private investment.	• Promotion and 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; • 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; *CSPGPL to obtain a Certificate of Commissioning from KREDL after commissioning of the project. Project should also be registered under the State Nodal Agency.*
7.	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.	Responsible for the technical coordination and supervision of programmes and is also entrusted with a number of statutory functions.
8.	Central Regulatory Election	To promote competition, efficiency and economy in bulk power markets, improve the quality of supply, promote	• Improve the operations and management of the regional transmission systems through Indian Electricity Grid Code (IEGC), Availability Based

S. No	Agencies	Description	Functions
	Commission	investments and advise government on the removal of institutional barriers to bridge the demand supply gap and thus foster the interests of consumers.	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.
9.	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	• 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. *CSPGPL and the O&M Contractor for module cleaning to obtain a Non- Objection Certificate (NOC) from Karnataka Ground Water Authority for utilisation of groundwater at site for cleaning of solar panels and domestic purpose.*
10.	Gram Sabha or the Panchayats	Local bodies which have been defined by the 73rd Constitutional Amendment Act, 1992	• 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. *Two (02) Non- Objection Certificates (NOCs) have been obtained for the project from the Gram Panchayat of Jojna and Santpur for the procurement of land.*
11.	Karnataka Power Transmission Company Limited (KPTCL)	Wholly Owned by Govt. of Karnataka. Mainly vested with the functions of Transmission of Power.	• Provide innovative, efficient and tailored electricity products and services with a strong emphasis on risk management for itself and its consumer. • Construction of Stations and 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. *Approval for route of transmission line from site to 110/33/11 kV substation for power evacuation has been obtained from KPTCL. Approval has also been obtained from Electrical Inspectorate, Karnataka for interconnection scheme and bay equipment along with protection equipment*.

3.2 Applicable Environment and Social Regulations and Policies

The relevant Acts, Rules and Policies pertaining to the project have been summarised in the following ***Table 3-2***.

Table 3-2: Applicable Environment and Social Laws and Regulations and Policies

S. No.	Issues	Relevance	Applicable Legislation	Agency Responsible	Applicable Permits and Requirements
1.	Environmental Protection	Scattering of debris and waste 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 MoEF&CC 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 for the solar power plant and ensure compliance under the Water Act.[1].
3.	License under Factories Act, 1948	Factory license is required as the project is generating, transforming and transmitting power.	**Chapter I of The Factories Act, 1948**	Factories Inspectorate, Karnataka	CSPGPL shall obtain Factory License from the State Government or Chief Inspectorate of Factories, Karnataka before starting operations of the project.
4.	Hazardous Wastes Management	The project will generate broken photo-voltaic cells, waste oil from transformer from switchyard. Solvents and chemicals used or cleaning etc.	**Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016 as amended in 2019**	KSPCB	As per the recent amendment dated 1st March 2019, an occupier shall not be required to obtain authorization for collection, reception, storage, transportation and disposal of hazardous wastes if Consent to Operate is not required from SPCB for the project activity. 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; • 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. *All the hazardous waste generated due to the project shall be stored and disposed as per the requirements of the Hazardous Waste Rules i.e., on a paved surface in a designated area with adequate secondary containment, with adequate labelling and before it is disposed to an* ***KSPCB approved vendor.***

[1] *As per latest directions of Central Pollution Control Board, dated March 2016, 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 KSPCB (https://www.kspcb.gov.in/consentCategory.html) "white category industries shall not be included in the Consent Mechanism. As per CPCB order dated 18th January 2017, the White category includes Solar Power Plants of all capacities. (*http://kredlinfo.in/scrollfiles/exemption%20from%20pollution%20board.pdf)

S. No.	Issues	Relevance	Applicable Legislation	Agency Responsible	Applicable Permits and Requirements
5.	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 to ensure to obtain license under the electricity act and ensure that the Health and Safety requirements specified under the rules are compiled to.
6.	Surface Transportation	Movement of vehicles during operational phase	**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 to ensure compliance of stipulated standards under rule 115. Safety compliance under the rules.
7.	Labour	Engagement of Labour at site	**Workmen's Compensation Act, 1923 & Rules 1924**	Deputy Chief Inspector of Factories	CSPGPL to ensure that compensation in accordance with the Act is paid to the workers in case of personal injury caused by accident arising out of and in the course of his employment.
8.	Labour	Engagement of bonded Labour at site	**Bonded Labour (Abolition) Act 1976**	Deputy Chief Inspector of Factories	All forms of bonded labour is abolished CSPGPL will ensure compliance
9.	Labour	Working conditions of contracted Labour working at the site	**The Contract Labour (Regulation and Abolition) Rules, 1971**	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
10.	Labour	Engagement of Child Labour at site	**The Child Labour (Prohibition and Regulation) Act, 1986**	Deputy Chief Inspector of Factories	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
11.	Labour	Provision of wages to labour engaged at the site	**Minimum Wages Act, 1948**	Deputy Chief Inspector of Factories	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
12.	Labour	Equal wages to male and female workers at site	**Equal Remuneration Act 1976**	Deputy Chief Inspector of Factories	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

S. No.	Issues	Relevance	Applicable Legislation	Agency Responsible	Applicable Permits and Requirements
	13.Labour	Engagement of Female Labour at site	**Maternity Benefit Act, 1961 including amendment as in Maternity Benefit (Amendment) Act, 2017**	Deputy Chief Inspector of Factories	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.

3.3 Policies Framework in India

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 table below.

Table 3-3: National and State Level Policies Applicable to the Project

S.N.	Name of the Policy	Description
1.	National Electricity Policy 2005	Government of India released the National Environment Policy in 2006. The present national policies for environmental management are contained in the National Forest Policy, 1988, the National Conservation Strategy and Policy Statement on Environment and Development, 1992; and the Policy Statement on Abatement of Pollution, 1992. Some sector policies such as the National Agriculture Policy, 2000; National Population Policy, 2000; and National Water Policy, 2002; have also contributed towards environmental management. All of these policies have recognized the need for sustainable development in their specific contexts and formulated necessary strategies to give effect to such recognition. 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.
2.	National Solar Mission	The objective of the Jawaharlal Nehru National Solar Mission (JNNSM) under the brand 'Solar India' is to establish India as a global leader in solar energy, by creating the policy conditions for its diffusion across the country as quickly as possible. The Mission has set a target of 20,000 MW and stipulates implementation and achievement of the target in 3 phases (first phase up to 2012-13, second phase from 2013 to 2017 and the third phase from 2017 to 2022) for various components, including grid connected solar power. The successful implementation of the JNNSM requires the identification of resources to overcome the financial, investment, technology, institutional and other related barriers which confront solar power development in India. The penetration of solar power, therefore, requires substantial support. The policy framework of the Mission will facilitate the process of achieving grid parity by 2022.
3.	National Environmental Policy, 2006	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 Environmental 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.
4.	Karnataka Solar Energy Policy 2014-2020	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. The Solar Policy has been formulated by KREDL with the following objectives: • To add solar generation of minimum 2000 MW by 2021 in a phased manner by creating a favourable industrial atmosphere; • To translate Karnataka into an investor friendly state; • To encourage public private participation in the sector;

S.N.	Name of the Policy	Description
		• To encourage decentralized generation & distribution of energy where access to grid is difficult; • To promote Research and Development and innovations, skill development in the sector. CSPGPL holds the responsibility for development of power evacuation facilities along with interconnection scheme and bay equipment along with protection equipment from the project till the grid sub-station of GESCOM.

3.4 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. The applicability of the Performance Standards is discussed in the ***Table 3-3*** below:

Table 3-4: Applicability of the IFC Performance Standards for the Project

S. No.	Performance Standard	Description and Applicability
1.	PS1 – Assessment and Management of Environmental and Social Risks and Impacts	***APPLICABLE*** 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. The PS 1 is applicable to projects with environment and/or social risks and/or impacts. Hence, PS 1 is applicable to the project necessitating an Environmental and Social Impact Assessment (ESIA) study to be conducted prior to commencement of the project. The project is a solar power project and will have environmental and social impacts such as stress on existing water resources, waste generation etc. Hero Future Energies has developed and implemented an Environmental and Social Management Framework to manage the risks associated with its operations. The ESMS will be implemented by CSPGPL at the project level.
2.	PS2 – Labour and Working Conditions	***APPLICABLE*** 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 applicability of PS 2 will be for the operation phase even though there would be fewer numbers of workers. It will not only cover the main plant employees, but all

S. No.	Performance Standard	Description and Applicability
		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 site in the operational phasel. CSPGPL is to 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.
3.	PS3 - Resource Efficiency and Pollution Prevention	***APPLICABLE*** PS3 recognizes that increased economic activity and urbanization often generate increased levels of pollution to air, water, and land, and consume finite resources in a manner that may threaten people and the environment at the local, regional, and global levels. The objectives of PS 3 are: • To avoid or minimize adverse impacts on human health and the environment by avoiding or minimizing pollution from project activities. • To promote more sustainable use of resources, including energy and water. • To reduce project-related GHG emissions. The solar project is a clean energy project and will not have major pollution sources associated with it. The construction works for the development of project entailed generation of wastes like wastewater, used oil from DG sets and construction debris. The operation phase will result in generation of minor quantities of waste such as used transformer oil, broken and defunct solar panels and waste water from cleaning of solar panels. CSPGPL should monitor emissions and manage waste to ensure that the requirements of PS 3 are being met.
4.	PS4 – Community Health, Safety and Security	***APPLICABLE*** 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. 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 during the operation phase will be limited to noise levels and glare impacts at adjoining villages which need to be kept within the acceptable norms. 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.
5.	PS5 – Land Acquisition and Involuntary Resettlement	***NOT APPLICABLE*** 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 implemented with appropriate disclosure of Information, consultation, and the informed participation of those affected.

S. No.	Performance Standard	Description and Applicability
		For the project, a total of 240.2 acres of private land has been purchased by CSPGPL through a broker, Mr. Raju Gowda based in Gulbarga from 56 landowners for settling up of the solar power plant and its associated facilities such as internal roads, office buildings, switch yard etc. The land as informed during discussions held with the landowners was used in undertaking rainfed agricultural activities. Over 5 years, because of the gradual decline in rainfall, the agricultural activities ceased and the land became fallow and unusable. Hence, 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.
6.	PS6 – Biodiversity Conservation and Sustainable Management of Living Natural Resources	***APPLICABLE*** 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. The objectives of PS 6 are: • To protect and conserve biodiversity. • To maintain the benefits from ecosystem services. • To promote the sustainable management of living natural resources through the adoption of practices that integrate conservation needs and development priorities. The project involved various activities such as removal of vegetation cover, levelling of land for site preparation, laying of new access roads, movement of vehicles and physical presence of solar panels which are likely to cause habitat loss.
7.	PS7 – Indigenous People	***NOT APPLICABLE*** Performance Standard 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. The project area or its surroundings does not support indigenous people. No material degradation or adverse impact is there on land resources on which indigenous peoples are dependent.
8.	PS8 – Cultural Heritage	***NOT APPLICABLE*** For the purposes of this Performance Standard, cultural heritage refers to tangible forms of cultural heritage, such as tangible moveable or immovable objects, property, sites, structures, or groups of structures, having archaeological (prehistoric), paleontological, historical, cultural, artistic, and religious values. There are no culturally important sites in or around the project site. The requirements of PS 8 are therefore not applicable to the project.

3.4.1 IFC Categorisation of Project

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.

3.4.2 World Bank EHS Guidelines

The Equator Principle III requires follow up of the environmental, health and safety requirements as per the following guidelines released by IFC on 30th April 2007:

- Environmental, Health, and Safety General Guidelines
- Environmental, Health, and Safety Guidelines for Electric Power Transmission and Distribution issued on 30th April 2007.

3.5 Applicable Environmental Standards

3.5.1 Ambient Air Quality

As per the IFC EHS guidelines (April 2007), “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 Standards (NAAQS), as notified under Environment (Protection) Rules 1986 and revised through Environment (Protection) Seventh Amendment Rules, 2009 are given ***Table 3-5***:

Table 3-5: 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*	40	30
	24 Hours**	80	80
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 2.5 µm) or $PM_{2.5}$, µg/m^3	Annual*	40	40
	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

Pollutant	Time Weighted Average	Concentration in Ambient Air	
		Industrial, Residential, Rural and other Areas	Ecologically Sensitive Area (notified by Central Government)
	24 Hours**	400	400
Benzene (C_6H_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

**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 1 hourly value 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.*

3.5.2 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 (6.00 a.m. to 10.00 p.m.) is **55 dB (A)** while the Leq hourly for night time (10.00 p.m. to 6.00 a.m.) is prescribed as **45 dB (A).** Noise standards notified by the MoEF&CC vide gazette notification dated 14th February 2000 based on the *A- weighted equivalent noise level (Leq)* are as presented in ***Table 3-6***.

Table 3-6: 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
D	Silence Zone*	50	40

**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.*

3.5.3 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 3-7: Standards for Occupational Noise Exposure

Total Time of Exposure per Day in Hours (Continuous or Short-term Exposure)	Sound Pressure Level in dB(A)
8	90
6	92
4	95
3	97
2	100
3/2	102
1	105

Total Time of Exposure per Day in Hours (Continuous or Short-term Exposure)	Sound Pressure Level in dB(A)
¾	107
½	110
¼	115
Never	>115

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.

3.5.4 Water Quality Standards

The designated best use classification as prescribed by CPCB for surface water is as given in ***Table 3-8***.

Table 3-8: Primary Water Quality Criteria for Designated Best Use Classes

Designated-Best-Use	Class	Criteria
Drinking Water Source without conventional treatment but after disinfection	A	• Total Coliforms Organism MPN/100ml shall be 50 or less • pH between 6.5 and 8.5 • Dissolved Oxygen 6mg/l or more • Biochemical Oxygen Demand 5 days 20°C 2mg/l or less
Outdoor bathing (Organised)	B	• Total Coliforms Organism MPN/100ml shall be 500 or less • pH between 6.5 and 8.5 • Dissolved Oxygen 5mg/l or more • Biochemical Oxygen Demand 5 days 20°C 3mg/l or less
Drinking water source after conventional treatment and disinfection	C	• Total Coliforms Organism MPN/100ml shall be 5000 or less • pH between 6 to 9 • Dissolved Oxygen 4mg/l or more • Biochemical Oxygen Demand 5 days 20°C 3mg/l or less
Propagation of Wild life and Fisheries	D	• pH between 6.5 to 8.5 • Dissolved Oxygen 4mg/l or more • Free Ammonia (as N) 1.2 mg/l or less
Irrigation, Industrial Cooling, Controlled Waste disposal	E	• pH between 6.0 to 8.5 • Electrical Conductivity at 25°C micro mhos/cm Max.2250 • Sodium absorption Ratio Max. 26 • Boron Max. 2mg/l
	Below-E	• Not Meeting A, B, C, D & E Criteria

Source: Central Pollution Control Board

As per the IFC EHS guidelines, the treated sewage discharge is required to meet the following guidelines.

Table 3-9: Treated sewage discharge guidelines as per IFC

S. No.	Parameter	Guideline Value
1.	pH	6-9
2.	BOD	30mg/l
3.	COD	125 mg/l
4.	Total Nitrogen	125 mg/l
5.	Oil and Grease	10 mg/l
6.	Total Suspended Solids	50 mg/l
7.	Total coliform bacteria	400 MPN/100 ml

3.6 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 3-10.***

Table 3-10: 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 17th September 1992 and also ratified the Copenhagen, Montreal and Beijing Amendments on 3rd March 2003.
2	UN (Rio) Convention on Biological Diversity	India is a party since: 1994-02-18 by: Ratification; Protocol - Party since: 11th 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	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. 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.
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	India has also ratified many of the International Labour Organization conventions that are relevant to the Project including: • 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. Environmental and Socio-Economic Baseline

4.1 Environmental Baseline

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 project area.

The Environmental and Social baseline study helps determine existing environmental conditions. Local knowledge and scientific field work provided most of the site-specific information used in this report. Existing information from the scientific literature (both published and unpublished), engineering studies and test work results, technical reports, and community socioeconomic studies were used wherever available. These studies were used to validate the baseline information.

The Project is located in Lingdahalli and Jonnikere villages in Aurad Taluka of Bidar District in Karnataka. A study area of 5 km from the project area was considered for the evaluation of environmental and social existing status and potential impacts. Activities that facilitated establishment of the baseline data include: site survey, ecological surveys, social surveys and interviews, processing of satellite imagery and secondary data review from established sources such as Indian Meteorological Department and Census of India amongst others.

This section covers the following topics:

- Physiography
- Geology
- Drainage
- Land Use
- Soil Classification
- Hydrogeology
- Climate and Meteorology
- Natural Hazards
- Noise Monitoring
- Ambient Air Quality
- Water Quality

4.1.1 Physiography

The district falls in deccan drop and represents a monotonous treeless extensive plateau. Physiographically, the district can be divided into two regions, i.e. northern low lands and southern high lands. The southern high lands are popularly known as Bidar plateau, which is made up of laterite. The ground altitudes are varying from 420 to 684 m above mean sea level (amsl). Bidar plateau has an elevation range from 640 to 684 m above msl. The ground surface is flat, gently sloping forming broad valleys and flat-topped hills. The flat-topped hills with Step like sides exhibit the terraced landscape. The elevation of the district is 710 m above mean sea level (MSL).

Figure 4-1 presents the Physiographical map of Karnataka with project location indicated on the Map.

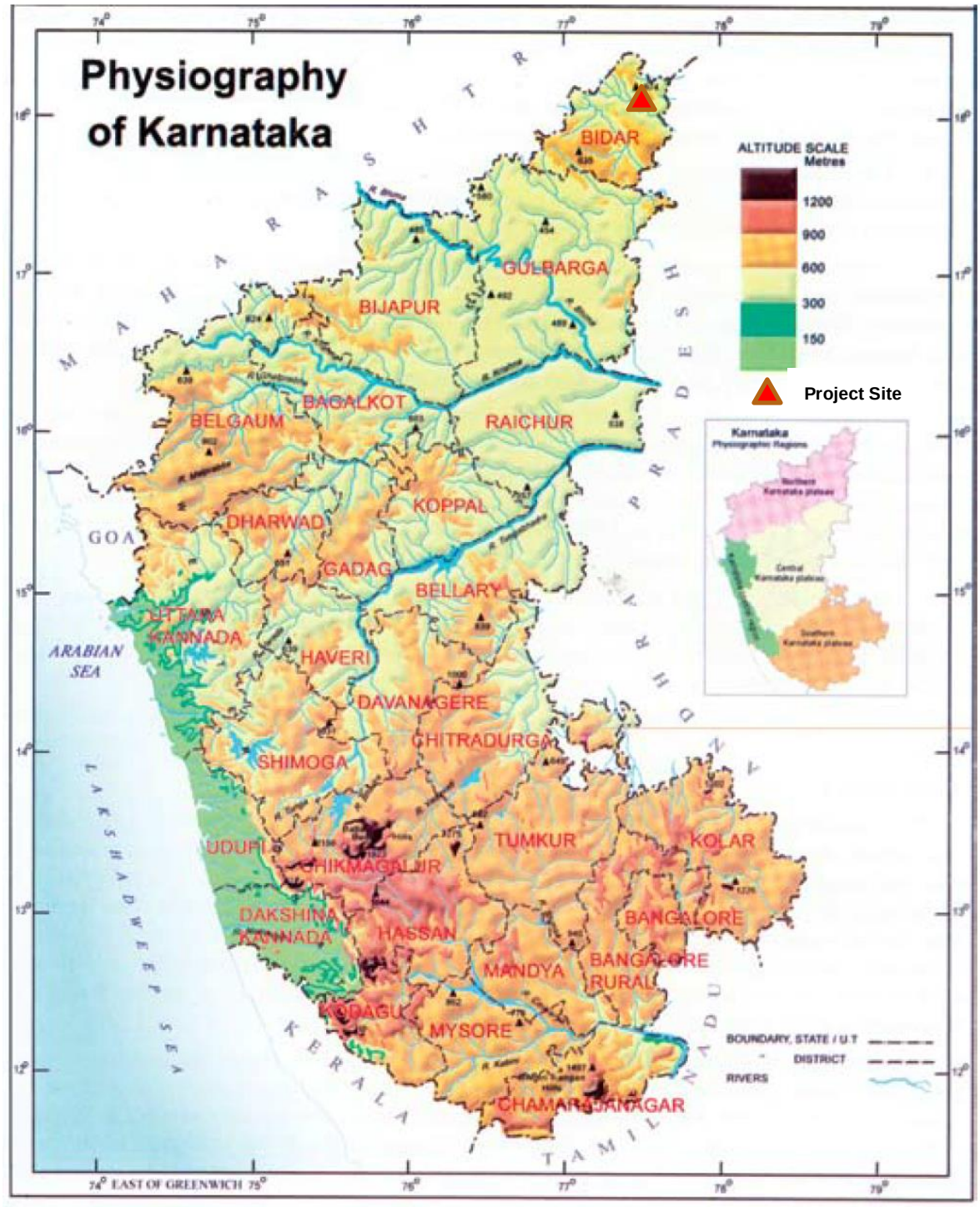


Figure 4-1:Physiographical map of Karnataka indicating Project Location

Source: A Handbook of Karnataka, Government of Karnataka

4.1.2 Geology

Bidar district forms part of the Northern Maidan region of Karnataka. The district is entirely covered by the Deccan trap flows of the tertiary period. The Deccan trap is composed of horizontal flows of basaltic lava. They generally form flat-topped hillocks and terrace-like features. The physical characteristics of individual flows show considerable variations. Some flows are hard and massive while others are weathered, soft and friable. This character has resulted in terraced landscape, suddenly ending in escarpments. The traps are seen generally 618 m above mean sea level. These are jointed and show the characteristics of spherical weathering leaving massive

hard cores. Columnar jointing is predominantly developed in these rocks, besides horizontal joints, which impart to the rocks bedded appearance. The top layers of the Deccan trap in parts of Bidar and Humnabad Taluk are altered to reddish vesicular laterite, forming an extensive undulating plateau. Secondary minerals like zeolites, quartz, calcite or some earthy or ferruginous material fill the vesicles. Well-developed columnar joints and spherical weathering are characteristic features of the massive basalt. The massive basalt and vesicular basalt are similar in term of compositionally and texturally. The southern half of the district is a high plateau about 715 m above mean sea level and is well drained. The average elevation of the district is between 580 to 610 m above mean sea level. Alluvial deposit is normally found along the banks of the Manjra River and its main tributaries. ***Figure 4-2*** shows the Geological Map of Karnataka state.

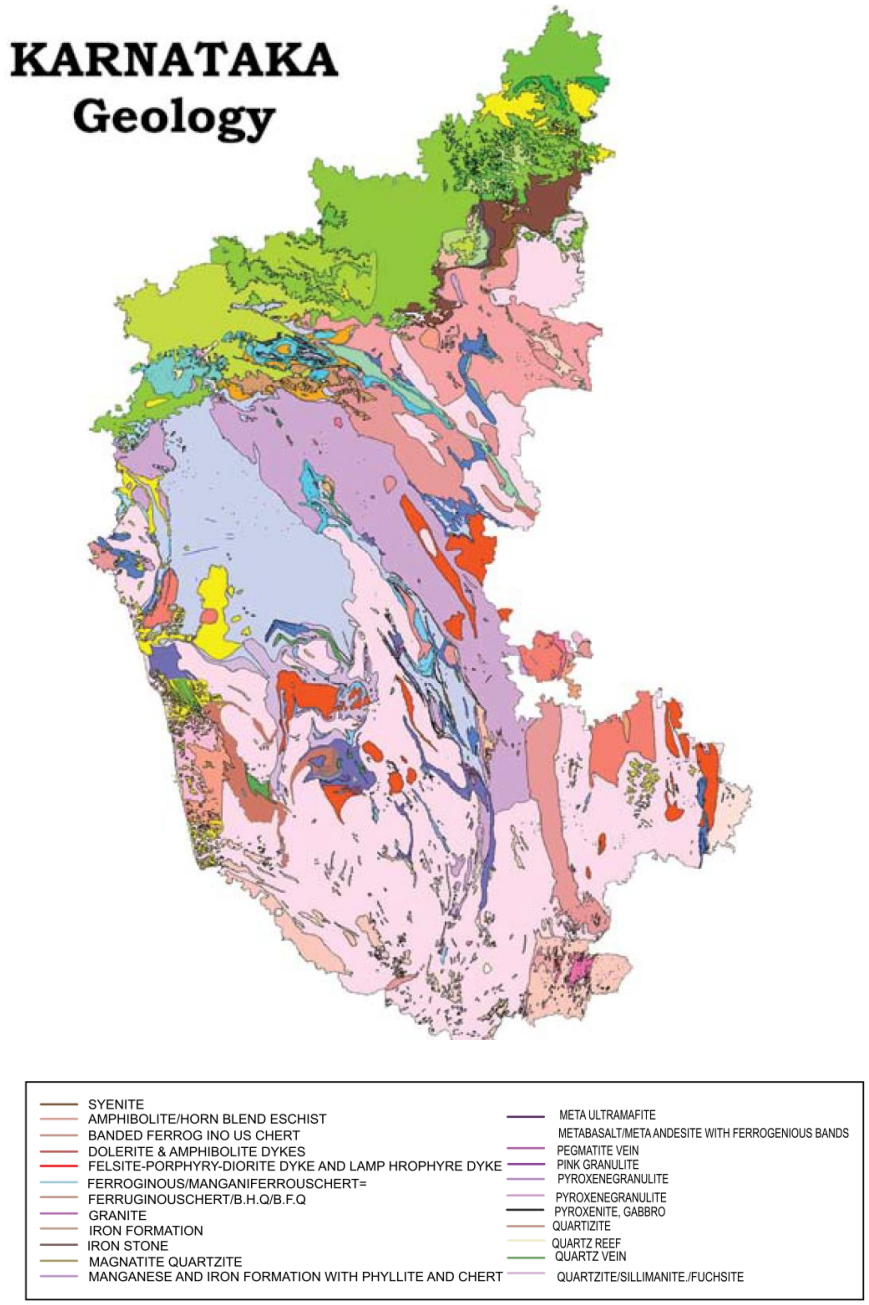


Figure 4-2: Geological Map of Karnataka

Source: A Handbook of Karnataka, Government of Karnataka

4.1.3 Drainage

The drainage pattern in the district varies from sub-dendritic to dendritic and some streams have a sub parallel drainage to the main river.

Major parts of the district are covered by Godavari basin, drained by its two major tributaries the Manjara and the Karanja Rivers. The Manjara River is a Perennial river flowing over a distance of 155 km in the central parts of the district and flows in eastern direction with a meandering course. The Karanja River flows in northern-western direction for 74 km with Karanja reservoir being major water source. The river Mullamari takes its origin near Matala village of Basavakalyan Taluk flows from west to east length of 38 sq. km and then flows into Gulbarga district and joins the river Kagna. The Kagna River is one of the main tributaries of Bhima river. Besides, there are several streams, which are of ephemeral in nature. Though there are large numbers of stream segments in all over the district, they are nonperennial or semi perennial in nature. The stream channels and low valleys remain dry for a long period in a year. The streams are small and flow only during the rainy season. The Manjra is of vital importance to arid region of Bidar district through which it runs forming a boundary for the Aurad taluka in the north and for the Bhalki and Bidar talukas in the south. The drainage map of Bidar district has been shown in the ***Figure 4-3*** below.

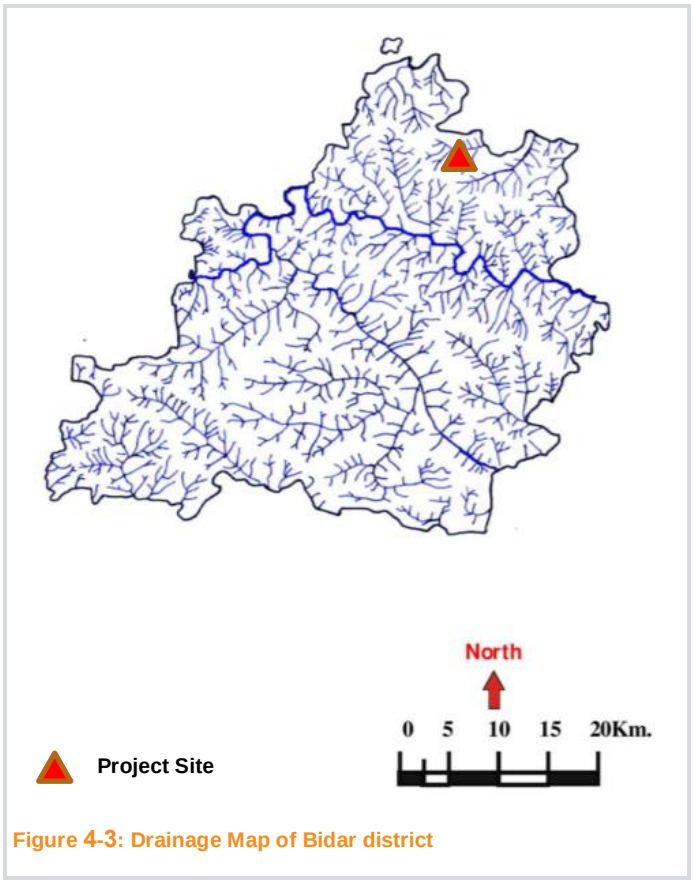


Figure 4-3: Drainage Map of Bidar district

The drainage pattern specific to the Project site has been shown in the ***Figure 4-4.***

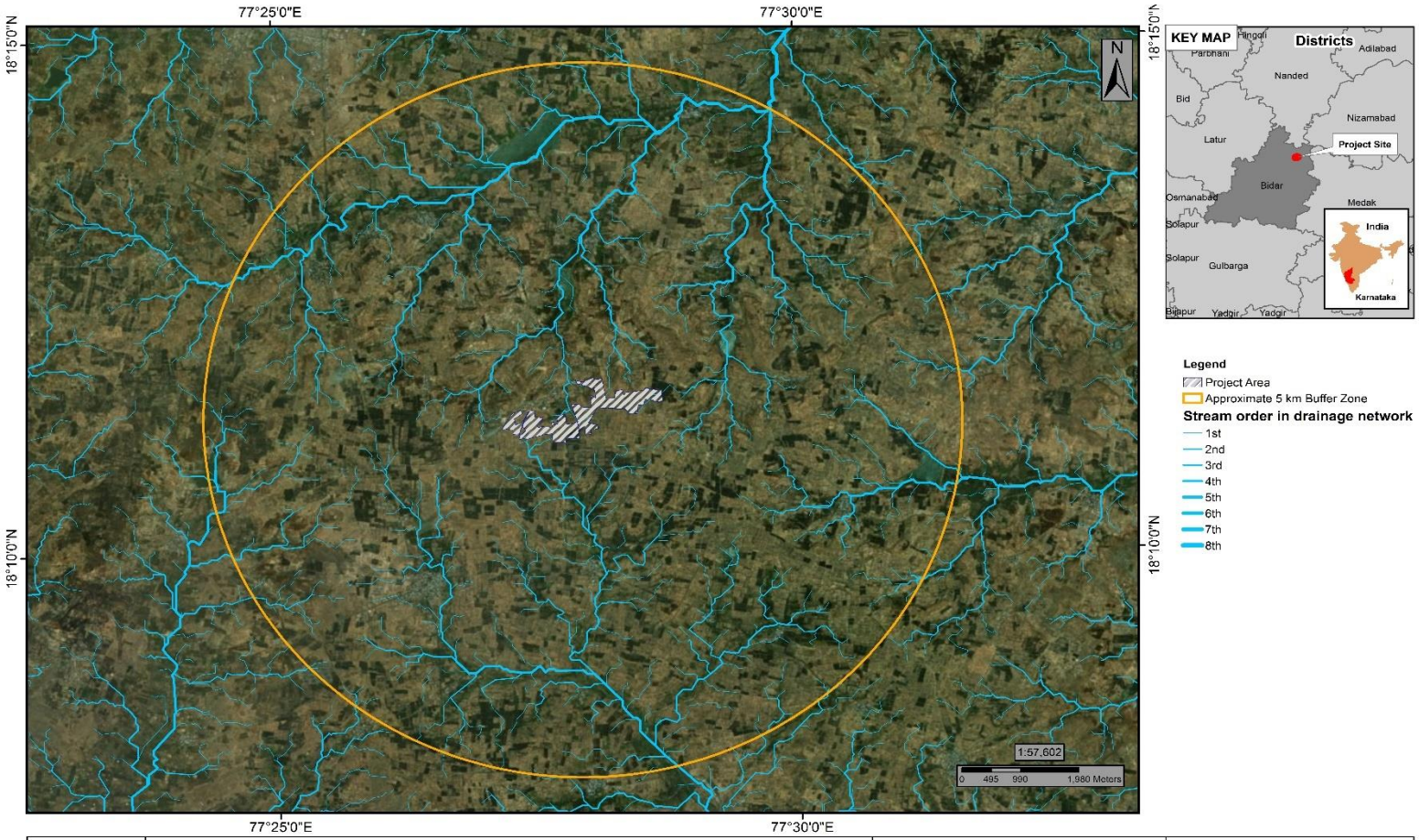


Figure 4-4. Drainage map of the Study Area

4.1.4 Land use and Land Cover

The total land resource of Bidar District is 5,460.12 sq. km. It has been utilized for various purposes. The district consists of five talukas' viz., Aurad, Bhalki, Bidar, Basavakalyan and Humnabad. The Aurad Taluka represents 22.4 percent of total geographical area of the district (1,227.2 sq. km).

The total area of the district has been put under many types of uses. The dominant land use types in Bidar district include forest area, non-agricultural area, barren land, cultivable waste land, permanent pasture land, area under trees and grooves, fallow land, net sown area and others. The area under 'others' category includes the area related to roads, railways, urban and rural settlements, quarrying and industrial etc. Land use/land cover map of the project area has been represented in the ***Figure 4-5***.

The Taluka has a total geographical area of 1,227.2 sq. km., out of which net sown area is 1060.8 sq. km. with once sown area of 190.7 sq. km, forest area is 23.11 sq. km., land not available for cultivation is 81.85 sq. km, uncultivable land is 78.28 sq. km and fallow land is 185.99 sq. km.

The project site specific Landuse has been presented in the following ***Table 4-1***,

Table 4-1: Landuse specific to Project Area

S. No.	Landuse Type	Area in Sq. km	% of total area
1.	Settlements	1.66	1.28
2.	Reservoirs/Ponds/Lakes	1.01	0.78
3.	Rivers/Streams	0.33	0.25
4.	Fallow Agricultural Land	94.58	72.99
5.	Barren Land/Uncultivable Land	9.29	7.17
6.	Agriculture Land	21.17	16.34
7.	Solar Park	1.38	1.06
8.	Mining Land	0.16	0.12
Total Area in sq. km.		**129.58**	**100**

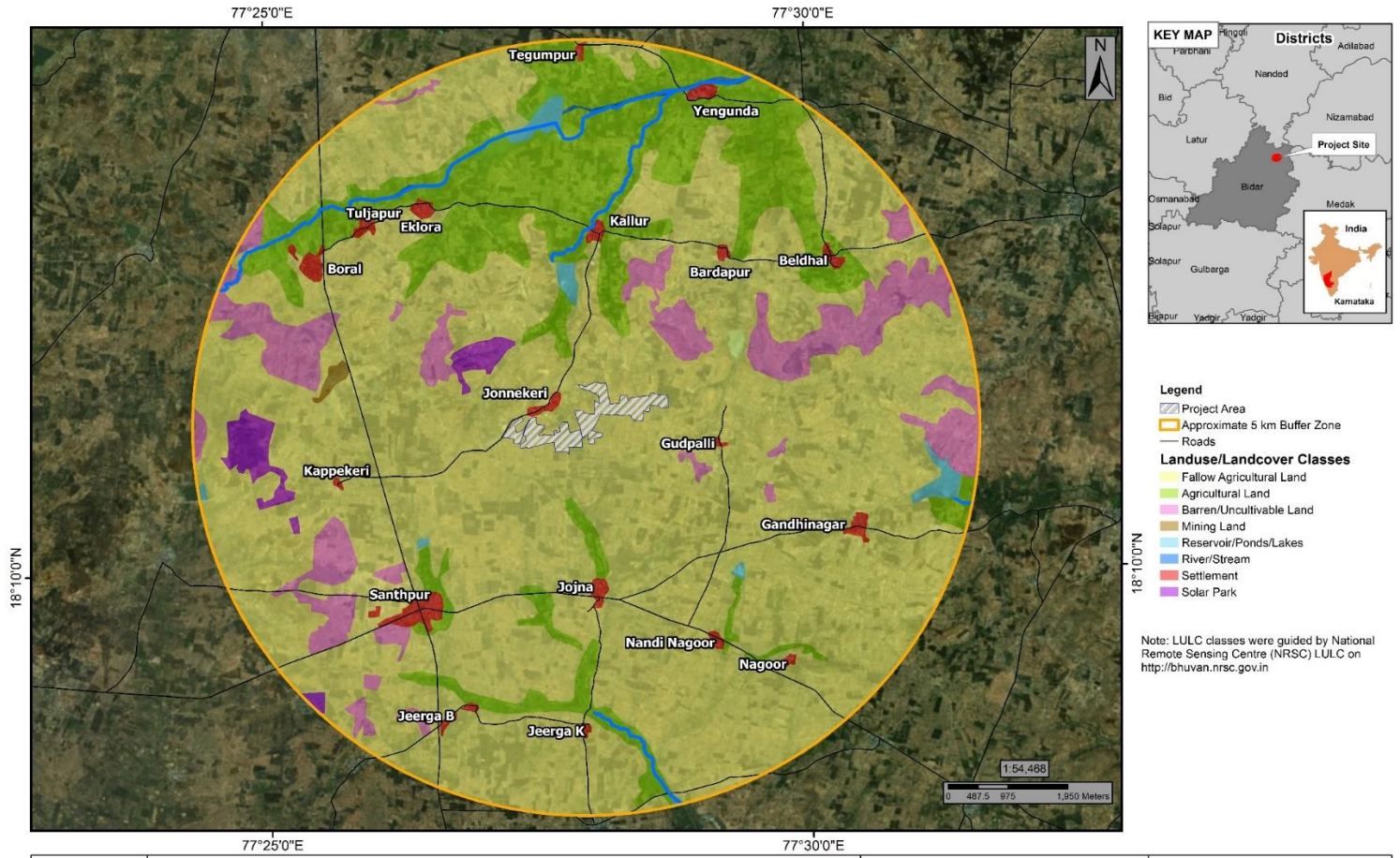


Figure 4-5. Landuse map of Study Area

4.1.5 Soil Types

Soil of the Bidar district is divided into two major forms:

Black Soils

Major parts of the district are comprised of black soils and are derived from Deccan traps. These are deep black in color and their texture varies from loam to clay. Lime concentration in this soil is high, resulting in poor infiltration capacities. Their infiltration characteristics are poor to moderate. This type of soils covers mainly in areas lying below 610 m contour and along the valley portions. The soils are characterized by swelling and shrinkage, plasticity and stickiness. The soils are generally calcareous, neutral to slightly alkaline in reaction. They are however, poor in organic matter, nitrogen and available phosphorus.

Lateritic Soils

Lateritic soil is confined to the central portion of the district. Lateritic soils are pale to bright red in color and clay to clayey loam in nature. This soil has moderate to good infiltration characteristics. This type of soil covers mainly areas lying above 610 m contour. The soil of the basalt plateau is generally black clayey soils of varying depth, characteristic of basaltic landscape. The major limitations of such soils are the deficiency of phosphates accentuated by high phosphate fixing capacity as Fe and Al phosphate, high acidity, toxicity of aluminum and manganese, deficiency of potassium, calcium, magnesium, zinc and boron.

Aurad taluka consists of shallow to medium black soil and also deep black soil. The soil consists of nitrate, sulphur and potash in smaller quantities. There is deficiency of copper and boron elements in the soil. The black soil is clay to clay loam in texture. The pH of the soil is neutral, low in carbon with low water holding capacity.

4.1.6 Hydrogeology

The entire district is underlain by lava flows of the Deccan trap except small areas covered with the laterites capping. Deccan trap consists of successive lava flows, almost horizontal in disposition. Individual flows show considerable variation in physical character, thickness, nature and extent of weathering etc. The basaltic lava flows are generally dark, grey, hard and compact. Each lava flows normally consists two units, i.e. lower massive basalt and upper vesicular basalt. Secondary minerals like zeolites, quartz, calcite or some earthy or ferruginous material fill the vesicles. Well-developed columnar joints and spherical weathering are characteristic features of the massive basalt. The presence of columnar joints in massive basalt also helps in the occurrence and movement of ground water. The massive basalt and vesicular basalt are similar in term of compositionally and texturally.

The depth to water level in the district varies from 1.45 to 17.73 m bgl in the area during the pre-monsoon period (May) and from 0.69 to 16.46 m bgl during the post monsoon (November) period.

The hydrogeology of the Bidar district is shown in the ***Figure 4-6***.

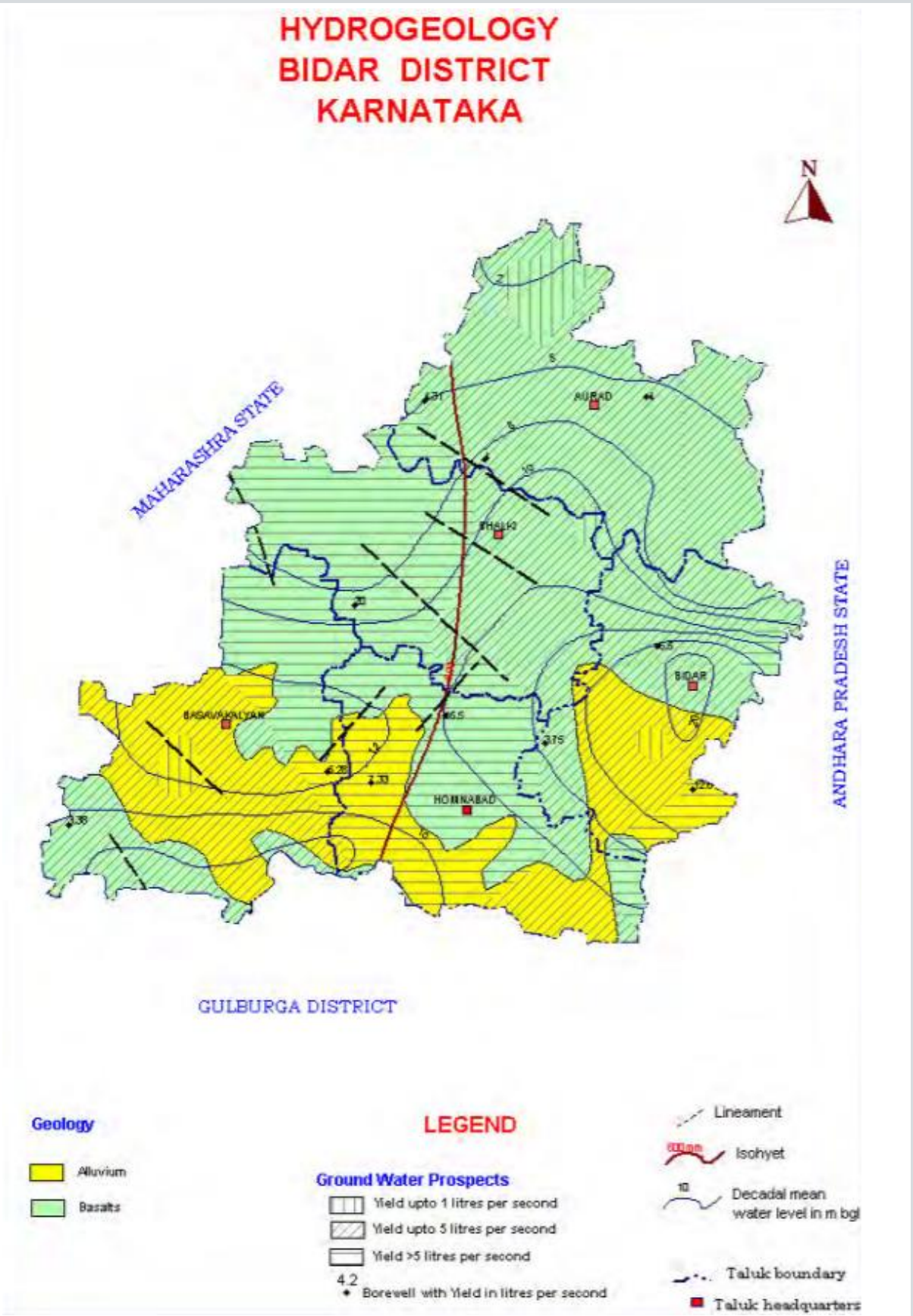


Figure 4-6. Hydrogeological map of Bidar district

Source: Ground Water Brochure, Bidar District, Karnataka, 2012

4.1.7 Climate and Meteorology

Karnataka located on the western coast, gets most of the precipitation from the southwest monsoon. The State enjoys three distinct climates varying with the seasons. The winter season from January to February is followed by summer season from March to May. The period from October to December forms the post-monsoon season.

The district experiences semi-arid climate with extreme summer. The year in the district may be divided into summer season from March to May, southwest monsoon season from June to September, post-monsoon season from October to November and winter season from December to February.

The climate of Bidar district is characterized by general dryness throughout the year except during the south-west monsoon. Dust storms and severe heat waves are common in the district between April and May. Temperature begins to rise towards the end of February till the end of May, which is the hottest month of the year with mean daily maximum temperature of 38.8°C and mean daily minimum of 25.9°C. December is the coldest month with mean daily maximum temperature of 27.3°C and mean daily minimum of 16.4°C. With the withdrawal of south west monsoon in the first week of October, there is slight increase in day temperature, but night temperature decreases rapidly. After October, both day and night temperatures decrease progressively.

4.1.7.1 Rainfall

Generally, the monsoon sets in the month of June and reaches climax in the month of September. The normal annual rainfall of the district is 827 mm. The annual number of the rainy days is about 45-55 days. Nearly 75%-80% of the rain is received during the southwest monsoon period (June- Sept). A few showers are also received during the North- East Monsoon, generally in the month of December.

Climate data published by Indian Meteorological Department (IMD), for Bidar for the period of 1981 to 2010 is given below in ***Table 4-2.***

Table 4-2: Meteorological Data based on observation from 1981 to 2010 for Bidar

Month	Mean Temperature		Relative Humidity (%)	Rainfall (mm)
	Daily Max (°C)	Daily Min (°C)		
January I[2]	29.1	16.3	66	12.2
II[3]			45	
February I	32.2	18.4	57	2.5
II			36	
March I	35.8	21.9	50	11.4
II			36	
April I	38.1	24.4	49	22.8
II			36	
May I	38.9	25.3	56	21.1
II			41	
June I	33.7	22.9	77	132.8
II			59	
July I	29.9	21.7	84	193.1
II			68	
August I	28.9	21.3	85	211.9
II			71	
September I	30	21.4	81	152.5
II			67	
October I	30.2	20.4	72	116.5
II			58	
November I	29	17.9	64	29.9

[2] Average (Mean) value of the parameter at 0300 UTC for the month
[3] Average value of the parameter at 1200 UTC for the month

Month	Mean Temperature		Relative Humidity (%)	Rainfall (mm)
	Daily Max (°C)	Daily Min (°C)		
II			52	
December I	28	15.8	64	5
II			49	
Total Annual Mean I	32.0	20.6	67	911.6
Mean II			52	
No. of Years			25	

Source: Climatological Tables of Observations in India (1981-2010), IMD report published 2015

Recent data for last five (5) years shows large variation in rainfall as shown in ***Table 4-3.***

Table 4-3: Average Annual Rainfall for Bidar District

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total Annual
2013	1.7	11.7	0.9	35.0	19.7	133.2	353.0	107.9	182.2	114.2	29.2	0.1	988.8
2014	0.0	6.4	67.7	12.9	41.1	52.5	114.7	197.6	93.4	24.3	21.0	11.5	643.1
2015	8.4	0.0	52.7	88.6	26.8	88.1	61.8	99.7	179.0	51.9	0.0	2.6	659.6
2016	0.8	1.7	23.2	20.6	60.8	263.7	231.1	90.0	472.1	137.8	0.0	0.2	1302
2017	0.0	0.0	35.4	1.5	10.6	212.0	75.9	221.8	132.1	136.8	29.0	0.0	855.1
Monthly average	2.18	3.96	35.9	31.72	31.8	149.9	167.3	143.4	211.7	93	15.84	2.88	s

*Source: IMD (*http://hydro.imd.gov.in/hydrometweb/(S(25chamycq2hbav45jwsphs55))/DistrictRaifall.aspx)

4.1.7.2 Humidity

The relative humidity is high during the southwest monsoon and generally between 65% to 75%. Summer is the driest part of the year, where the relative humidity in the afternoon is between 30% and 40%.

4.1.7.3 Wind Speed

Wind is generally moderate in strength with some increase in force during the latter half of the summer season and during the monsoon. During south west monsoon season, winds mainly blow between the south west and north east direction. In the post monsoon season, wind blow predominantly between north and east direction. During winter season winds are variable in direction. Winds between north and west directions are rare. Cyclonic storms seldom pass through the district. Some of the post monsoon storms from the Bay of Bengal become defused after crossing the coast. Thunder storms occur frequently during the summer season and some of them are accompanied with hail.

Wind Hazard Map of Karnataka showing the project site is presented as ***Figure 4-7*** below. It can be noted that Project site falls in Moderate damage risk zone B (V_b=39 m/s).

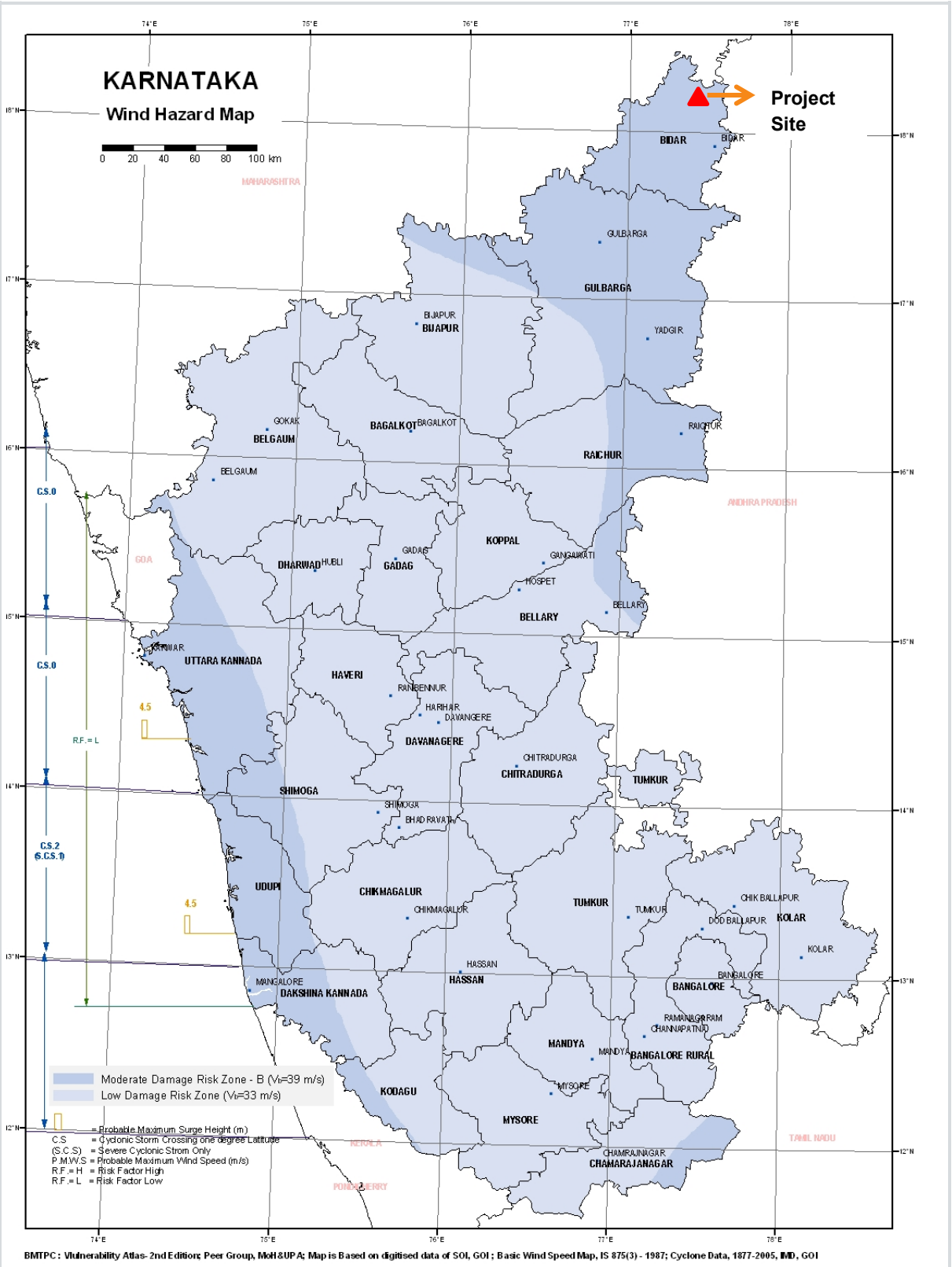


Figure 4-7. Wind Hazard Map of Karnataka showing Project District

Source: BMTPC Vulnerability Atlas: 2nd Edition, digitised on GOI Maps

4.1.7.4 Drought

Bidar district is located in the North Karnataka plateau of Karnataka State, which falls in the Hot semi-arid tract. The Taluka Aurad falls under the North eastern transitional zone (Zone 1) of the Agro-climatic zones of the Karnataka State.

The Government of Karnataka has declared the talukas as affected by drought in 2018 for Kharif and Rabi season in 2018 of which Aurad Taluka in Bidar district has been named as one of the talukas.

4.1.7.5 Seismicity

As per the Revised Earthquake Hazard Mapping, 22.13% of the total geographical area of the state is under 'moderate' earthquake damage risk zone and remaining area of the state is under 'low' damage risk zone. The Karnataka state is categorized as moderate to low seismic risk zone.

The solar power project under the Bidar District of Karnataka hence lies in Seismic Zone II (Low Damage Risk Zone (MSK VI) as can be seen in ***Figure 4-8*** below.

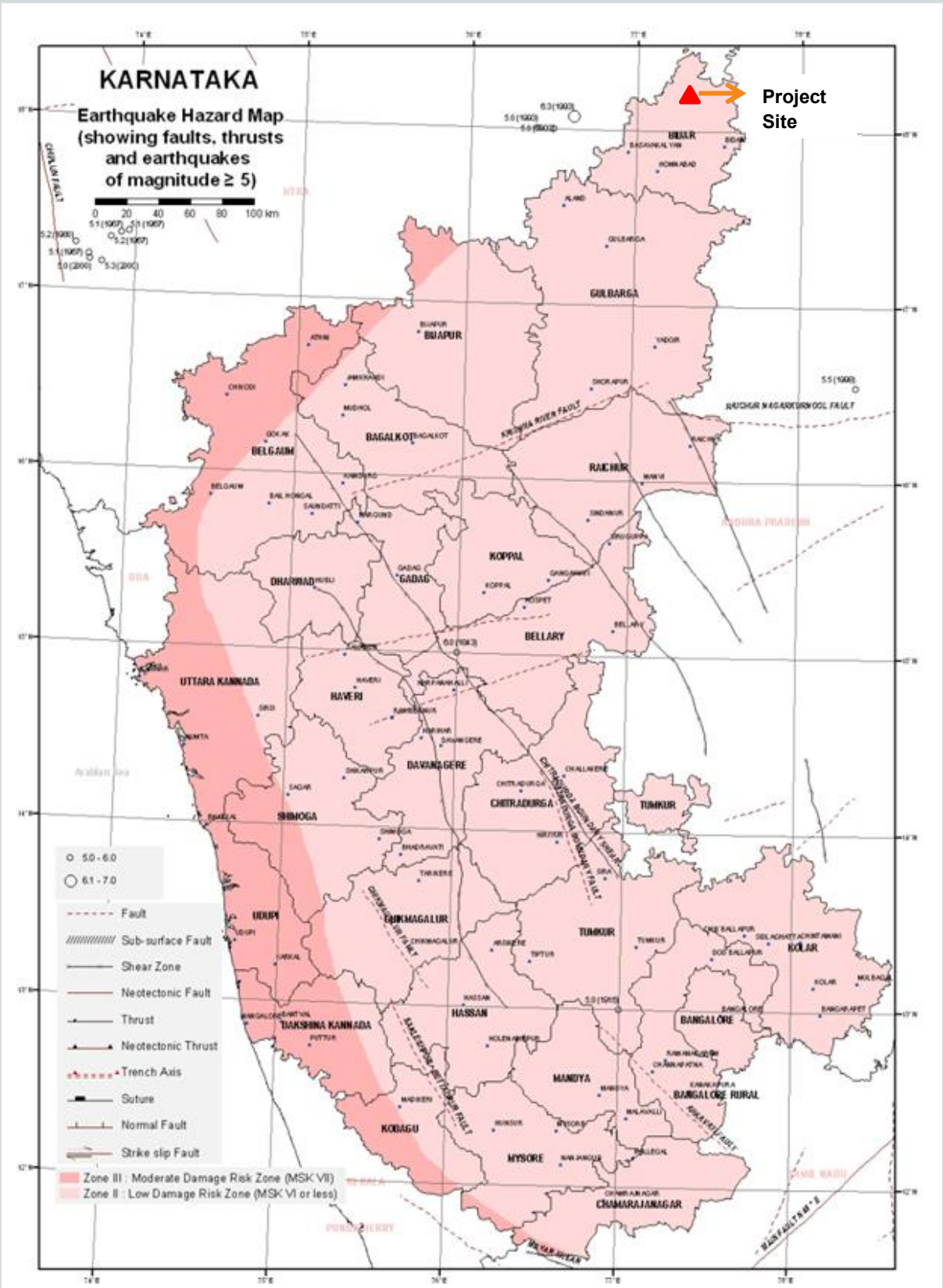


Figure 4-8:Earthquake Hazard Map of Karnataka State

Source: BMTPC Vulnerability Atlas: 2nd Edition, digitised on GOI Maps

4.2 Air, Water, Noise and Soil Baseline

In order to evaluate the environmental quality in the study area, monitoring was carried out for one season in the month of March 2019 at all the identified locations during site survey by an external laboratory, M/s Eco Services India Private Limited, which is accredited to National Accreditation Board for Testing and Calibration Laboratories (NABL) in accordance with ISO/IEC 17025:2005. The monitoring locations for ambient air, noise, water quality, soil quality and traffic have been represented in the ***Figure 4-9*** below.

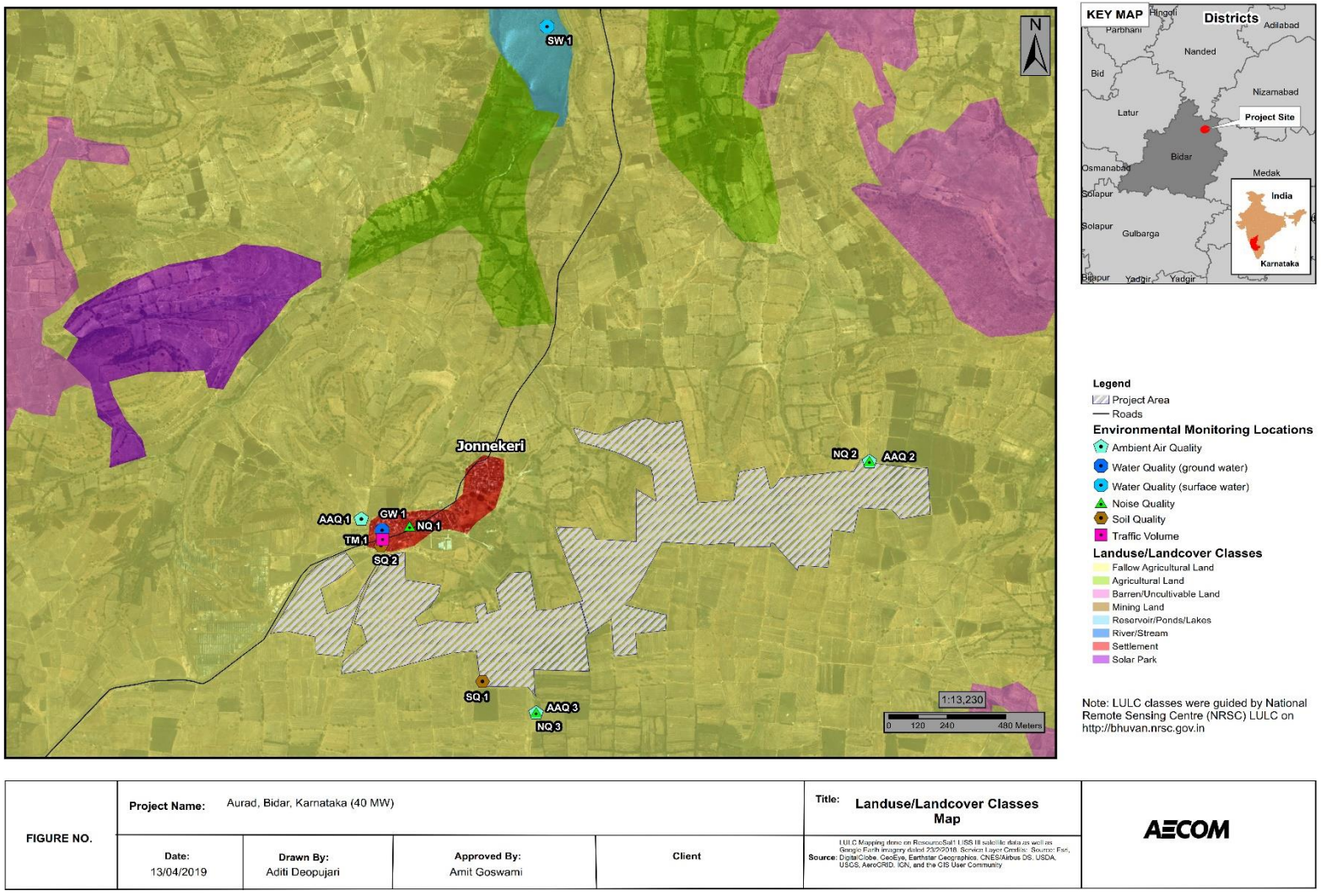


FIGURE NO.	Project Name: Aurad, Bidar, Karnataka (40 MW)				Title: Landuse/Landcover Classes Map	AECOM
	Date: 13/04/2019	Drawn By: Aditi Deopujari	Approved By: Amit Goswami	Client	Source: LULC Mapping done on ResourceSat1 LISS III satellite data as well as Google Earth imagery dated 23/2/2018. Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community	

Figure 4-9: Environment Monitoring Locations for 40 MW Solar Project in Aurad

4.2.1 Ambient Air Quality

Solar power projects in particular do not cause any emissions during its operation phase and fugitive dust emissions are witnessed only during construction phase of the project.

Ambient air was monitored in the project area for the month of March to estimate the quality of ambient air. The air quality was analysed at three (03) locations to estimate the concentration of primary pollutants in the ambient air. The sampling locations were selected considering the presence of habitation nearby and their accessibility. The geographical coordinates of the ambient air monitoring locations selected has been provided in ***Table 4-4.***

Table 4-4: Air Quality Monitoring Locations

Sample Code	Geo-graphical Coordinates	Sampling Location
AAQ-1	18° 11.468'N, 77° 27.380'E	Jonnikere village (Downwind to project site)
AAQ-2	18° 11.587'N, 77° 28.566'E	Site Boundary (Upwind to project site)
AAQ-3	18° 11.011'N, 77° 27.781'E	Near Farmlands (Crosswind to project site)

Source: AECOM Site Survey, March 2019

The ambient air quality results were compared to the National Ambient Air Quality Standards (NAAQS, 2009) for residential area and the analysis results of air quality have been presented below in the ***Table 4-5***.

Table 4-5: Results of Ambient Air Monitoring

Pollutant	Time Weighted Average	*Concentration in Ambient Air (Industrial, Residential, Rural and Other Areas)*	AAQ-1	AAQ-2	AAQ-3
Sulphur Dioxide (SO_2), µg/m3	24 Hours	*80*	8.8	8.2	8.0
Nitrogen Dioxide (NO_2), µg/m^3	24 Hours	*80*	16.2	15.1	15.9
Particulate Matter (size less than 10 µm) or PM_{10}, µg/m^3	24 Hours	*100*	68	52	43
Particulate Matter (size less than 2.5 µm) or PM $_{2.5}$, µg/m^3	24 Hours	*60*	19	16	12
Ozone (O_3), µg/m^3	8 Hours	*100*	BDL (<5.0)	BDL (<5.0)	BDL (<5.0)
Lead (Pb), µg/m^3	24 Hours	*1*	BDL (<0.001)	BDL (<0.001)	BDL (<0.001)
Carbon Monoxide (CO), mg/m^3	8 Hours	*2*	BDL (<1.14)	BDL (<1.14)	BDL (<1.14)
Ammonia (NH_3), µg/m^3	24 Hours	*400*	BDL (<5.0)	BDL (<5.0)	BDL (<5.0)
Benzene (C_6H_6), µg/m^3	Annual	*5*	BDL (<1.0)	BDL (<1.0)	BDL (<1.0)
Benzo (O) Pyrene (BaP), particulate phase only, ng/m^3	Annual	*1*	BDL (<0.8)	BDL (<0.8)	BDL (<0.8)
Arsenic (As), ng/m^3	Annual	*6*	BDL (<1.0)	BDL (<1.0)	BDL (<1.0)
Nickel (Ni), ng/m^3	Annual	20	BDL (<0.3)	BDL (<0.3)	BDL (<0.3)

Source: Laboratory Results, April 2019

BDL: Below Detectable Limit

Inference

It was observed that the concentration of oxides of sulphur and oxides of nitrogen were well within the limits prescribed in NAAQS, 2009. The particulate matter was also observed to be well below the standards prescribed for residential area. Other parameters were not detected in the air samples at the locations.

4.2.2 Ambient Noise Quality

Ambient Noise level was monitored continuously for 24 hours at three (3) locations around the project area at the identified receptor locations using Sound Level Meter. The noise levels obtained were analysed to arrive at the equivalent continuous noise level (Leq) for day and night time. The day and night time hours ranged from 06:00 to 22:00 hrs and 22:00 to 06:00 hrs respectively.

The sampling locations can be categorised as residential area. Therefore, the results of the ambient noise level monitoring presented in ***Table 4-7*** are compared with National Ambient Air Quality Standards (NAAQS) in respect of noise limits for day time and night time for residential area. The description and geographical coordinates of the monitoring locations is provided in the ***Table 4-6*** below.

Table 4-6: Details of Noise Quality Monitoring Locations

Sample Code	Geo-graphical Coordinates	Sampling Location
NQ-1	18° 11.449'N, 77° 27.492'E	Jonnikere village (Sensitive receptor)
NQ-2	18° 11.587'N, 77° 28.566'E	Site Boundary
NQ-3	18° 11.011'N, 77° 27.781'E	Near Farmlands

Source: AECOM Site Survey, March 2019

Table 4-7: Results of Ambient Noise level Monitoring

Location Code	*Noise Standard (Residential Area)*	NQ-1	NQ-2	NQ-3
L_{eq} Day dB (A)	*55*	47.8	50.7	46.5
L_{eq} Night dB (A)	*45*	41.6	41.4	38.9

Source: Laboratory Results, April 2019

Inference

It is observed that the noise levels at the monitoring locations ranged from 46.5-50.7 dB (A) during the daytime and 38.9 to 41.6 dB (A) during night time. The ambient noise levels at all the sampling locations were found to be within the noise standards for day time and night time for Residential Area.

4.2.3 Water Quality

The inhabitants of the Project villages near the Project site source their drinking and domestic use water from underground bore-wells in the villages. The households are also supplied with pipeline water from government supply.

Two (02) water samples, one from open well from Jonnikere village and one surface water sample from a perennial water body which is reportedly used for domestic purpose and irrigation by nearby villagers in Jonnikere village were selected to assess the water quality of the Project area. Sample of groundwater was examined for physico-chemical, heavy metals and biological parameters as per standard testing procedures and compared to Drinking Water Standards, IS 10500: 2012. The results of the surface water sample are compared with the CPCB classification of quality for the inland surface water. Location details and geographical coordinates of the sampling locations are presented in ***Table 4-8.***

Table 4-8: Details of Water Quality Monitoring Locations

S. No.	Location Code	Geographical Coordinates	Sampling Locations
1.	GW 1	18° 11.440'N, 77° 27.428'E	Bore well at Jonnikere Village (Ground water source)
2.	SW 1	18° 12.610'N, 77° 27.829'E	Water body near Project site (Used for domestic purpose, irrigation by nearby villages)

Source: AECOM Site Survey, March 2019

Table 4-9 presents the results of analysis of the ground water samples which are compared with acceptable and permissible limits as specified in the drinking water standards IS 10500:2012.

Table 4-9: Results of Ground Water and Surface Water Quality Analysis

S. No.	Parameters	Unit	GW1	SW1	*AL(PL)*
1.	Colour	Hazen	BDL	BDL	*5 (15)*
2.	Odour	-	Agreeable	Agreeable	*Agreeable*
3.	Taste	-	Agreeable	Agreeable	*Agreeable*
4.	Turbidity	NTU	1.0	**46**	*1(5)*
5.	pH	-	7.21	7.82	*6.5-8.5 (NR)*
6.	Dissolved Oxygen (DO)	mg/l	-	7	-
7.	Biological Oxygen Demand (BOD)	mg/l	-	6.6	-
8.	Chemical Oxygen Demand (COD)	mg/l	-	20	-
9.	Electrical Conductivity	µmhos/cm	761	532	-
10.	Total Dissolved Solids	mg/l	426	298	*500 (2000)*
11.	Total Alkalinity as $CaCO_3$	mg/l	**214**	126	*200 (600)*
12.	Total Hardness as $CaCO_3$	mg/l	**322**	168	*200 (600)*
13.	Chloride as Cl	mg/l	20	30	*250 (1000)*
14.	Sulphate as SO_4	mg/l	18	21	*200 (600)*
15.	Fluoride as F	mg/l	0.8	0.3	*200 (600)*
16.	Nitrate as NO_3	mg/l	3	9	*250 (1000)*
17.	Phenolic Compound as C_6H_5OH	mg/l	BDL	BDL	*0.001 (0.002)*
18.	Sulphide as S^{2-}	mg/l	BDL	BDL	*0.05 (NR)*
19.	Calcium as Ca	mg/l	**78**	35	*75 (200)*
20.	Magnesium as Mg	mg/l	**31**	19	*30 (100)*
21.	Iron as Fe	mg/l	BDL	0.3	*0.3 (NR)*
22.	Mercury as Hg	mg/l	BDL	BDL	*0.001 (NR)*
23.	Cadmium as Cd	mg/l	BDL	BDL	*0.003 (NR)*
24.	Arsenic as As	mg/l	BDL	BDL	*0.01 (0.05)*
25.	Lead as Pb	mg/l	BDL	BDL	*0.01 (NR)*
26.	Manganese as Mn	mg/l	BDL	BDL	*0.1 (0.3)*
27.	Zinc as Zn	mg/l	BDL	BDL	*5 (15)*
28.	Total Chromium as Cr	mg/l	BDL	BDL	*0.05 (NR)*
29.	Copper as Cu	mg/l	BDL	BDL	*0.05 (1.5)*
30.	Boron as B	mg/l	BDL	BDL	*0.5 (1.0)*
31.	Nickel as Ni	mg/l	BDL	BDL	*0.02 (NR)*
32.	Selenium as Se	mg/l	BDL	BDL	*0.01 (NR)*
33.	Free Residual Chlorine	mg/l	BDL	BDL	*0.2 (1.0)*
34.	Aluminium as Al	mg/l	BDL	BDL	*0.03 (0.2)*
35.	Ammonia as N	mg/l	BDL	BDL	*0.5 (NR)*
36.	Barium as Ba	mg/l	BDL	BDL	*0.7 (NR)*
37.	Pesticides	-	ND	ND	*- (NR)*
38.	Mineral Oil	mg/l	BDL	BDL	*0.5 (NR)*

S. No.	Parameters	Unit	GW1	SW1	*AL(PL)*
39.	Silver as Ag	mg/l	BDL	BDL	*0.1 (NR)*
40.	Cyanide as CN	mg/l	ND	ND	*0.01 (NR)*
41.	Molybdenum as Mo	mg/l	BDL	BDL	*0.07 (NR)*
42.	Chloramines as Cl_2	mg/l	ND	ND	*4.0 (NR)*
43.	Polychlorinated Biphenyl (PCB)	mg/l	ND	ND	*0.005 (NR)*
44.	Polynuclear aromatic hydrocarbons (PAH)	mg/l	ND	ND	*0.0001 (NR)*
45.	Anionic Detergents as MBAS	mg/l	BDL	BDL	*0.2 (1.0)*
46.	Total Coliform	MPN/100 ml	<2	<2	*Shall not be detectable in any 100 ml sample*
47.	E. Coli	-	<2	<2	*Shall not be detectable in any 100 ml sample*

Source: Laboratory Results, August 2018, ND- Not Detected

Note: AL- Acceptable Limit; PL – Permissible Limit; NR – No Relaxation as per IS10500:2012

Inference

- **Ground Water:** The pH value of the sample was observed to be within the prescribed range indicating neutral balance. The Hardness and alkalinity value in the ground water sample exceeds the acceptable limit but is within the permissible limit. Chemical parameters such as Chloride, Sulphate and Fluoride are within the acceptable limit. Calcium and Magnesium were noted to be exceeding the Acceptable limit but is within the Permissible limit. Other heavy metal parameters are below detectable limit. The ground water sample also shows presence of total and faecal coliforms in negligible quantity. All other parameters were observed to be within the Acceptable limits as specified in the drinking water standard of IS 10500:2012.
- **Surface Water:** The surface water sample has DO of 7 mg/l with pH value of 7.82, BOD of 6.6 mg/l and Total coliform of <2/100ml. Mineral and metal parameters such as Magnesium, Ammonia and Iron were found to be well within the Acceptable Limits. It was noted that Total and faecal coliform are present in the water samples in a negligible amount and indicates that the water has been contaminated with the faecal matter. The presence of bacterial contamination is an indicator that a potential health risk exists for individuals consuming this water directly without disinfection. Coliform bacteria may occur in water samples as a result of the overflow of domestic sewage or nonpoint sources of human and animal waste.

4.2.4 Soil Environment

Soil samples from two (02) locations were collected and analysed to evaluate the soil quality for physio-chemicals and heavy metals concentration in soil in the environment study area. The details of the soil quality monitoring locations are given in the ***Table 4-10.***

Table 4-10: Details of Soil Quality Monitoring Locations

S. No.	Sampling Locations	Location Code	Geographical Location
1	SQ 1	18° 11.084'N, 77° 27.657'E	Soil quality at Project Site
2	SQ 2	18° 11.404'N, 77° 27.425'E	Soil quality at Jonnikere Village

Source: AECOM Site Survey, March 2019

The physical and chemical characteristics of the soil samples were evaluated and compared with the standard soil classification provided by the Indian Council of Agricultural Research (ICAR) as depicted in the ***Table 4-11*** below***:***

Table 4-11: Standard Soil Classification

Soil Parameters	Classification	
pH	Normal to saline	6.0 to 8.5
	Tending to become alkaline	8.5-9.0

Soil Parameters	Classification	
	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

The results of soil quality analysis have been presented in the ***Table 4-12*** below:

Table 4-12: Results of Soil quality analysis

S. No.	Parameters	Unit	Sampling Locations	
			SQ1	SQ2
1	pH	-	6.63	6.74
2	Electrical Conductivity	µmhos/cm	116	150
3	**Texture**			
	Sand	%	14	5
	Silt	%	13	7
	Clay	%	72	83
4	Phosphorous (as P)	µg/g	0.2	43
5	Potassium (as K)	m.eq/100g	2	1.96
6	Sodium (as Na)	m.eq/100g	4	4.4
7	Total Nitrogen (as N)	%	0.112	0.154
8	Cation Exchange Capacity	Meq/l	37	43
9	Permeability	%	0.7	0.1
10	Porosity	%	2.5	0.2
11	**Particle Size Distribution**			
	10 mm	%	0.3	0.2
	4.75 mm	%	33	27
	2 mm	%	32	43
	425 microns	%	30	25
	75 microns	%	2	5

Source: Laboratory Results, April 2019

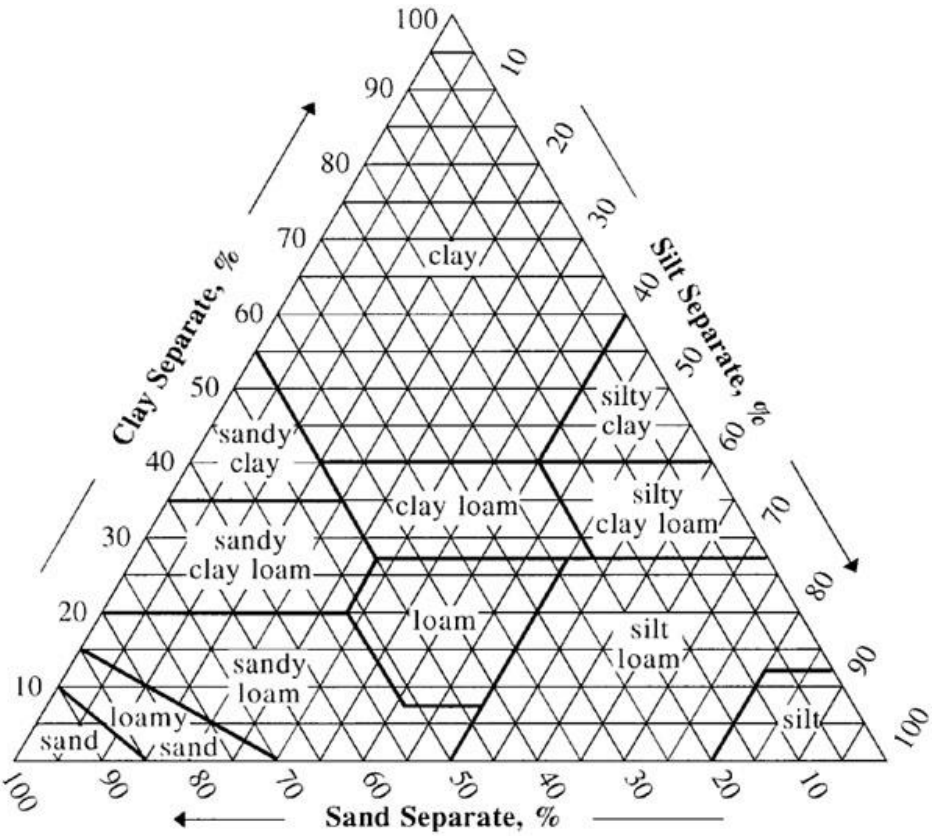


Figure 4-10: Soil Texture Diagram

(Source: United States Department of Agriculture
https://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/survey/?cid=nrcs142p2_054167)

Inference

It can be inferred from the results that the soil samples analysed show varied characteristics. The pH value of the soil samples, SQ1 and SQ 2 indicate normal to saline condition. Electrical conductivity of soil samples varies from 116-150 µmhos/cm indicating that soil falls under Normal category. The Phosphorous value in the sample SQ1 is 0.2 µg/g whereas in SQ 2 is 43 µg/g. Nitrogen values in the samples ranges from 0.112-0.154% and the Sodium concentration ranges from 4-4.4 m.eq/100g. The cation exchange capacity ranges from 37-43 for the samples. The samples are about 0.2-2.5% porous whereas the permeability in sample ranges from 0.7% in SQ1 and 0.1 % in SQ 2.

As per the Soil texture diagram (shown below in the Figure 4-10) prescribed by the United States Department of Agriculture (USDA), it can be deciphered that the texture of soil sample SQ 1, i.e. the soil at the project site is “Clay soil”, and the texture of soil sample SQ 2, the soil in the Jonnikere village is also “Clay soil”.

4.3 Ecological Environment

This section of the report provides a summary of the terrestrial ecology assessment undertaken for the project. It outlines the survey methodology used and describes the project area’s existing ecological baseline conditions. This baseline data is further used to predict potential impacts of the project on the ecology of the project area and suggests mitigation measures to reduce the predicted impacts.

The project site spreading over an area of 240.5 acres is located in the Bidar district of Karnataka State. An entire area falling under direct footprint of the project activities was delineated and referred to in this section as the ‘Project Area’. The project area, along with an area extending outward up to a distance of approximately 5 km

radius of the project area boundary, was considered as the Study Area for ecological assessment towards the ESIA and is referred to in this section as the 'Study Area'.

4.3.1 Ecological Description of the Study Area

The study area represents a tract of land located in the Deccan plateau region of Karnataka State. The overall terrain of the Study Area is flat to gently undulating, fragmented by a few ridges and hills. All of the solar panels in the project are distributed on the flat plains, mainly uncultivated farmlands.

The Study Area is characterized by natural habitats such as patches of vegetation in open areas and hills, lakes and seasonal streams. Modified habitats in the Study Area are represented by agricultural lands, tar and dirt roads, ponds, wells, habitations and solar power projects. Most of the cultivable plains in the study area are utilized for agricultural purposes whereas uncultivated patches are covered mainly by open scrub vegetation. The soil in the Study Area is black cotton soil supporting major crops like Sorghum, Soyabean, Pigeon Pea, vegetables like Brinjal, Tomato, Chili and fruits like Pomegranate.

A section of the State Highway15 connecting Wanamarapalli to Raichur running north-south passes through eastern part of the Study Area is the most significant habitat fragmenting feature in the area. A second major road is the State Highway 123, AP border to Hulsur running east-west through the southern part of the Study Area. A third major road is the Jonnekeri village road connecting the village to State Highway 15, running west-east through the central part of the Study Area and providing an access road for the project. A number of dirt roads and foot-trails are the other fragmenting features of the habitats in the Study Area.

The significant natural waterbody in the Study Area is the Kallur lake located approximately 1.5 km towards north of the project. A few other waterbodies such as lakes in Santpur and Lingdahalli villages also forms important habitats in the Study Area.

Besides this project, two other operational solar power projects, namely, 3.0 MW ground mounted solar power plant by ClearSky Solar Private Limited located adjacent to western boundary of the present project and 3.0 MW ground mounted solar power plant by M/s Aurad Solar Private Limited located approximately 3.8 km west of the project boundary. The aerial space around the Study Area is interrupted mainly by transmission towers and cables.

4.3.2 Methodology

The existing ecological baseline of the Study Area was generated on the basis of primary data recorded through field studies conducted on 27th and 28th February, 2019 and supported by secondary data collated from a variety of legitimate sources. The information sources are quoted at the pertinent places in the report.

4.3.2.1 Primary Data

A desk-based screening and a walk-over survey was carried out to select data-collection sites that appropriately represent the range of habitats and microhabitats present in the study area. Based on the habitat features of the study area, nine (09) sites were selected to collect quantitative data on floristic species. Only the higher floristic and faunal groups, namely angiosperms and vertebrates, were covered by the terrestrial ecological study.

The standard quadrat study methodology was adopted for the assessment of the floristic diversity in the study area. The quadrats laid were of size 20 m x 20 m for recording trees, large shrubs and large woody climbers, 5 m x 5 m for small shrubs and 1m x 1 m for herbs. For each quadrat the different species and number of individuals of each species present within the quadrat area were noted.

At each quadrat site, faunal diversity was recorded through both, direct evidence, that is, visual sightings, and indirect evidence, such as calls, nests, burrows, droppings, scats, moults and tracks, observed during the study.

While recording primary data on fauna, only occurrence of a species at a given site was noted, without enumerating the individuals sighted.

The timings of the quadrat-studies covered most of the diurnal faunal activity-period, from mid-morning till early evening. Given the preliminary nature of this survey, the emphasis of the studies was kept limited to only the higher flora, and amongst the fauna, to only the higher and diurnal fauna.

The percentage-frequency, abundance and density per hectare of each plant-species were calculated on the basis of quantitative floristic data recorded through the quadrat studies. The quantitative avifaunal data recorded during the walk-over of the quadrat-sites was processed to get the percentage frequency of each bird-species recorded. The following formulae were used for calculating the values for % frequency, abundance and density of the plant species encountered in the quadrat-studies:

% Frequency of species A = Number of quadrats of occurrence of species A/ Total number of quadrats studied X100

Abundance of species A = Number of individuals of species A in total quadrats studied/ Number of quadrats of occurrence of species A

Density of species A = Number of individuals of species A in total quadrats studied/ Total area studied for species A (in hectares)

The following formula is used for calculating % frequency of the bird species encountered in the quadrat-studies:
% Frequency of species A = Number of quadrats of occurrence of species A/ Total number of quadrats studied X100

Table 4-13 that follows present the details of the 09 quadrat sites along with their location co-ordinates, elevation from the mean sea level (msl), distance and direction from the project site boundary and associated habitat feature(s) and ***Figure 4-11*** presents the map showing quadrat locations.

Table 4-13: Details of quadrat locations

Quadrat	Location Co-ordinates	Elevation (m)	Distance (km) and direction from the project site boundary	Habitat Feature(s)
Q1	18° 11' 25.45" N, 77° 27' 39.69" E	590	0.27, N	Natural vegetation and agriculture
Q2	18° 12' 45.56" N, 77° 27' 54.07" E	539	1.98, N	Lake
Q3	18° 12' 32.87" N, 77° 29' 22.87" E	531	2.30, NE	Natural vegetation
Q4	18° 12' 14.21" N, 77° 29' 32.26" E	565	1.98, NE	Hill forest
Q5	18° 11' 08.94" N, 77° 28' 59.84" E	585	0.75, SE	Natural vegetation
Q6	18° 09' 53.50" N, 77° 29' 17.33" E	592	2.92, SE	Lake
Q7	18° 10' 33.81" N, 77° 27' 44.56" E	587	0.82, S	Seasonal stream, relic forest patch
Q8	18° 10' 14.56" N, 77° 26' 23.58" E	590	2.20, SW	Lake
Q9	18° 11' 28.78" N, 77° 27' 15.17" E	598	0.24, NW	Natural vegetation

Source: AECOM Primary Survey

4.3.2.2 Secondary Data

Primary data gathered through field-surveys is supported with secondary data collected from various sources such as reference books, research journals, scientific reports, websites of governmental departments, educational or research institutions and consultations with population residing in the Study Area.

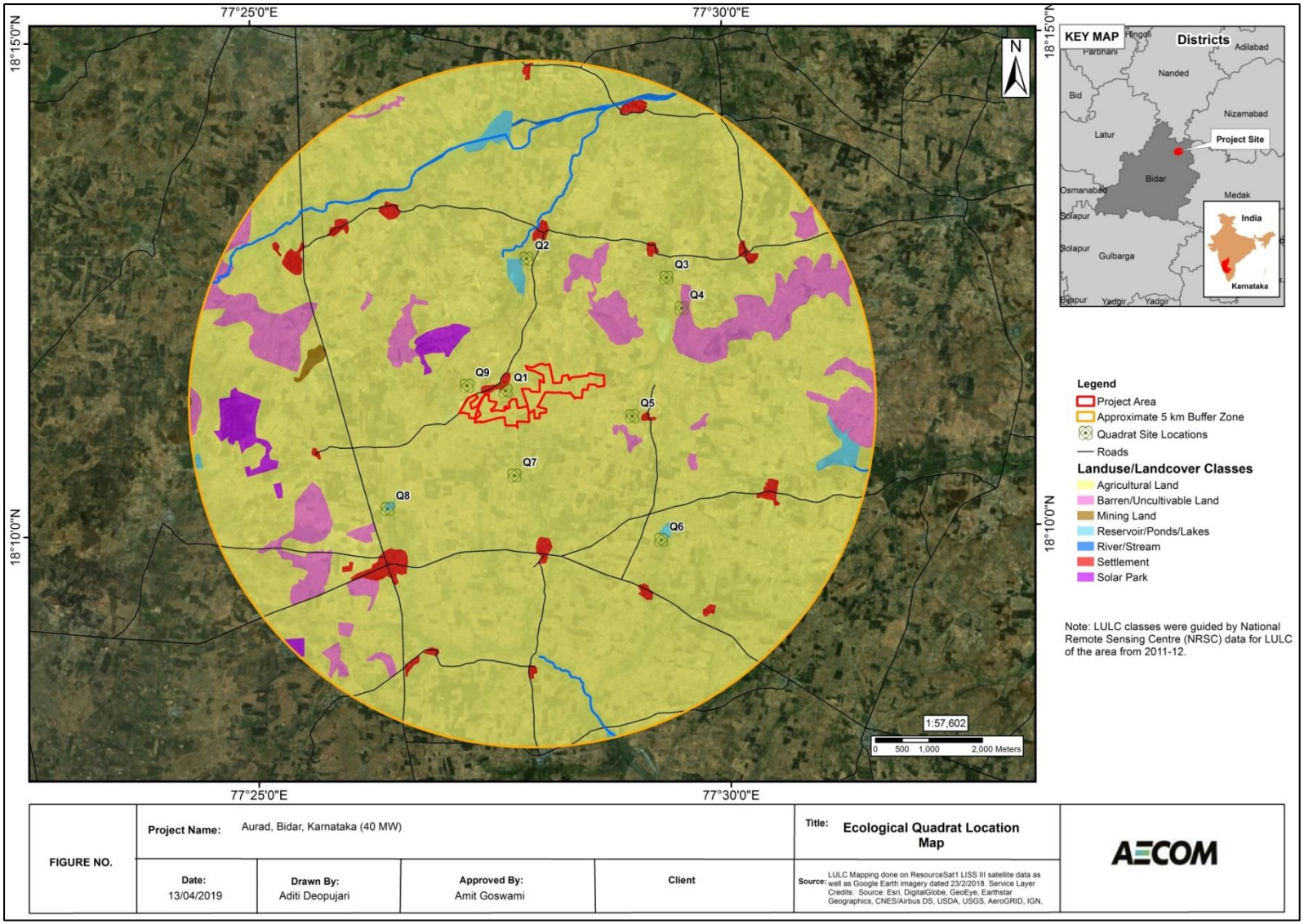


Figure 4-11: Map showing the Quadrat Site Locations

4.3.3 Higher Flora of the Study Area

4.3.3.1 Forest Types

According to the Champion and Seth Classification of Indian Forests, the natural vegetation of the study area is classifiable into the following two forest-types, each with its own typical floristic profile.

Type 6A/C1 (Sub-group 6A - Southern Tropical Thorn Forest, Sub-division C1 – Southern Thorn Forest)

These 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.

It is an open and low forest 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 which are showing xerophytic adaptations.

The formation of this forest type is usually resulted from the excessive tree cutting and browsing. If given protection, such areas are likely to lead to the regeneration of elements of a Tropical Dry Deciduous Forests.

Species associated with these forests include:

Trees such as *Acacia nilotica, Acacia polyacantha, Aegle marmelos, Albizia lebbeck., Azadirachta indica, Butea monosperma, Flacourtia indica, Grewia* spp.*, Canthium coromandelicum* and *Ziziphus* spp.;

Shrubs such as *Gymnosporia senegalensis*, *Opuntia elatior* and *Calotropis procera;*

Herbs such as *Alternanthera sessilis, Celosia argentea, Croton bonplandianus, Euphorbia hirta, Hyptis suaveolens, Pulicaria* spp. and *Hedyotis* sp.

Grasses such as *Apluda mutica*, *Aristida spp.*, Anderopogon sp., *Heteropogon contortus* and *Themeda* spp.

Type 5/E5 (Edaphic sub-type E5 – Butea Forest of Group 5 - Tropical Dry Deciduous Forests)

This edaphic type of Tropical Dry Deciduous Forests is often found in patches where soil is shallow and gravelly. This type of forests often resulted from degradation of Tropical Dry Deciduous Forests. Formations of such forests are characterized by *Butea monosperma.* Most of the soil is bare, with only a thin cover of grasses.

The typical plant species associated with these forests include:

Trees such as *Butea monopserma*, *Anogeissus latifolia* and *Azadirachta indica;*

Shrubs such as *Lantana camara* and *Gymnosporia montana;* and

Grasses such as *Apluda mutica* and *Heteropogon* sp.

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

4.3.3.2 Flora Recorded in the Quadrats

At least 82 species of angiosperms, including 50 woody species and 32 non-woody species have been recorded in the quadrats studied during the site survey.

Table 4-14 lists the plant species and presents details of quantitative floristic data recorded during the quadrat studies carried out at the 09 aforementioned locations. The woody and non-woody floristic species are listed in separate sections, along with the details, including the scientific and local name of each species, its habit and the family in which it is placed as per APG-IV classification system for angiosperms, percentage frequency, abundance and density of each species

Table 4-14: Details of Plant Species recorded in the Quadrats

S. No.	Scientific Name	Local Name	Habit	Family	% frequency	Abundance	Density/ha
	Woody Species						
1	*Acacia nilotica* subsp. *cupressiformis*	Babli	Tree	Fabaceae	33.33	06.33	52.78
2	*Acacia nilotica* subsp. *indica*	Babli	Tree	Fabaceae	44.44	05.00	55. 56
3	*Acacia polyacantha*	-	Tree	Fabaceae	11.11	02.00	05.56
4	*Aegle marmelos*	Bilvapatre	Tree	Rutaceae	11.11	02.00	05.56
5	*Albizia lebbeck*	-	Tree	Fabaceae	22.22	01.50	08.33
6	*Annona squamosa*	-	Tree	Annonaceae	44.44	01.50	16.67
7	*Anogeissus latifolia*	Dindala	Tree	Combretaceae	11.11	02.00	05. 56
8	*Azadirachta indica*	Turakabevu	Tree	Meliaceae	100.00	06.11	152.78
9	*Bauhinia racemosa*	Aapta	Tree	Fabaceae	11.11	01.00	02.78
10	*Bridelia retusa*	Gojji	Tree	Phyllanthaceae	11.11	02.00	05.56
11	*Buchanania cochinchinensis*	Charoli	Tree	Anacardiaceae	44.44	03.75	41.67
12	*Butea monosperma*	Muttuga	Tree	Fabaceae	100.00	05.33	133.33
13	*Calotropis procera*	Bili aekka	Shrub	Apocynaceae	33.33	01.67	13.89
14	*Canthium coromandelicum*	Karemullu	Tree	Rubiaceae	11.11	01.00	02.78
15	*Cassia fistula*	Phalus	Tree	Fabaceae	11.11	01.00	02.78
16	*Cassine glauca*	Kannurmara	Tree	Celastraceae	11.11	01.00	02.78
17	*Cryptostegia grandiflora*	Hambu rubber gida	Woody climber	Apocynaceae	22.22	01.50	08.33
18	*Erythrina suberosa*	Halivana	Tree	Fabaceae	33.33	02.33	19.44
19	*Eucalyptus sp.*	-	Tree	Myrtaceae	11.11	02.00	05.56
20	*Ficus benghalensis*	Aala	Tree	Moraceae	33.33	01.33	11.11
21	*Ficus racemosa*	Rumadi	Tree	Moraceae	44.44	01.75	19.44
22	*Flacourtia indica*	Dodda Gejjalakai	Tree	Salicaceae	44.44	03.50	38.89
23	*Gmelina arborea*	Shivani	Tree	Lamiaceae	11.11	01.00	02.78
24	*Grewia* sp.	-	Tree	Malvaceae	11.11	02.00	05.56
25	*Gymnosporia emarginata*	Thandarasa	Shrub	Celastraceae	11.11	02.00	05.56
26	*Gymnosporia montana*	kankada	Shrub	Celastraceae	22.22	01.50	08.33
27	*Gymnosporia senegalensis*	Thondarasi	Shrub	Celastraceae	44.44	02.50	27.78
28	*Ipomoea carnea*	-	Shrub	Convolvulaceae	22.22	12.50	69.44
29	*Ixora brachiata*	Koraji	Tree	Rubiaceae	11.11	02.00	05.56
30	*Ixora* sp.	-	Shrub	Rubiaceae	11.11	01.00	02.78
31	*Lannea coromandelica*	Ajjashringi	Tree	Anacardiaceae	22.22	01.50	08.33
32	*Lantana camara*	Chitrangi	Shrub	Verbenaceae	11.11	03.00	08.33
33	*Lysiloma latisiliquum*	Subabool	Tree	Fabaceae	11.11	02.00	05.56
34	*Mangifera indica*	Mavu	Tree	Anacardiaceae	44.44	01.75	19.44
35	*Morinda citrifolia*	Sapanga	Tree	Rubiaceae	88.89	03.50	77.78
36	*Opuntia elatior*	Dabbagalli	Shrub	Cactaceae	11.11	02.00	05.56

37	*Pavatta* sp.	-	Shrub	Rubiaceae	11.11	01.00	02.78
38	*Phoenix sylvestris*	Ichalu mara	Tree	Arecaceae	22.22	01.50	08.33
39	*Prosopis cineraria*	Banni	Tree	Fabaceae	11.11	04.00	11.11
40	*Ricinus communis*	Haralu	Shrub	Euphorbiaceae	22.22	01.50	08.33
41	*Santalum album*	Srigandha mara	Tree	Santalaceae	11.11	02.00	05.56
42	*Syzygium cumini*	Neerale	Tree	Myrtaceae	44.44	01.75	19.44
43	*Tamarindus indica*	Hunase mara	Tree	Fabaceae	22.22	01.50	08.33
44	*Tectona grandis*	Thega mara	Tree	Lamiaceae	33.33	02.67	22.22
45	*Terminalia bellirica*	Tare mara	Tree	Combretaceae	11.11	01.00	02.78
46	*Terminalia catappa*	-	Tree	Combretaceae	11.11	01.00	02.78
47	*Vachellia farnesiana*	-	Tree	Fabaceae	11.11	02.00	05.56
48	*Ventilago denticulata*	-	Woody climber	Rhamnaceae	11.11	02.00	05.56
49	*Ziziphus jujuba*	Bugari mara	Tree	Rhamnaceae	55.56	01.60	22.22
50	*Ziziphus nummularia*	Mulluhannu	Shrub	Rhamnaceae	22.22	01.00	05.56
	Non-woody Species						
51	*Achyranthes aspera*	Uttarani	Herb	Amaranthaceae	33.33	06.00	50.00
52	*Alternanthera sessilis*	Honagonne soppu	Herb	Amaranthaceae	44.44	05.50	61.11
53	*Anderopogon* sp.	-	Herb	Poaceae	44.44	04.00	44.44
54	*Apluda mutica*	-	Herb	Poaceae	77.78	09.71	188.89
55	*Barleria* sp.	-	Herb	Acanthaceae	55.56	03.20	44.44
56	*Blumea membranacea*	-	Herb	Asteraceae	33.33	04.00	33.33
57	*Cardiospermum halicacabum*	Bekkinabudde gida	Herb	Sapindaceae	11.11	02.00	05.56
58	*Carthamus tinctorius*	Khushabi	Herb	Asteraceae	11.11	34.00	94.44
59	*Celosia argentea*	-	Herb	Amaranthaceae	33.33	09.33	77. 78
60	*Chrozophora rottleri*	Sutta mara	Herb	Euphorbiaceae	11.11	05.00	13.89
61	*Cocculus hirsutus*	Dhagadiballi	Climber	Menispermaceae	22.22	01.50	08.33
62	*Croton bonplandianus*	Utti gida	Herb	Euphorbiaceae	22.22	03.00	16.67
63	*Datura innoxia*	-	Herb	Solanaceae	11.11	03.00	08.33
64	*Dimeria* sp.	-	Herb	Poaceae	66.67	09.00	150.00
65	*Elusine indica*	-	Herb	Poaceae	77.78	08.85	172.22
66	*Euphorbia hirta*	Halukudi	Herb	Euphorbiaceae	55.56	04.20	58.33
67	*Hedyotis* sp.	-	Herb	Rubiaceae	33.33	04.00	33.33
68	*Heliotropium* sp.	-	Herb	Boraginaceae	33.33	05.33	44.44
69	*Heteropogon* sp.	-	Herb	Poaceae	66.67	03.67	61.11
70	*Hyptis suaveolens*	Natitulasi	Herb	Lamiaceae	88.89	04.00	88.89
71	*Ipomoea* sp.	-	Climber	Convolvulaceae	22.22	01.50	08.33
72	*Lepidagathis cristata*	Nari goodi	Herb	Acanthaceae	77. 78	05.00	97.22
73	*Parthenium hysterophorus*	-	Herb	Asteraceae	33.33	06.00	50.00
74	*Phyllanthus fraternus*	Nela nelli kai	Herb	Phyllanthaceae	22.22	03.50	19.44

75	*Pulicaria wightiana*	-	Herb	Asteraceae	44.44	05.50	61.11
76	*Senna auriculata*	Honambre gida	Undershrub	Fabaceae	55.56	04.00	55.56
77	*Spermacoce pusilla*	-	Herb	Rubiaceae	55.56	03.20	44.44
78	*Themeda quadrivalvis*	-	Herb	Poaceae	77.78	06.00	116.67
79	*Themeda triandra*	-	Herb	Poaceae	66.67	08.33	138.89
80	*Tridax procumbens*	Kari balli	Herb	Asteraceae	33.33	05.33	44.44
81	*Vigna* sp.	-	Climber	Fabaceae	11.11	02.00	05.56
82	*Xanthium strumarium*	Maralu ummatali	Herb	Asteraceae	33.33	02.67	22.22

Source: AECOM Primary Survey

As per the floristic quantification resulted from the quadrat studies, native tree species such as *Azadirachta indica* and *Butea monosperma* occurs as the most common species of the natural vegetation in the Study Area. *Buchanania cochinchinensis* and *Morinda citrifolia* characterizes the forest patches in plains in the Study Area. The hill forests in the Study Area are typically dominated by *Acacia* spp., whereas, the hill slopes are featured by shrub species such as *Gymnosporia senegalensis*, *Calotropis procera* and *Ziziphus nummularia*. The native grass species including *Apluda mutica, Themeda* spp. and *Anderopogon* sp. forms herbaceous cover of the Study Area. Forbes such as *Hyptis suaveolens, Spermacoce pusilla* and *Euphorbia hirta* are occur to form small patches of herbaceous cover of the Study Area.

Aegle marmelos

Butea monosperma

Cardiospermum helicacabum

Carthamus tinctorius

	
Ixora brachiata	*Lepidagathis cristata*
	
Pulicaria wightiana	*Ventilago denticulata*
	
Xanthium strumarium	*Ziziphus nummularia*

Source: AECOM Primary Survey

4.3.4 Higher Fauna of the Study Area

This section of the report presents the detail of the higher faunal species, namely, mammals, birds, reptiles, amphibians and fishes, having recorded ranges that include the Study Area. The detailed species-tables are provided as appendices to this report. Each annexed table gives the scientific and common names of each species, the conservation status assigned to it by the International Union for Nature and Natural Resources

(IUCN) and the Schedule of the Wildlife Protection Act, 1972 (WPA) under which it is listed. Details of the species recorded during the field studies appear in **bold** font in each annexed table.

4.3.4.1 Mammals

At least 48 species of mammals have recorded ranges that include the study area. Of these, one species of rodent, Three-striped Palm Squirrel (*Funambulus palmarum*) was recorded through direct sighting, whereas 3 species, namely, Bonnet Macaque (*Macaca radiata*), Indian Crested Porcupine (*Hystrix indica*) and Indian Hare (*Lepus nigricollis*) were recorded through indirect evidences.

Significant species among the total recorded species include 5 globally threatened species, of which, 1 species, namely, Indian Pangolin (*Manis crassicaudata*) is designated as Endangered by the IUCN and 3 species, namely, Four-Horned Antelope (*Tetracerus quadricornis*), Sambar (*Rusa unicolor*) and Common Leopard (*Panthera pardus*) are designated as Vulnerable by the IUCN. With respect to the WPA, 8 species are listed in Schedule I, namely, Indian Chevrotain (*Moschiola indica*), Four-Horned Antelope (*Tetracerus quadricornis*), Blackbuck (*Antilope cervicapra*), Common Leopard (*Panthera pardus*), Grey Wolf (*Canis lupus*), Rusty Spotted Cat (*Prionailurus rubiginosus*), Honey Badger (*Mellivora capensis*) and Indian Pangolin (*Manis crassicaudata*). All of these species have large known ranges beyond the study area and hence, are not deemed as species of conservation concern with respect to the Study Area.

Appendix A presents details of the mammals of the Study Area.

4.3.4.2 Avifauna

At least 235 species of birds including 164 resident and 71 migratory have recorded ranges that include the study area. Of these, 32 species were recorded during the field studies. Significant species reported from the Study Area include 7 globally threatened species, comprising 3 designated by the IUCN as Critically Endangered, namely White-rumped Vulture (*Gyps bengalensis*), Indian Vulture (*Gyps indicus*) and Red-headed Vulture (*Sarcogyps calvus*), 2 designated as Endangered, namely, Lesser Florican (*Sypheotides indicus*) and Egyptian Vulture (*Neophron percnopterus*) and 2 designated as Vulnerable, namely, Woolly-necked Stork (*Ciconia episcopus*) and Common Pochard (*Aythya ferina*) and 10 designated as Near Threatened, namely, Painted Stork (*Mycteria leucocephala*), Black-headed Ibis (*Threskiornis melanocephalus*), Red-necked Falcon (*Falco chicquera*), Laggar Falcon (*Falco jugger*), Great Thick-knee (*Esacus recurvirostris*), River Tern (*Sterna aurantia*), Darter (*Anhinga melanogaster*), Pallid Harrier (*Circus macrourus*), Black-tailed Godwit (*Limosa limosa*) and Eurasian Curlew (*Numenius arquata*). All these species have large known ranges beyond the study area and hence, are not deemed as species of conservation concern with respect to the study area.

Appendix B presents details of the resident birds and ***Appendix C*** presents details of the migratory birds of the Study Area.

4.3.4.2.1 Quantitative Avifaunal Data

Table 4-15 below presents the details of bird species recorded during the quadrat studies along with scientific name, common name, resident status and % frequency of each species.

Table 4-15: Details of bird species recorded in the quadrats

S. No.	Scientific Name	Common Name	Status	% Frequency
1	*Threskiornis melanocephalus*	Black-headed Ibis	Resident	11.11
2	*Butorides striata*	Striated Heron	Resident	22.22
3	*Ardeola grayii*	Indian Pond Heron	Resident	33.33
4	*Bubulcus ibis*	Cattle Egret	Resident	44.44
5	*Mesophoyx intermedia*	Intermediate Egret	Resident	11.11
6	*Microcarbo niger*	Little Cormorant	Resident	22.22
7	*Milvus migrans*	Black Kite	Resident	33.33
8	*Haliastur indus*	Brahminy Kite	Resident	22.22
9	*Elanus caeruleus*	Black-winged Kite	Resident	22.22

S. No.	Scientific Name	Common Name	Status	% Frequency
10	*Fulica atra*	Eurasian Coot	Resident	11.11
11	*Vanellus malabaricus*	Yellow-wattled Lapwing	Resident	22.22
12	*Vanellus indicus*	Red-wattled Lapwing	Resident	11.11
13	*Charadrius dubius*	Little Ringed Plover	Resident	22.22
14	*Stigmatopelia chinensis*	Spotted Dove	Resident	33.33
15	*Stigmatopelia senegalensis*	Laughing Dove	Resident	22.22
16	*Apus affinis*	Little Swift	Resident	66.67
17	*Coracias benghalensis*	Indian Roller	Resident	44.44
18	*Halcyon smyrnensis*	White-throated Kingfisher	Resident	33.33
19	*Merops orientalis*	Green Bee-eater	Resident	77.78
20	*Dicrurus macrocercus*	Black Drongo	Resident	66.67
21	*Corvus splendens*	House Crow	Resident	22.22
22	*Hirundo smithii*	Wire-tailed Swallow	Resident	44.44
23	*Acridotheres tristis*	Common Myna	Resident	22.22
24	*Lanius schach*	Long-tailed Shrike	Resident	22.22
25	*Copsychus saularis*	Oriental Magpie Robin	Resident	33.33
26	*Pycnonotus cafer*	Red-vented Bulbul	Resident	55.56
27	*Ploceus philippinus*	Baya Weaver	Resident	33.33
28	*Anthus rufulus*	Paddyfield Pipit	Resident	22.22
29	*Actitis hypoleucos*	Common Sandpiper	Winter	11.11
30	*Motacilla flava*	Yellow Wagtail	Winter	11.11
31	*Ardea cinerea*	Grey Heron	Winter	11.11
32	*Tadorna ferruginea*	Ruddy Shelduck	Winter	11.11

Source: AECOM Primary Survey

4.3.4.3 Reptiles

At least 27 reptile species have recorded ranges that include the Study Area. None of these species was recorded during the field studies. Of the species having recorded ranges that include the Study Area, 1 species, namely Indian Python (*Python molurus*) is listed in Schedule I of the WPA. None of these species having recorded ranges that include the Study Area is designated as threatened by the IUCN. All of the recorded species have large known ranges beyond the study area, hence it is unlikely that the habitats of the Study area are critical to their survival.

Appendix D presents details of the reptile species of the Study Area.

4.3.4.4 Amphibians

At least 12 amphibian species have recorded ranges that include the Study Area. None of these species was recorded during the field studies. None of the species having recorded ranges that include the Study Area is listed in Schedule I of the WPA or designated as threatened by the IUCN.

Appendix E presents details of the amphibians of the Study Area.

4.3.4.5 Fishes

At least 35 fish species have recorded ranges that include the Study Area. None of these species was recorded during the field studies. None of the species having recorded ranges that include the Study Area, is listed in

Schedule I of the WPA. 01 species, namely Yellow Mahaseer (*Tor khudree*) is designated as Endangered and 2 species, namely Indian Butter-Catfish (*Ompok bimaculatus*) and Shark Catfish (*Wallago attu*) are designated as Near Threatened by the IUCN.

Appendix F presents details of the fishes of the Study Area.

4.3.5 Habitat Profile of the Study Area

4.3.5.1 Natural Habitats

Natural habitats in the study area are represented by patches or individuals of species associated with dry deciduous scrub forests, grasslands, a few hills and knolls, lakes and seasonal wetlands.

Contiguous stretches of natural forests covering the hill ranges represent the most significant natural habitat in the Study Area. Lakes in villages Kallur and Santpur and a few seasonal streams flowing to or through the Study Area presents significant natural habitat feature in the area. While none of these natural habitats, as observed in the study area, is in a pristine state, they show typical and diverse floristic profiles which are likely to support the presence of some characteristic species of wild fauna.

Natural vegetation towards north boundary of the Project Site

Kallur Lake

Natural vegetation in the Study Area near Bardapur village

Natural hill forest in the Study Area

Natural hill forest in the Study Area

Natural vegetation near Santhpur village

Relic forest patch along stream near Jojna village

A seasonal stream near Jojna village

4.3.5.2 Modified Habitats

Modified habitats of the Study Area are represented by a number of tar and dirt roads, foot-trails, cultivated and follow farmlands, orchards, ponds, dug-wells, habitations and a solar power project. Aerial habitats in the Study Area are modified by transmission powerlines.

The observed range of modified habitats is likely to be supporting a number of faunal species specially species that are known to be associated with thorn forests, grasslands and cultivated farmlands. Orchards and farmlands in the study area are especially likely to be serving as feeding habitats for a variety of faunal species, including bats.

Agricultural fields	Coconut Orchard
	
A dug well in Jonnekeri village	Habitations in Jonnekeri village
	
A stretch of dirt road connecting Jonnekeri and Jojna crossing through zone 1& 2 of the project	A road connecting Jonnekeri to State Highway 15
	
Solar panels at the Project Site	Transmission lines

Source: AECOM Primary Survey

4.3.5.3 Critical Habitats

Habitats, either natural or modified, that are critical for the survival of IUCN-designated Critically Endangered (CR) or Endangered (EN) species, migratory species, congregatory species and endemic or restricted range species are considered to be critical habitats.

This section lists such species having recorded ranges that include the study area. Available data indicates that the Study Area is unlikely to be of critical importance to the survival of any of the species listed.

4.3.6 Critically Endangered or Endangered Species

At least 8 IUCN-designated Critically Endangered or Endangered species have recorded ranges that include the Study Area. ***Table 4-16*** presents the details of these species, including the scientific and common names of each species and the conservation status assigned to it by the IUCN. None of these species was recorded in the Study Area during the field studies.

Table 4-16: Critically Endangered or Endangered Species of the Study Area

S. No.	Scientific Name	Common Name	IUCN Status*
Mammals			
1	*Manis crassicaudata*	Indian Pangolin	EN
Birds			
2	*Neophron percnopterus*	Egyptian Vulture	EN
3	*Gyps bengalensis*	White-rumped Vulture	CR
4	*Gyps indicus*	Indian Vulture	CR
5	*Sarcogyps calvus*	Red-headed Vulture	CR
6	*Rhinoptilus bitorquatus*	Jerdon's Courser	CR
7	*Sypheotides indicus*	Lesser Florican	EN
Fishes			
8	*Tor khudree*	Yellow Mahseer	EN

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

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; Vivek Menon (2014) Indian Mammals: A Field Guide. Hachette Book Publishing India Pvt. Ltd., Gurgaon, India; R. J. Ranjit Daniels, (2002). Freshwater Fishes of Peninsular India, Indian Academy of Sciences, University Press; IUCN (2019). The IUCN Red List of Threatened Species. Version 2019-1.

4.3.7 Migratory Species

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.

A total of 71 species of migratory birds have recorded ranges that include the study area. All of these species are listed in ***Appendix C*** of the report. Of these, 4 migratory bird species were recorded in the Study Area during the field survey.

4.3.8 Congregatory Species

Congregatory species includes the species that gather in globally significant numbers at a particular site and at a particular time in their life cycle for feeding, breeding or resting (during migration).

At least 4 congregatory species, all birds, have recorded ranges that include the study area. None of these was recorded in the Study Area during the field studies.

Table 4-17 lists the congregatory species having recorded ranges that include the Study Area.

Table 4-17: Congregatory Species of the Study Area

S. No.	Scientific Name	Common Name	IUCN Status*	WPA Schedule**
1	*Phalacrocorax niger*	Little Cormorant	LC	IV
2	*Phalacrocorax fuscicollis*	Indian Cormorant	LC	IV
3	*Phalacrocorax carbo*	Great Cormorant	LC	IV
4	*Mycteria leucocephala*	Painted Stork	NT	IV

** Status assigned by the International Union for Conservation of Nature and Natural Resources, where NT – Near Threatened and 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 (2019). The IUCN Red List of Threatened Species. Version 2019-1.

4.3.9 Endemic / Restricted Range Species

At least 08 species have ranges restricted to a particular region that includes the Study Area. Of these, one mammal species, namely Bonnet Macaque (*Macaca radiata*) was recorded in the Study Area during the field studies.

These listed species have relatively large ranges spread across many parts of western and central India. The study area represents a small part of the total recorded ranges of these species. As also, the data collated on the habitats of the study area indicate that these habitats are unlikely to be critical to the survival of any of the endemic species listed.

Table 4-18 presents the details of these species, including the scientific and common names of each species and the distribution range to which it is endemic.

Table 4-18: Endemic / Restricted Range Species of the Study Area

S. No.	Scientific Name	Common Name	Distribution Range
Mammals			
1	*Anathana ellioto*	Southern Tree Shrew	Peninsular India
2	*Macaca radiata*	Bonnet Macaque	Peninsular India
Birds			
3	*Galloperdix lunulata*	Painted Spurfowl	Peninsular India
4	*Galloperdix spadicea*	Red Spurfowl	Peninsular India
5	*Perdicula argoondah*	Rock Bush Quail	Western & Central India
6	*Gallus sonneratii*	Grey Junglefowl	Southern Peninsula
7	*Strix ocellata*	Mottled Wood Owl	Peninsular India
8	*Rhipidura (albicollis) albogularis*	White-spotted Fantail	Peninsular India

Sources: Jathar, G.A. & Rahmani, A.R. (2006). Endemic Birds of India. Buceros: ENVIS Newsletter: Avian Ecology & Inland Wetlands. Vol. 11, No.2 & 3; IUCN (2019). The IUCN Red List of Threatened Species. Version 2019-1.

4.3.10 Designated Areas

4.3.10.1 Legally Protected Areas

Chincholi Wildlife Sanctuary (approximate location: 17°47' 0.00"N 77° 43' 0.00"E) spreading over 149.58 sq. km area is the nearest legally protected area. It is situated about 47 km to the southeast from the nearest point of the Study Area boundary.

4.3.10.2 Internationally Recognized Areas

Important Bird Area

Manjira Wildlife Sanctuary (approximate location: 17º 57' 52" N, 78º 02' 22" E), covering approximately 20 sq. km, is the nearest Important Bird Area (IN 219). The boundary of the Manjara Wildlife Sanctuary is situated approximately 60 km east of the nearest point on the study area boundary.

Majira Wildlife Sanctuary, a protected area designated for protection of Mugger crocodile (*Crocodylus palustris*). The reservoir in the sanctuary is known to provide considerable ecological diversity to support a large population of wetland birds. Around 73 species of birds are recorded from this site. The IBA criteria are triggered by presence of Bar-headed Goose (*Anser indicus*), Ruddy Shelduck (*Todama ferruginea*), Lesser Adjutant (*Leptoptilos javanicus*) and Indian Skimmer (*Rhyncops albicolis*). [4]

Ramsar Sites

Kolleru Lake (approximate location: 16° 37' 00" N 81° 12' 00" E), covering an area of approximately 901 sq. km, (Site No. 1209) forming a part of Kolleru Wildlife Sanctuary is the nearest Ramsar Site. It is located approximately 426 km of the study area boundary.

It is a natural eutrophic lake, situated between the two major river basins of the Godavari and the Krishna and provides habitat for a number of resident and migratory birds, including declining numbers of the vulnerable Grey Pelican (*Pelecanus philippensis*). The lake is known to regularly support more than 50,000 waterfowls and provides habitats to almost 61 species of fishes and 12 species of prawns. It also sustains culture and capture fisheries, agriculture and related occupations of the people in the area[5].

4.3.11 Ecological Services

4.3.11.1 Provisioning Services

The Study Area provides provisioning ecosystem services through the soil in which agricultural crops are cultivated by the local communities, as also, wild plants that serve the food, fodder, fuel-wood and timber needs of the local communities. Details of each of these provisioning services are given below.

Crops

Table 4-19 presents details on major crops cultivated in the study area including scientific name, common name, family to which each species belongs and type of crop.

Table 4-19: Crops of the Study Area

S. No.	Scientific Name	Common Name	Family	Type of Crop
1	*Cajanus cajan*	Pigeon Pea	Leguminosae	Pulse
2	*Capsicum annuum*	Chili	Solanaceae	Fruit
3	*Carthamus tinctorius*	Safflower	Asteraceae	Oilseed
4	*Cocos nucifera*	Coconut	Arecaceae	Fruit
5	*Glycine max*	Soyabean	Fabaceae	Legume
6	*Mangifera indica*	Mango	Anacardiaceae	Fruit
7	*Punica granatum*	Pomegranate	Lythraceae	Fruit
8	*Ricinus communis*	Castor bean	Euphorbiaceae	Oilseed

[4] http://datazone.birdlife.org/site/factsheet/manjira-wildlife-sanctuary-iba-india/details

[5] https://rsis.ramsar.org/RISapp/files/RISrep/IN1209RIS.pdf?language=en

S. No.	Scientific Name	Common Name	Family	Type of Crop
9	*Solanum lycopersicum*	Tomato	Solanaceae	Vegetable
10	*Solanum melongena*	Brinjal	Solanaceae	Vegetable
11	*Sorghum bicolor*	Sorghum, Jowar	Poaceae	Grain
12	*Vigna radiata*	Mung Bean	Fabaceae	Pulse

Source: AECOM Primary Survey

Fodder

The natural vegetation of the Study Area, including the plant cover of fallow farmlands, provides fodder to the livestock of the local communities, mainly goats and cattle.

Fuelwood and Timber

The trees and shrubs growing naturally in the study area provide fuel-wood and timber to the local communities.

Fishing

The lake situated in Kallur village is utilized for fishing by the local communities. The lake is annually leased for fishing by Gram Panchayat through tendering process.

Worshipping material

Flowers of *Butea monosperma* and leaves of *Aegle marmelos* are used for worshipping lord Shiva by the local communities in the Study Area.

Mango Orchard in the Study Area

Sorghum farm in the Study Area

Safflower and Sorghum farms in the Study Area	Safflower farm in the Study Area

Source: AECOM Primary Survey

4.3.11.2 Regulating Services

The natural functioning of the ecosystems in the Study Area leads to the following processes that provide both, direct and indirect benefits to the local communities.

Ground Water Recharge

The natural and seasonal water-flows in the Study Area contribute to the recharge of wells, ponds and lakes of the area, which provide the freshwater needs of the local communities. The vegetation cover of the area also helps to slow down the surface run-off, which in turn increases the percolation of water into sub-surface layers, thereby promoting the recharge of groundwater.

Surface Water Purification

The plants and soil organisms of the Study Area absorb and process a number of chemical compounds dissolved in local water-flows, effectively recycling wastes and purifying the water. The vegetation cover of the Study Area, especially its collective root systems, also acts as a physical filtration system, filtering out particulate matter as the water flows towards the area's ponds, lakes and streams. Thus, the study area contributes to the regulation of the water-quality of the area by purifying surface water.

Soil Erosion Control

The vegetation cover of the Study Area anchors soil-particles and binds them together, lowering the rate of soil erosion by water and wind. Thus, the Study Area contributes to control of soil erosion in the area.

Pollination and Pest Control

The vegetation cover of the Study Area provides habitats to a range of faunal species that include pollinator species, such as, pollen or nectar feeding insects and birds, as well as, insectivorous species, including frogs, lizards, birds and bats. By harbouring such species, the study-area provides pollinator-services and pest-control services to natural, as well as, agricultural plants in the area.

4.3.11.3 Supporting Services

The natural functioning of the ecosystems of the Study Area lead to the following processes that create or maintain basic natural resources, such as soil-nutrients and photosynthetic production, that support human life-sustaining activities, such as farming, food-gathering, cooking and grazing of livestock.

Nutrient Capture and Recycling

The food-chains constituted by the organisms of the Study Area are continuously involved in the capture and transfer of the macro and micro nutrients in the soil, water and air, effectively recycling nutrients and making them available in the nutrient-sinks of the local ecosystems. The biomass generated by the Study Area, and transferred physically by water and wind, helps recharge the soil-fertility in the surrounding area. Thus, the natural vegetation and topography of the Study Area contribute to the natural productivity of the area.

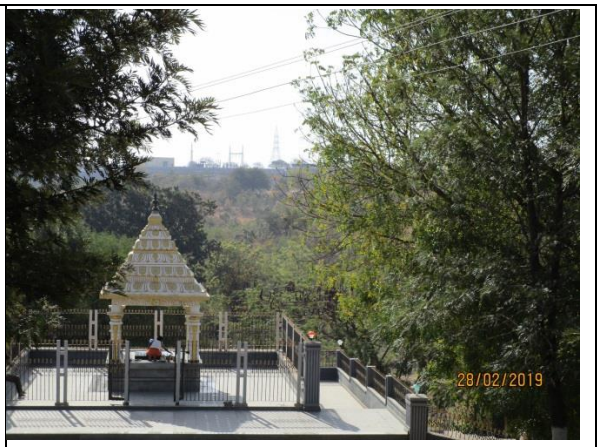
Primary Production

The photosynthetic organisms of the study-area act as primary producers, creating food-reserves that directly or indirectly support the consumers of the area, including the local communities. This primary production includes, besides a number of resources utilized directly by local communities (and covered under Provisioning Services), the grass blades and leaves consumed by grazing and browsing animals like grasshoppers, bugs, beetles, snails, goats and sheep, the flowers, pollen and flower-nectar consumed by butterflies, moths, bees and sunbirds, the seeds consumed by seed and grain-eaters like ants, sparrows, larks, pipits and mice, and the fruits consumed by birds and bats.

4.3.11.4 Cultural Services

A few temples in the study area provide significant cultural services to the local communities in the area. Patri Swami Temple situated approximately 140 m north of the project boundary is one of the significant temple

providing cultural services to the local communities in the Study Area. An annual festival is celebrated in the temple on Ugadi, a regional New Year day.

	
Patri Swami Temple in Jonnekeri Village	Patri Swami Temple in Jonnekeri Village

4.4 Socio-economic Profile

This section of the report primarily summarises the socio-economic characteristics of the project area and the area of influence from the macro district level to the micro village level. The data collected through desk-based review have been studied and analysed to present a comprehensive analysis of the socio-economic characteristics of the project area and its influenced area. Information gathered through consultations undertaken with landowners and representative of the village falling within the project area have also been analysed and presented below,

4.4.1 Approach and Methodology

The scope of work as detailed earlier in the proposal has been the guiding criteria for the undertaking the Social Impact Assessment (SIA) Study. The project location and the associated facilities fall primarily in the Bidar District of the state of Karnataka. In order to undertake the representative sample comprising the primary survey and identification and consultation of the stakeholders, the location of the project and its associated facilities was considered for the study.

A structured questionnaire was prepared to undertake the interviews and evaluate the socio-economic status of the representative sample of the project affected families comprising the landowners. In addition, discussions were also held with representatives of the villages falling within the project area to provide an understanding of the socio-economic status of the people residing in the area.

Secondary Data Review:

A detailed review and assessment of the secondary data available on the project location was done wherein the turbines and associated facilities are to operate. Detailed reviews of available documents on the socio- economic characteristics of the project-influenced areas were undertaken. The documents referred to for the desk-based research are,

- Primary Census Abstract (PCA), 2011; Office of the Registrar General & Census Commissioner, India; Ministry of Home Affairs
- Village Directory Data (VDA), 2011; Office of the Registrar General & Census Commissioner, India; Ministry of Home Affairs
- Statistical Abstract Karnataka, 2015-16
- Brief Industrial Profile of Bidar District (MSME), 2012

Primary Data:

Primary data was collected on the socio- economic status of the villages wherein the project is located through identification of stakeholders and thereafter consultations undertaken with them. The data collected have been

collated and analysed to understand the impact of the project on the area. Additionally, traffic data was conducted by M/s Eco Services India Private Limited on 30th March 2019 as part of primary data collection.

4.4.2 Administrative Profile

Bidar district is in the northern most part of Karnataka state with geographical area of 5460 sq.km. It is bounded by Nizamabad and Medak districts of Andhra Pradesh state on the eastern side, Latur and Osmanabad districts of Maharashtra state on the western side, Nanded district of Maharashtra state on the northern side and Gulbarga district on southern side.

The Bidar district is constituted by five talukas i.e. Aurad, Basavakalyan, Bhalki, Bidar and Humnabad with Bidar being the headquarters of the district. There are 621 revenue villages and 175 Gram Panchayats within the District.

4.4.3 Project Area

The project area is spread across two villages, namely Jonnikere and Lingdahalli under Aurad Taluka in Bidar District. The section below provides information regarding details of the socio-economic profile of the project area.

Study Area

To assess the impacts of the project in the surrounding area, an area of 2 km radius has been considered as the project area of influence from the project area. The project area and its area of influence have been cumulatively termed as 'study area'. The table below represents the villages falling within the two (02) kilometre radii of the project location:

Table 4-20: Villages within 2-kilometre radii of Project location

District	Sub-District (Taluka)	Villages and Hamlets
Bidar	Aurad	Lingadhalli
		Jonnekeri
		Jojna

4.4.4 Demographic Profile of the Study Area

The demographic profile section below intends to present an understanding of the prevalent demography in the study area. The population of the study area has been analysed below with a focus on the size and its composition.

4.4.4.1 Population

District Level

The District level population has been represented in the table below:

Table 4-21: District Level Population in the Study Area

District	Total Population (2011)	Male Population (2011)	Female Population (2011)	Sex Ratio (female as per 1000 males)
Bidar	17,03,300	8,70,665 (51.1%)	8,32,635 (48.8%)	956

Source: Primary Census Abstract 2011

The table above represents that the sex ratio of Bidar District is 956 females per 1000 males. Female population of Bidar comprises of 48.8% (8, 32, 635) of the total population of Bidar district.

Taluka Level

The Taluka level population has been represented in the table below:

Table 4-22: Taluka level Population in the Study Area

Taluka	Total Population (2011)	Male Population (2011)	Female Population (2011)	Sex Ratio (females as per 1000 males)
Aurad		1,42,309	1,36,091	956
	2,78,400	(51.1%)	(48.8%)	

Source: Primary Census Abstract 2011

The table above represents that the sex ratio of Aurad Taluka is 956 females to 1000 males. Female population comprises of 48.8% (1, 36, 091) of the total population of Aurad taluka.

Village Level

The village level population in the study area has been represented in the table below:

Table 4-23: Village Level Population in the Study Area

Taluka	Village	Total Population (2011)	Male Population (2011)	Female Population (2011)	Sex Ratio (females as per 1000 males)
Aurad	Lingdahalli	734	380	354	931
			(51.7%)	(48.2%)	
	Jonnikere		501	488	974
		989	(50.6%)	(49.3%)	
	Jojna		1201	1126	937
		2327	(51.6%)	(48.3%)	

Source: Primary Census Abstract 2011

The table above represents that the highest population amongst the study area villages is Jojna village at 2327 followed by Jonnikere village at 989 and lastly Lingdahalli village at 734. Sex ratio amongst the villages is highest in Jonnikere village at 974 followed by Jojna village at 937 and lastly Lingdahalli village at 931 to every 1000 males.

4.4.4.2 Status of Literacy level

Literacy indicates the ability of a person to read and write. For the purpose of identifying literate persons for the Census in India, the benchmark taken is that of an individual above the age of seven (07) years who can both read and write in any Indian language. Analysis of literate population in the country is essential as education is considered a vehicle for development and progress and the increase of female educated persons is an indicator of inclusive growth and social progress.

District Level

The District level literate population has been represented in the table below:

Table 4-24: District Literacy Level in the Study Area

District	Total Population (2011)	Total Literate Population (2011)	Male Literate Population (2011)	Female Literate Population (2011)
Bidar	17,03,300	10,42,673	5,97,198	4,45,475
		(61.2%)	(57.2%)	(42.7%)

Source: Primary Census Abstract 2011

It can be noted from the above table that at the district level the literacy level comprises of 61.2% (10,42,673) to the total population of 17,03,300. The female population comprises of 42.7% (4,45,475) of the literate population (10,42,673) of Bidar District.

Taluka Level

The Taluka level literate population has been represented in the table below:

Table 4-25: Taluka Literacy Level in the Study Area

District	Taluka	Total Population (2011)	Total Literate Population (2011)	Male Literate Population (2011)	Female Literate Population (2011)
Bidar	Aurad	2,78,400	1,62,496	94,666	67,830
			(58.3%)	(58.2%)	(41.7%)

Source: Primary Census Abstract 2011

It can be noted that the literacy level of Aurad is at 58.3% (1,62,496) in relation to its total population of 2,78,400. The female literate population is at 41.7% (67,830) of the total population.

Village Level

The Village level literate population has been represented in the table below:

Table 4-26: Village Literacy Level in the Study Area

Taluka	Village(s)	Total Population (2011)	Total Literate Population (2011)	Male Literate Population (2011)	Female Literate Population (2011)
Aurad	Lingadhalli	734	419	247	172
			(57%)	(58.9%)	(41%)
	Jonnekeri		508	312	196
		989	**(51.3%)**	(61.4%)	(38.5%)
	Jojna		1433	865	568
		2327	**(61.5%)**	(60.3%)	(39.6%)

Source: Primary Census Abstract 2011

It can be noted in the table above that Jojna village has the highest literacy level at 61.5% (1433) followed by Lingdahalli village at 57% (419) and lastly Jonnikere village at 51.3% (508). Female literacy levels in all study area villages is less than 45% with the lowest female literacy in Jonnekeri village at 38.5% (196) followed by Jojna village at 39.6% (568) and lastly Lingdahalli village at 41% (172).

4.4.5 Presence of Vulnerable Communities and Groups

Vulnerable groups are those groups of people who may find it difficult to lead a comfortable life, and lack developmental opportunities due to their disadvantageous positions. Further, due to adverse socio-economical, cultural, and other practices present in each society, they find it difficult many a times to exercise their human rights fully[6].

The accessibility to development opportunities or its absence thereof can be attributed to the level of integration and responsiveness to mediums which enhance and improve livelihoods. Marginalization from the resources can be a result of social exclusion thereafter hindering all round development and improvement of livelihood of these groups. Categories such as scheduled tribes, scheduled castes primitive tribal group, legally released bonded labour and manual scavengers and other backward classes are recognised as socially excluded categories by the constitution of India. Recognising the relative backwardness of these weaker/socio-economically disadvantaged sections of the society, the Constitution of India guarantees equality before the law (Article 14) and enjoins the State to make special provisions for the advancement of any socially and educationally backward classes or for SCs (Article 15(4)).

The section below aims to define the status of these socially excluded categories/ groups within the study area.

[6] Human Rights of Vulnerable & Disadvantaged Groups; Dr. T. S. N. Sastry; University of Pune; 2012

4.4.5.1 Scheduled Caste and Scheduled Tribe Population

The tables below depict the representation of Scheduled Castes (SC) and Scheduled Tribes (ST) in the District, Taluka and Village levels:

District Level

The table below represents the SC and ST population at the District Level,

Table 4-27. District Level SC and ST Population in the Study Area

District	Total Population (2011)	SC Population (2011)	SC Male Population (2011)	SC Female Population (2011)	ST Population (2011)	ST Male Population (2011)	ST Female Population (2011)
Bidar	17,03,300	3,99,785	2,04,280	1,95,505	2,35,822	1,19,787	1,16,035
		(23.4%)	(51%)	(48.9%)	(13.8%)	(50.7%)	(49.2%)

Source: Primary Census Abstract 2011

It can be noted from the table above that the Scheduled Tribe population in Bidar district is 13.8% (2,35,822) and the Scheduled Caste population is 23.4% (3,99,785) of the total population. The female SC and ST population is at 48.9% (1,95,505) and 49.2% (1,16,035) respectively.

Taluka Level

The table below represents the SC and ST population at the sub district Level:

Table 4-28. Taluka Level SC and ST Population in the Study Area

Taluka	Total Population (2011)	SC Population (2011)	SC Male Population (2011)	SC Female Population (2011)	ST Population (2011)	ST Male Population (2011)	ST Female Population (2011)
Aurad		88,683	45,470	43,213	30,582	15,631	14,951
	2,78,400	(31.8%)	(51.2%)	(48.7%)	(10.9%)	(51.1%)	(48.8%)

Source: Primary Census Abstract 2011

It can be noted from the table above that the Scheduled Tribe population in Aurad Taluka is 10.9% (30582) and the Scheduled Caste population is 31.8% (88,683) of the total population at the sub district level. The female population is at 48.7% (43,213) and 48.8% (14,951) in Scheduled Caste and Scheduled Tribe communities respectively.

Village Level

The table below represents the SC and ST population at villages/town level:

Table 4-29. Village Level SC and ST Population in the Study Area

Mandal	Villages	Total Population (2011)	SC Population (2011)	SC Male Population (2011)	SC Female Population (2011)	ST Population (2011)	ST Male Population (2011)	ST Female Population (2011)
Aurad	Lingdahalli	734	292	150	142	17	12	5
			(39.7%)	(51.3%)	(48.6%)	(2.3%)	(70.5%)	(29.4%)
	Jonnekeri		213	107	106	274	143	131
		989	(21.5%)	(50.2%)	(49.7%)	(27.2%)	(52.1%)	(47.8%)
	Jojna	2327	565	291	274	163	81	82
			(24.2%)	(51.5%)	(48.4%)	(7%)	(49.6%)	(50.3%)

Mandal	Villages	Total Population (2011)	SC Population (2011)	SC Male Population (2011)	SC Female Population (2011)	ST Population (2011)	ST Male Population (2011)	ST Female Population (2011)

Source: Primary Census Abstract 2011

The table above represents that the highest Scheduled Tribe population amongst the study area villages falls in Jonnekeri village at 27.2% (274) to its total population of 989. Villages of Lingdahalli and Jojna have less than 10 percent of Scheduled Tribe population at 2.3% (17) and 7% (163) to its total population of 734 and 2327 respectively. Female population is lowest in the Scheduled Tribe community of Lingdahalli village at 29.4% (5) of the total ST population of 17.

4.4.6 Workforce Population

The working population of the area means the population of the area who is engaged in productive activity and contribute towards economic and social growth of the area.

The section below will elaborate on the number and type of workforce population in the study area:

District Level

The table below represents the district level workforce population:

Table 4-30. District Level Workforce in the Study Area

District	Total Population (2011)	Total Workforce Population (2011)	Male Workforce Population (2011)	Female Workforce Population (2011)
Bidar	17,03,300	7,02,608	4,59,050	2,43,558
		(41.2%)	(65.3%)	(34.6%)

Source: Primary Census Abstract 2011

The table above indicates that the total workforce population of Bidar district comprises of 41.2% (702608) of the total population (17,03,300). Female workforce population comprises of 34.6% (243558) of the total working population.

Taluka Level

The table below represents the sub district level workforce population:

Table 4-31. Taluka Level Workforce in the Study Area

District	Mandal	Total Population (2011)	Total Workforce Population (2011)	Male Workforce Population (2011)	Female Workforce Population (2011)
Bidar	Aurad	2,78,400	1,21,346	76,939	44,407
			(43.5%)	(63.4%)	(36.5%)

Source: Primary Census Abstract 2011

The table above represents that the total workforce population of Aurad Taluka comprises of 43.5% (1,21,346) of the total population (2,78,400). Female workforce population comprises of 36.5% (44,407) of the total working population.

Village Level

The table below represents the village level workforce population:

Table 4-32. Village level Workforce Population in the Study Area

Mandal	Villages	Total Population (2011)	Total Workforce Population (2011)	Male Workforce Population (2011)	Female Workforce Population (2011)
Aurad	Lingdahalli	734	271	222	49
			(36.9%)	(81.9%)	(18%)
	Jonnekeri		544	297	247
		989	(55%)	(54.5%)	(45.4%)
	Jojna	2327	944	683	261
			(40.5%)	(72.3%)	(27.6%)

Source: Primary Census Abstract 2011

It can be noted in the table above that Jonnekeri village has the highest workforce population at 55% (544) to its total population of 989. It is followed by Jojna village at 40.5% (944) and lastly by Lingdahalli village at 36.9% (271) to its total population of 2327 and 734 respectively. Female representation in the total workforce is lowest in Lingdahalli village at 18% (49) to its total workforce population of 271.

4.4.6.1 Main and Marginal Workforce Population

The workforce population can be further segregated into Main and Marginal Workers. Main workers are those who have been engaged in economically productive activities for more than one hundred eighty-three (183) days and Marginal workers are those workers who have been engaged in any economically productive activity for less than one hundred eighty -three days (183) days. This section of the report represents the Main and Marginal Workforce population in the study area.

District Level

The table below represents the district level Main and Marginal Workforce population,

Table 4-33. Type of Workforce Population in the District Level

District	Total Workforce Population (2011)	Main Workforce Population (2011)	Main Male Workforce Population (2011)	Main Female Workforce Population (2011)	Marginal Workforce Population (2011)	Marginal Male Workforce Population (2011)	Marginal Female Workforce Population (2011)
Bidar	7,02,608	5,51,763	3,84,430	1,67,333	1,50,845	74,620	76,225
		(78.5%)	(69.6%)	(30.3%)	(21.4%)	(49.4%)	(50.5%)

Source: Primary Census Abstract 2011

The table above represents that 78.5% (5,51,763) of the total workforce population (7,02,608) of Bidar district is engaged as Main workforce population. It can be noted that the main female workforce population comprises of only 30.3% (1,67,333) of the total working population. However, in the marginal workforce population it can be noted that the women's participation in the workforce (50.5%) is higher than that of males (49.4%) working population.

Taluka Level

Main and Marginal workforce population in the Mandal level has been represented in the figure below,

Table 4-34. Type of Workforce Population in the Taluka Level

Taluka	Total Workforce Population (2011)	Main Workforce Population (2011)	Male Main Workforce Population (2011)	Female Main Workforce Population (2011)	Marginal Workforce Population (2011)	Male Marginal Workforce Population (2011)	Female Marginal Workforce Population (2011)
Aurad	1,21,346	94,149	65,358	28,791	27,197	11,581	15,616
		(77.5%)	(69.4%)	(30.5%)	(22.4%)	(42.5%)	(57.4%)

Source: Primary Census Abstract 2011

The table above represents that 77.5% (94,149) of the total workforce population (1,21,346) of Aurad Taluka is engaged as Main workforce population. It can be noted that the main female workforce population comprises of only 30.5% (28,791) of the total working population. However, in the marginal workforce population it can be noted that the women's participation in the workforce (57.4%) is higher than that of males (42.5%) workforce population.

Village Level

The table below represents Main and Marginal Workforce Population at the Village level.

Table 4-35. Main and Marginal Workforce Population in the Study Area

Taluka	Villages	Total Workforce Population (2011)	Main Workforce Population (2011)	Main Male Workforce Population (2011)	Main Female Workforce Population (2011)	Marginal Workforce Population (2011)	Marginal Male Workforce Population (2011)	Marginal Female Workforce Population (2011)
Aurad	Lingdahalli	271	148	142	6	123	80	43
			(54.6%)	(95.9%)	(4.05%)	**(45.3%)**	(65%)	(34.9%)
	Jonnekeri	544	520	292	228	24	5	19
			(95.5%)	(56.1%)	(43.8%)	**(4.4%)**	(20.8%)	(79.1%)
	Jojna	944	678	551	127	266	132	134
			(71.8%)	(81.2%)	(18.7%)	**(28.1%)**	(49.6%)	(50.3%)

Source: Primary Census Abstract 2011

The table above represents that the highest main workforce population amongst the study area villages is in Jonnekeri village at 95.5% (520) to its total workforce population of 544. 43.8% (228) of female representation in the main workforce population of Jonnekeri is also noted. Jojna village has the second highest main workforce population at 71.8% (678) with female representation in the main workforce population at 18.7% (127). Marginal workforce population comprises of 4.4% (24), 28.1% (266) and 45.3% (123) in Jonnekeri village, Jojna village and Lingdahalli village respectively.

4.4.6.2 Occupational Pattern

Occupational pattern distribution of a population in an area indicates the development and diversification of an economy. The trend suggests that developed countries have higher distribution of population in the services and secondary sectors and the developing or underdeveloped countries have higher concentration of population in the primary (i.e. the agricultural) sector. For the Census Survey, the occupations are classified into Cultivators, Agricultural Labourers, Household (HH) Industries and Others[7].

As main workforce population comprises majority of the workforce population in the state, district and village levels. The Occupational Pattern of the Main Workforce population in the study area has been represented in the section below.

[7] the type of workers that come under this category of 'OW' include all government servants, municipal employees, teachers, factory workers, plantation workers, those engaged in trade, commerce, business, transport banking, mining, construction, political or social work, priests, entertainment artists, etc

District Level

The District level occupational pattern has been presented in the table below:

Table 4-36 District Level Occupational Pattern of Study Area

District	Main Workforce Population (2011)	Main Cultivator Population (2011)	Male Cultivator Population (2011)	Female Cultivator Population (2011)	Main Agri. Labourers Population (2011)	Male Agri. Labourers Population (2011)	Female Agri. Labourers Population (2011)	Main HH Industries (2011)	Male HH Industries (2011)	Female HH Industries (2011)	Others Occupation (2011)	Male Others Occupation (2011)	Female Others Occupation (2011)
Bidar	5,51,763	1,30,304	97,388	32,916	1,98,559	1,07,089	91,470	11,687	7,873	3,814	2,11,213	1,72,080	39,133
		(23.6%)	(74.7%)	(25.2%)	(35.9%)	(53.9%)	(46%)	(2.1%)	(67.3%)	(32.6%)	(38.2%)	(81.4%)	(18.5%)

Source: Primary Census Abstract 2011

The table above represents that the agricultural activities related occupations comprises of 59.5% of the main occupation in the district. Cultivators are at 23.6% (1, 30, 304) and Agricultural Labourers is at 35.9% (1, 98, 559) of the total workforce population. The highest percentage of the main workforce population is engaged as Others at 38.2% (2, 11, 213). The highest female population are engaged as Agricultural Labourers at 46% (91,470) of the total main workforce population.

Taluka Level

The Taluka level occupational pattern has been presented in the table below,

Table 4-37 Taluka Level Occupational Pattern of Study Area

Taluka	Main Workforce Population (2011)	Main Cultivator Population (2011)	Male Cultivator Population (2011)	Female Cultivator Population (2011)	Main Agri. Labourers Population (2011)	Male Agri. Labourers Population (2011)	Female Agri. Labourers Population (2011)	Main HH Industries (2011)	Male HH Industries (2011)	Female HH Industries (2011)	Others Occupation (2011)	Male Others Occupation (2011)	Female Others Occupation (2011)
Aurad	94,149	32,101	24,209	7892	37,818	21,541	16,277	1827	1292	535	22,403	18,316	4087
		(34%)	(75.4%)	(24.5%)	(40.1%)	(56.9%)	(43%)	(1.9%)	(70.7%)	(29.2%)	(23.7%)	(81.7%)	(18.2%)

Source: Primary Census Abstract 2011

The table above represents that the agricultural activities related occupations comprises of 74.1% of the main occupation in Aurad Taluka. Cultivators are at 34% (32,101) and Agricultural Labourers is at 40.1% (37,818) of the total workforce population. The highest percentage of the main workforce population is engaged as Agricultural labourers at 40.1% (37,818). The highest female population is engaged as Agricultural Labourers at 43% (16,277) of the total main workforce population.

Village Level

The village level occupational pattern has been presented in the table below,

Table 4-38 Village Level Occupational Pattern of Study Area

Village	Main Workforce Population (2011)	Main Cultivator Population (2011)	Male Cultivator Population (2011)	Female Cultivator Population (2011)	Main Agri. Labourers Population (2011)	Male Agri. Labourers Population (2011)	Female Agri. Labourers Population (2011)	Main HH Industries (2011)	Male HH Industries (2011)	Female HH Industries (2011)	Others Occupation (2011)	Male Others Occupation (2011)	Female Others Occupation (2011)
Lingdahalli	148	34	34	0	44	41	3	20	19	1	50	48	2
		(22.9%)	(100%)	(-)	(29.7%)	(93.1%)	(6.8%)	(13.5%)	(95%)	(5%)	(33.7%)	(96%)	(4%)
Jonnekeri	520	74	47	27	140	64	76	2	1	1	304	180	124
		(14.2%)	(63.5%)	(36.4%)	(26.9%)	(45.7%)	(54.2%)	(0.3%)	(50%)	(50%)	(58.4%)	(59.2%)	(40.7%)
Jojna	678	309	274	35	225	149	76	4	3	1	140	125	15
		(45.5%)	(88.6%)	(11.3%)	(33.1%)	(66.2%)	(33.7%)	(0.58%)	(75%)	(25%)	(20.6%)	(89.2%)	(10.7%)

Source: Primary Census Abstract 2011

It can be noted from the table above that Jojna village has the highest number of main workforce population engaged in occupations related to agricultural activities at 78.6%. Jonnekeri has the highest number of people engaged as others at 58.4% (304). Female representation is highest in the agricultural labourer's occupation in Jonnekeri village at 54.2% (76). Amongst the study area villages it is noted that lowest representation of women is found in Lingdahalli village across all occupations as in cultivators occupation there are no women involved, agricultural labourers has only 6.8% (3) females, household industries has only 5% (1) and lastly in others 4%(2).

4.4.7 Public Utilities

Village Data Abstract (VDA) 2011, a publication of the Directorate of Census Operations has been taken as the primary source of information for the data on existing infrastructure facilities at the village level of the study area. It has been further supplemented on recent data based on the consultations undertaken during the site visit.

4.4.7.1 Educational Facilities

According to Village Data Abstract 2011, there is one (01) government pre-primary school in Jojna and Lingdahalli villages. As per consultation held during the site visit, it was noted that Jonnekeri village also has a pre-primary school present in the village. There are primary schools in Jojna and Jonnekeri villages. Jojna, Jonnekeri and Lingdahalli villages also have middle schools. For higher educational facilities, community members of these villages travel to Santpur and Aurad which are located at a distance of five (05) to ten (10) kilometres.

4.4.7.2 Healthcare Infrastructure Facilities

Amongst the study area villages, Jojna village has a Primary Sub health centre (PHSC). The nearest health care facility for Jonnekeri village is located at less than five (05) kilometres and between 5-10 kilometres for Lingdahalli village. Specialised clinics such as Maternity care, veterinary hospitals are not present in any of the study area villages and local population have to traverse to Aurad and Bidar to avail these facilities.

4.4.7.3 Road Infrastructure

According to VDA 2011, road infrastructure in all three (03) study area villages is a combination of black topped (pucca) and gravel (kuccha) roads.

4.4.7.4 Transportation and Communication Facilities

According to VDA 2011, government bus services ply in all the study area villages. This is further supplemented by the private vehicles such as buses and vans. Amongst the study area villages, according to VDA 2011 Jojna village is the only village that has a Post office.

4.4.7.5 Banking Facilities

According to VDA 2011, there are no commercial banks and cooperative societies in all three (03) study area villages. However, government banks are present in Santpur.

4.4.7.6 Other Infrastructural Facilities

Water Supply

Government Water supply is the primary source of water supply in Lingdahalli and Jonnekeri villages. All study area villages have borewells and handpumps as their water supply infrastructure.

Sanitation Facilities

According to VDA 2011, only Lingdahalli village has covered drainage status amongst the three (03) study area villages. All households in the study area villages have sanitation facilities present.

Electricity Supply Facilities

All the study area villages have access to electricity.

Cooking Fuel Facilities

In the study area villages, combination of LPG cylinders and wood are used by the local population as cooking fuel.

4.5 Stakeholder Engagement and Consultation

Stakeholder consultations are an important process through which a two way dialogue is created between the project proponent and the stakeholders. 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.

4.5.1 Stakeholder Consultation Objective and Scope

The stakeholders for the project were prioritized by identifying their direct and indirect influence and interest level with the project. The key stakeholders that were consulted as part of the study included the following,

- Land Owners who sold their land for the project
- Representative of Member of Santpur Gram Panchayat
- Site Representatives of CSPGPL and HFE Representatives

A questionnaire with a list of open-ended questions was used to initiate the discussion process, details of the responses of which have been presented in the following sections. Additionally, signatures of the stakeholders consulted during the site visit have been provided as ***Appendix G***.

4.5.1.1 Views expressed by Landowners

Two (02) landowners were consulted during the site visit to understand the process of purchase including the determination of payments. The respondents were uniform in their replies that land prices were determined on the basis of one to one negotiation with the Land Aggregator (T. Santosh Kumar) used by CSPGPL. It was further mentioned that all landowners received INR 3,00,000 for an acre which was two times over and above the prevailing market rates. Payments have been disbursed to all sellers and received by them, respectively. The landowners were informed about the project that was to be set up in the area and did not have any concerns or issues regarding the development. It was further mentioned that the land was sold primarily because of the reduction of rainfall over the years which resulted in lesser land being used for agricultural purposes. As most of the land in the villages was rainfed, this led to most of the landowners with land of no productive use, hence, leading them to sell their land and use the payment for their own benefits. Sample sale deeds were provided by the client for review. Additionally, details of the information provided for all land purchased for the project as received by HFE has been provided below,

Table 4-39. Details of Land Purchased for the Project

S. No.	Survey Number	Land Owner name	Land Extent		
			Acres	Guntas	Kharab
1.	7	Jagannath	1	32	0
	27/1		2	29	0
2.	7/3A	Rajukumar Gundappa	4	0	0
3.	9/A	Gundagonda Narsagonda	9	0	0
4.	10	Nagashetty Vishwanath	11	9	
5.	33/1	Nagashetty	2	20	
6.	15/1	Umakant And Kashayya	3	27	
7.	11/1	Parvathi	4	0	0
8.	19/1	Bharatha	1	39	0
9.	19/1	Rajkumar Shivram	1	39	0
10.	19/1	Kalavathi	1	28	0

S. No.	Survey Number	Land Owner name	Land Extent		
			Acres	Guntas	Kharab
11.	19/1	Sonamma Kallappa	1	39	0
12.	19/3	Kavitha	1	0	0
13.	20/1	Sharanappa	2	29	
14.	20/1	Shivakumar	2	30	
15.	25/1	Jaiprakash	10	0	0
16.	26/1/1	Shivaraj	1	6	
	26/1/1	Basavaraj	1	6	
17.	26/1/2	Dhanaraj	1	0	0
18.	26/1/2	Shanmukayya	0	39	0
19.	26/1/2	Rachayya	2	0	5
20.	26/1/3	Sangayya	8	35	10
	26/2/2	Sangayya	3	33	6
21.	26/2/3	Lakshmi Bai	0	26	
22.	26/2/4	Sangayya	4	32	12
23.	27/2	Ramdas	3	25	0
24.	26/1/1	Madolayya	3	19	8
25.	44	Gurunath	5	0	0
26.	34/1	Basappa	2	0	0
27.	35/A	Kushal Rao	2	0	0
28.	35/D	Ramkishan	2	0	0
29.	36	Narsareddy	5	0	0
30.	8/4	Datatrey Gundappa	6	0	
31.	43/2B	Bassamma	2	8	10
32.	42/1A	Lingappa	3	12	
33.	43/1	Lingappa	13	32	
	42/1	Shivraj			
	43/1	Shivraj			
34.	8/4paiki	Sharanappa	3	10	
35.	34/1	Basappa	2	0	0
36.	7/3B	Nagamma	5	0	0
37.	35/.	Kashinath S/O Basavantharao	17	18	0
38.	21/2	Malikarjun S/O Manappa	3	36	0
39.	9/B	Dattatrya S/O Narsingha	4	20	0
40.	35/.	Kashinath S/O Basavantharao	1	20	0
41.	21/4	Baburao	5	4	0
42.	42/2/A	Bellure Anjareddy	5	22	1.11
43.	42/2/K	Bellure Anjareddy	2	31	26
44.	41/1	Itabai	4	0	9
45.	20/2	Malikarjun	5	13	7
46.	21/3	Rajamma	9	1	0
47.	20/1	Vaijnath	1	28	0
48.	35/.	Baburao	2	28	0
49.	34	Kallappa	2	0	0
50.	27/2	Pander Sanjeev	3	25	0
51.	41/*	Arjun	4	0	0

S. No.	Survey Number	Land Owner name	Land Extent		
			Acres	Guntas	Kharab
52.	41/*	Chandrappa	4	0	0
53.	35/*	Ramkishan	3	10	0
54.	20/1	Ratnamma	1	0	0
55.	20/1	Mallikarjun	4	20	0
56.	20/1	Shankrappa	4	20	0
57.	41/K	Maruti	4	0	0
		Total	218	900	
		Total Extent	240.2		

Source: HFE

Consultation with Site Employees

Consultation with land sellers

Consultation with land seller

Consultaion with land seller

4.5.1.2 Views expressed by Member of Gram Panchayat, Santpur

The member of the Gram Panchayat was contacted to gather his views on the socio-economic profile of the villages that fall under Santpur Gram Panchayat. It was mentioned that all the households in the area practice agriculture and cultivate Tur, Jowar and Soyabean. Due to less rainfall over the last few years, the practice of agriculture has suffered and people are taking up opportunities as labourers. Most of the population in the area practice Hinduism with few families following Christianity. It was further mentioned that the population in the area were aware of the project developments as there were existing operational solar projects in the area. The land primarily used for the project was barren as agriculture has been affected in the area due to lesser rainfall over the years. No issues or concerns were highlighted or informed by the local population. Employment opportunities in the form of security guards, cleaners and local suppliers have benefitted the local population.

Gender Profile of the Villages

To comprehend the existing living pattern of the local population residing across the project area, a look at the socio-economic status of women and the role that women have been playing both at the domestic and economic level needs to be taken into consideration. As the patriarchal values are entrenched in Indian society, women often play a more subordinated and dependent role. Even though they constitute almost half the population, various indicators pertaining to literacy level, labour force participation, mortality rate etc. reveal the dismal status of women to that of men.

According to the UN Gender Development Index, 2014 India ranks 132 out of 187 countries worldwide. As per the 2011 Census data, Karnataka has a total female population of 30,128,640 with sex ratio of 973 females to every 1000 males. A total of 68.08% of the female population are literates in the State.

While interacting with the Gram Panchayat Representative, information relating to the gender profile in the area was also gathered. It was reported that no government schemes for women have been introduced in any of the Gram Panchayats. The main activities undertaken by women were mostly in the form of engagement of agriculture activities and household chores. As per his opinion, women do not have any access to maternal hospitals in the area and have to travel to Bidar at a distance of 35 km for child delivery related concerns. There are around ten (10) women Self-Help Groups (SHGs) which are prominent in the area. The SHGs usually consist of 10 members and funds collected within the SHGs are utilised in the agricultural activities and livestock rearing.

4.5.1.3 Views expressed by CSPGPL and HFE Representatives

During discussions held with representatives of CSPGPL and HFE, it was noted that all land for the project activities were private agricultural land. The price for the land purchase was determined based on the prevailing market value. All land parcels procured for the project were directly negotiated individually by the land aggregator (T. Santosh Kumar) with the land owners. All land sellers have been provided payments higher (twice) than the prevailing market value. All payments have been disbursed to the 56 land sellers. No Objection Certificates (NOC) from the Santpur and Jojna Gram Panchayats have been obtained by the Company and NOC from Jojna Panchayat attached as ***Appendix H*** to the report. NOC from Santpur Gram Panchayat was not available for review.

The community around the vicinity of the project site are aware of the project development and are aware of the Site Supervisor identity. In case of any issues/concerns, it was stated that they directly contact the Supervisor.

Formal grievance redressal mechanism has been set up for the project, the details of which are presented as ***Annexure I***. However, there are plans for setting one up for the project on the lines of the mechanism developed in the Environment and Social Management System (ESMS) of HFE. The identified person from the Community will be the Sarpanch(s) of the respective Gram Panchayats and from HFE it will be the Site Incharge. However, formal decision on this aspect is yet to be finalised and implemented. Corporate Social Responsibility (CSR) activities are yet to be initiated onsite by the company. It was stated that the Company will plan activities based on the community needs and this will be initiated once all construction activities onsite will be completed.

4.6 Traffic Data

The project involved transportation of solar panels and other components on trucks/trailers through village roads during peak construction phase. During the current phase, i.e. Operation phase, traffic movement for the project activities is restricted only to the movement of project vehicles and materials for maintenance.

The Solar Project is well connected through State Highway 15 (SH-15). It is a two-lane two-way undivided road.

Assessment of existing traffic conditions in the project area was undertaken to identify the problems with respect to traffic movement and to formulate the possible alternative solutions and the need for organizing the same in an efficient and economical manner. A traffic volume count survey was conducted at one location, i.e. Village access road of Jonnikere village connecting to the project site, which is used for transportation of the materials and is the main connecting road for the site. The two-way traffic volume counts were recorded for during peak hours in morning (from 7:00 am to 11:00 am) and also in evening (4:00 pm to 8:00 pm), once during the study period to assess the existing traffic composition. The details of the traffic monitoring location have been provided in ***Table 4-40*** below.

Table 4-40: Traffic Monitoring Location

S. No.	Sampling Locations	Location Code	Geographical Location
1	TM 1	18° 11.419'N, 77° 27.429'E	Village road connecting to site (Access road)

The traffic monitored has been divided into the following four categories/classes:

- Two wheelers (motor cycle, scooters);
- Three wheelers (auto rickshaw, motorized cart);
- Four wheelers (passenger cars, pick up vans);
- Six wheelers (light commercial vehicles, trucks & buses)
- Bicycles; and
- Others (carts).

Since the vehicles are of different types, a factor needs to be accounted for each of them in order to express them at par in single unit terms. The factors, commonly known as Passenger Car Unit (PCU) factors that are generally adopted have been given in the following ***Table 4-41***,

Table 4-41: PCU Factors adopted for Traffic Volume Survey

Vehicle Type	PCU Factor
Two Wheelers (Motor Cycle, Scooter etc.)	0.75
Three Wheelers (Autorickshaw, motorised carts etc.)	1.2
Four Wheelers (Passenger cars, Pickup vans etc.)	1
Six Wheelers (Light Commercial vehicles, Trucks and Buses etc.)	3.7
Bicycles	0.5
Others (Carts etc.)	2

Source: The Indian Roads Congress Code – IRC 109-1990

The traffic volume counts have been furnished in the following ***Table 4-43*** below.

Table 4-42: Traffic Volume Count

Vehicle Class	Morning Peak (7:00 am to 11:00 am)		M. Factor	PCU	Evening Peak (4:00 pm to 8:00 pm)		M. Factor	PCU
	Total Number	% Composition			Total Number	% Composition		
Two Wheelers	110	76	0.5	59	125	79	0.5	62
Three Wheelers	2	13	1	21	17	11	1	17
Four Wheelers	0	4.6	1	11	11	7	1	11
Six Wheelers	0	0.6	3	6	4	2.5	3	12
Bicycles	0	1.9	0.5	1.5	1	0.6	0.5	0.5
Others	0	0	3	0	0	0	3	0

Source: Laboratory Results, April 2019

Inference

It is noted that out of the total vehicles observed, highest % of vehicles observed is two wheelers, followed by three wheelers and four wheelers both in the morning and evening peak hours. The total number of PCUs for morning hours is 98 and 102 for the evening hours. The contribution of the six wheelers, bicycles and cars is negligible in morning but significant in evening hours.

5. Analysis of Alternatives

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

- No Project Scenario;
- Alternate Location for the project;
- Alternate Source of power generation; and
- Alternate routes for transmission lines.

5.1 No Project Scenario

According to a survey conducted by the World Energy Council, as the population increases and as the growing rate of electrification places huge requirements on energy supplies, the total primary energy demand of India is expected to increase by almost 150% by 2035.

During the last four years, the state of Karnataka has undertaken extensive electrification under Rajiv Gandhi Grameen Vidyutikaran Yojana (RGGVY) scheme. As on March 2015, there were 12, 56,592 (10, 15,586 rural and 2, 41,006 urban) households left for electrification. As per the Load Generation Report 2018- 2019, Ministry of Power, Government of India, the anticipated peak power demand for the state of Karnataka for year 2018-2019, will be 11,000 MW against the availability of 10,947 MW and hence will experience a power deficit of 0.5%. Whereas, the peak power demand for the state of Karnataka for year 2017-2018, was 11,138 MW against the availability of 10,534 MW and hence experienced power deficit of 5.4%. The anticipated power supply position of Karnataka in terms of Energy requirement and Peak demand for the year 2018-19 is given in the ***Table 5-1*** below,

Table 5-1: Power supply position of Karnataka during 2018-19

State	Energy				Peak			
	Requirement	Availability	Surplus (+)/ Deficit (-)		Requirement	Availability	Surplus (+)/ Deficit (-)	
	(MU)	(MU)	(MU)	%	(MW)	(MW)	(MW)	%
Karnataka	73,621	77,140	+3,519	4.8	11,000	10,947	-53	0.5

Source: Load Generation Balance Report 2018-19, Central Electricity Authority (http://www.cea.nic.in/reports/annual/lgbr/lgbr-2018.pdf)

It can be noted from the above table that the State of Karnataka will have power surplus of about 4.8% through the year 2018-2019 however, there will be a power deficit of 0.5% for peak energy requirement.

Based on the data extracted from Load Generation Balance Report, month-wise, power supply position of Karnataka met during the year 2017-18 in terms of peak demand and energy is represented in ***Table 5-2*** below,

Table 5-2: Power Supply position of Karnataka during 2017-2018

	Apr-17	May-17	Jun-17	Jul-17	Aug-17	Sep-17	Oct-17	Nov-17	Dec-17	Jan-18	Feb-18	Mar-18
Month-wise power supply position of Karnataka during the year 2017-18 (in terms of peak demand)												
Peak Demand (MW)	9,992	9,376	8,648	8,980	8,970	8,450	8,404	9,715	10,144	10,381	10,235	10,857
Peak Availability (MW)	9,987	9,358	8,612	8,978	8,970	8,407	8,404	9,688	10,100	10,347	10,212	10,802
Surplus (+)/Deficit (-) (MW)	-5	-18	-36	-2	0	-43	0	-27	-44	-34	-23	-55
(%)	-0.1	-0.2	-0.4	0.0	0.0	-0.5	0.0	-0.3	-0.4	-0.3	-0.2	-0.5
Month-wise power supply position of Karnataka during the year 2017-18 (in terms of energy)												
Requirement (MU)	6,229	5,455	4,958	5,411	5,339	4,526	4,463	5,784	6,165	6,471	6,007	7,061
Availability (MU)	6,226	5,453	4,957	5,410	5,333	4,520	4,455	5,723	6,160	6,464	6,002	6,999
Surplus (+)/Deficit (-) (MU)	-3	-2	-1	-1	-6	-6	-8	-61	-5	-7	-5	-62

	Apr-17	May-17	Jun-17	Jul-17	Aug-17	Sep-17	Oct-17	Nov-17	Dec-17	Jan-18	Feb-18	Mar-18
(%)	-0.1	-0.1	0.0	0.0	0.0	-0.2	-0.1	-0.1	-0.1	-0.1	-0.1	-0.9

As on 30th September 2018, Karnataka state has a total power generation capacity of 27,170.35 MW from all the sources. Out of which, 9,960.82 MW is contributed by thermal and 698 MW is contributed by nuclear. Hydro (renewable) and RES (MNRE) contribute 3,599.80 MW and 12,911.73 MW respectively. The details have been presented in ***Table 5-3*** below.

Table 5-3: Installed Capacity (in MW) of power utilities in Karnataka State (as on 30th September 2018)

Ownership/ Sector	Model wise break up							Grand Total
	Thermal				Nuclear	Hydro (Renewable)	RES* (MNRE)	
	Coal	Gas	Diesel	Total				
State	5020.00	0.00	127.92	5147.92	0.00	3599.80	155.33	8903.05
Private	1958.50	0.00	25.20	1983.70	0.00	0.00	12756.40	14740.10
Central	2829.20	0.00	0.00	2829.20	698.00	0.00	0.00	3527.20
Sub-total	9807.70	0.00	153.12	9960.82	698.00	3599.80	12911.73	27170.35

** RES includes SHP, BP, U&I, Solar and Wind Energy as on 30.09.2018*

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

Source: CEA (http://www.cea.nic.in/reports/monthly/installedcapacity/2018/installed_capacity-09.pdf)

Karnataka is rich in solar resources and solar energy will complement the conventional sources of energy in a large way. The state of Karnataka is blessed with about 240 to 300 sunny days with good solar radiation. 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/m^2/day annually. Insolation varies from 4.5 to 7.0 kWh/m^2/day throughout the year. All districts of the state receive average insolation of 5.5 to 6.5 kWh/m^2/day annually except Kodagu (5-5.5 kWh/m^2/day) as presented in ***Figure 5-1***.

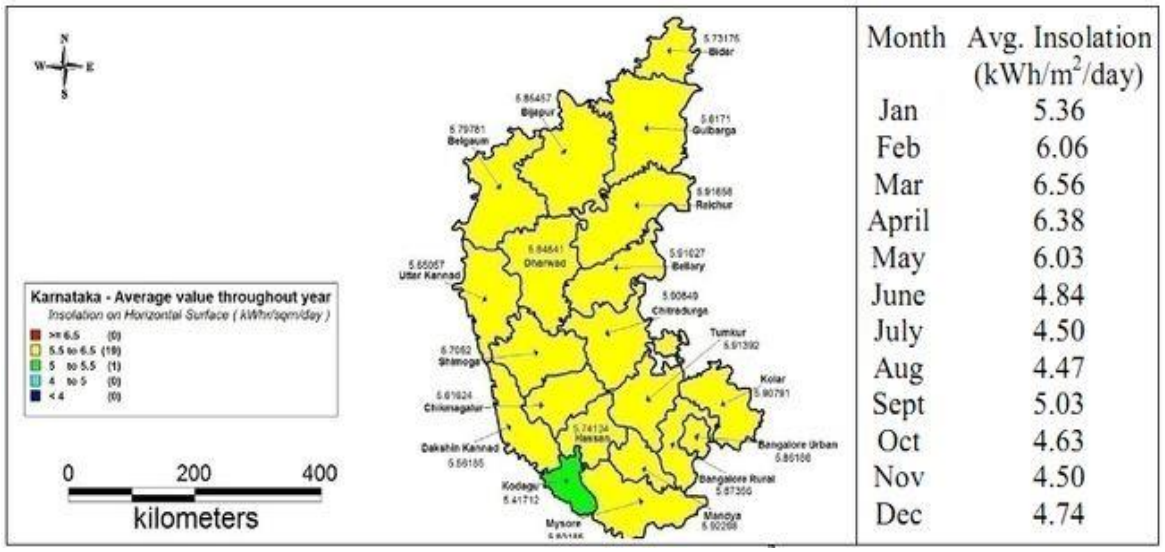


Figure 5-1: Average Annual Solar Insolation (kWh/m2/day) in Karnataka

As per the prevailing technical norms, any place with DNI more than or equal to 5.00 kWh/m^2/day is considered suitable for solar thermal power projects that use only direct solar radiation. As regards with SPV power projects, they use both direct and diffuse radiation and hence values below 5.00 kWh/m^2/day are also acceptable. However, as per Karnataka Renewable Energy Development Limited (KREDL), annual average global horizontal irradiation at Aurad taluka is 5.74 kWh/m^2 as presented in ***Table 5-4.***

Table 5-4: Average GHI and DNI values at Project Taluka

Taluka	Latitude	Longitude	Altitude	Annual Average GHI (kWh/m^2)	Annual Average DNI (kWh/m^2)
Aurad	18° 5' 0"	77° 25' 48"	542	5.94	5.22

Source: Karnataka Renewable Energy Development Limited (KREDL)
GHI: Global Horizontal Irradiance
DHI: Direct Norma Irradiance

Solar Radiation at Site

The project site experiences an average global horizontal irradiance on month basis falling in range of 1900 to 2050 kWh/m^2 as detailed in Table 5-5. This irradiance is generally suitable for the reasonably good energy generation. ***Table 5-5*** below presents the levels of irradiance (month wise) at the project site.

Table 5-5: Month Wise level of Irradiance for the site region

Months	Average Monthly Global Horizontal Irradiance (kWh/m^2/month)
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 (August 2016)

The 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 'Current Project' and 'No- Project' Alternative have been assessed against potential environment and social impacts that are envisaged. Going forward with the current project alternative is considered the best possible option as opposed to 'No Project' since the 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 5-6: Comparison of overall environmental impacts as a result of the Current Project against the 'No-Project' Alternative

Environmental and Social Components	Current 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*

5.2 Alternate Location for Project

Solar power projects are non-polluting energy generation projects and are dependent on the availability of sufficient solar irradiation. The 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:

- ***Easy Access:*** Easy access to site or connectivity with main road or highways helped 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 15 (Bidar Road).
- ***Shadow***: Shadow free or minimum shadow area improves plant generation. There are no major structures within 1 km of the site.
- ***Settlements***: Site is located away from major settlements and villages;
- ***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;
- ***Electrical infrastructure***: Grid sub-station is present at a distance of about 5 km from the site, will allow minimum transmission losses and also saves transmission cost of project.
- ***Climate***: The site experiences moderate rainfall, solar irradiation in the range of 1900-2050 kWh/m^2/month, low relative humidity, is good for setting up of a Solar power plant;
- ***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. 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.

5.3 Alternate Source of Power Generation

India has an installed capacity of 3,50,162 MW GW as on 28th February 2019 as per the Ministry of Power. In terms of fuel, coal-fired plants account for 54.6% of India's installed electricity capacity followed by renewable energy and hydropower which accounts for 21.2% and 13.0% respectively. Nuclear plants account for 1.9% of power generated. The source wise installed capacity in India is presented in ***Figure 5-2.*** 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 5-7.***

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.

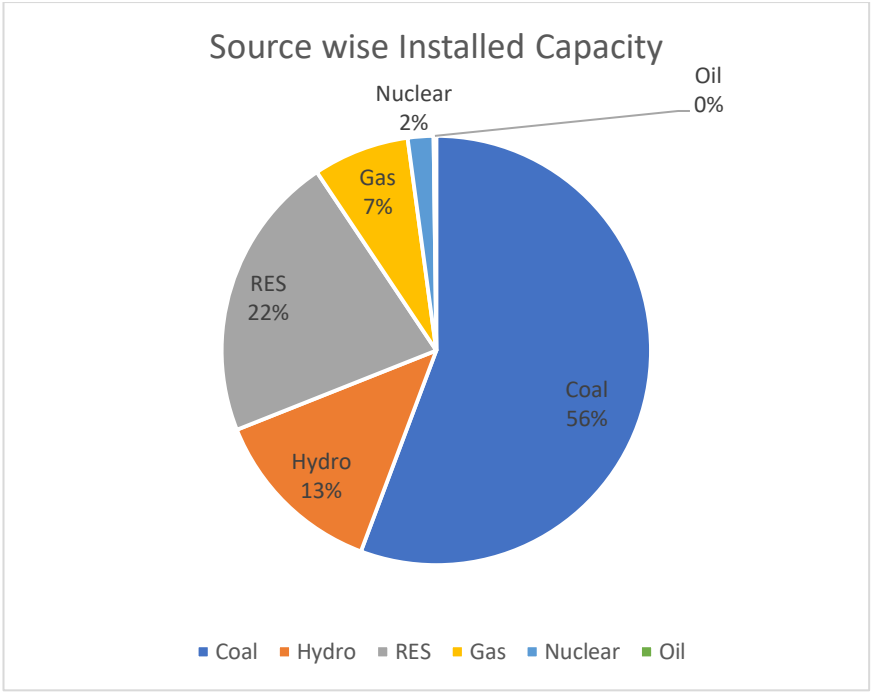


Figure 5-2: Source wise Installed Capacity in India as on 28th February 2019

Source: Ministry of Power (2019)

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 5-7:Comparative analysis of Various Power Generation Options

Alternative	Cost (₹/kWh) *	Plant Load Factor **	Average Lifecycle GHG Emission (tonnes CO_2e/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 a target of renewable energy capacity to 175 GW by the year 2022. While about 100 GW 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 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.

5.4 Alternate Route for Transmission Line

Power from the solar PV plant is being evacuated to the 110/33/11 kV grid substation at Santpur (owned by Karnataka Power Transmission Corporation Limited) which is located at a distance of about 5 km from the site. 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. No house or community structure are located under the transmission line;
3. Any route which has the presence of a monument of cultural or historical importance, community structures, or houses is exempted;
4. Only Right of way has been secured by providing adequate compensation to the land owners where transmission poles have been installed in Santpur village;
5. Areas requiring extensive clearing of vegetation have been avoided; and
6. 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. The land procured has been on a willing buyer / willing seller basis (please refer to Section 2.6 for more details on the land procurement process). The project area is rain fed region and agriculture is limited during rainy season only, and it was reported that habitations, community structures, or residential areas have been avoided and by passed during the procurement stage. The transmission route therefore has been chosen considering the above social conditions, in addition distance to be covered, financial benefits.

Consideration of all the above factors has reduced the environmental and social footprint of the transmission line.

5.5 Conclusion

United Nation's Intergovernmental Panel on Climate Change (IPCC) has projected that renewable energy can provide approximately 77% of global primary energy supply by 2050. The state level incentives provided by the new government of Karnataka are attractive enough to influence the solar power companies.

As mentioned in the sections above, the project has many advantages like elevating the standard of rural economies, increasing the power supply of the energy deficit state of Karnataka in an environmentally friendly manner. The project with existing options for site, mode of power generation, route of transmission line etc., is the appropriate alternative and is beneficial for the region.

6. Evaluation of Impacts

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 as required. Impacts during the operation and decommissioning 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.

6.1 Impact Assessment Criteria

Identified impacts have been appraised through social and environmental components and have been presented in ***Table 6-1*** 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 6-1: 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 (05) years	the anticipated recovery of the impacted environmental aspect is within 5 years
	Long Duration	when impact extends beyond five (05) 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	While for ecology, high intensity refers to changes that result in serious

Criteria	Sub-Classification	Defining Limit	Remarks
		exceeds 30%	destruction to species, productivity or critical habitat.
Nature: Refers to whether the effect is considered beneficial or adverse	Beneficial	-	Useful to Environment and Community
	Adverse	-	Harmful to Environment and Community

A "significance assessment matrix" has been adopted in order to assess impacts appraised as per criteria mentioned in Table 6-1. The below ***Table 6-2*** provides the impact significance criteria adopted for assessment.

Table 6-2: 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		
Local	Long	Low		
Local	Short	High	Moderate	Moderate
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		

6.2 Impact Evaluation Matrix

Table 6-3 below presents the impact identification matrix for operation and decommissioning phases of the project, based on environmental, occupational health and safety and social variables. Each of the impacts identified has been further discussed and corresponding mitigation measures have been proposed.

Table 6-3: Impact Identification Matrix – Operation and Decommissioning Phase

Environment, Health & Safety and Social Impact Assessment Variables	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 equipment		•
Ambient Noise Quality		
Material Handling and Storage		
Repair and Maintenance Works of solar panels	•	•
Demobilization of construction equipment		
Traffic and Transport		
Material Handling and Storage		
Demobilization of construction equipment	•	
Soil Resources		
Site Preparation and vegetation clearance		
Demobilization of construction equipment		
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		

6.3 Environmental Impacts

6.3.1 Operation Phase

6.3.1.1 Soil Quality

Compaction of soils from increased levelling and grading of areas during the construction phase within the site has resulted 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 sediment load in run-off.

During the current phase, i.e. the operation phase, there will be limited disturbance to soil however repair and maintenance of underground cables and associated utilities and transformer 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. Accidental spillage of lubricant, fuel and other chemicals may potentially cause soil degradation.

Mitigation Measures

- Disturbance to soil from repair and maintenance activity will be limited and proper restoration of soil wherever excavation is undertaken will be ensured.
- CSPGPL shall make buyback agreements for defunct panels and for replacement and disposal of transformer oil by the supplier, otherwise arrangements for disposal of defunct panels and waste oil by Karnataka State pollution Control Board (KSPCB) authorised recyclers will be required to be made.
- 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.
- Fuel and used oil will be stored in demarcated storage areas with adequate secondary containment and appropriate capacity.
- Spill control and prevention mechanism will be developed, and all the employees will be trained.

Significance of Impact

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

Table 6-4: Impact Significance- Soil Quality

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

6.3.1.2 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 is expected given the fact that IBAs located are far from 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.

6.3.1.3 Water Resources and Quality

The water requirements for the plant during operations will be predominantly for washing of solar PV modules to remove bird droppings, dust and other dirt, and domestic water consumption. Assuming a minimum of 1 liter of water per module, the water requirement for cleaning the whole plant (2,73,560 modules) will be approximately 300 kilo liters, at one time. With a cleaning schedule of once a month, it is estimated that approximately 300-350 kilo liters of water will be required for cleaning purpose on monthly basis and the requirements will be met through water tankers supplied by the EPC contractor. As per the information provided by the site personnel, the EPC contractor will extract the ground water from borewells in nearby villages for supplying the water.

Project site falls in safe zone, as per status of groundwater utilization of Bidar District. However, extraction of groundwater is to be undertaken after taking the required approval from the authority (Central Ground Water Board) by the EPC contractor. Two (02) tanks of capacity 5,000 L each have also been constructed at the site, which will be filled by the water received from water tankers for module cleaning. A Reverse Osmosis (RO) plant will be installed at site for treatment of tanker water for module cleaning. Water for domestic purpose such as toilets and cleaning in the site office will also be supplied by the water tankers. Drinking water requirement at the site for operation phase is ~40L/day and is sourced through a RO plant in Santpur.

Availability of the water in the area

Aurad Taluka of Bidar District has been categorized as 'Safe Area' for ground water abstraction as per Groundwater Information Booklet for Bidar district published by Central Ground Water Board (CGWB) in 2012. As per the estimations provided by CGWB for Aurad Taluka in July 2009, net annual ground water availability is 5354 hectare-meters (ham) and existing gross ground water draft for domestic and industrial water supply is 547 ham (which is ~10% of the total available ground water). It is estimated that cleaning of the solar panels will require 600 m^3 of water on monthly basis (considering frequency of cleaning twice a month). Hence, the water requirement on yearly basis is calculated to be 0.72 ha-m (0.06x 12 months) which is 0.13% of the existing ground water available for domestic and industrial water supply in Aurad Taluka.

Predominantly, agricultural activities in the area are 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 2012 ham which forms 37% of total net available ground water.

As informed by the site personnel, CSPGPL is evaluating the possibility of rain water harvesting at site and rain water harvesting system will be implemented after the completion of drainage work at the site.

Waste Water

During Operational phase, 10-12 site engineers, safety in charge, technicians and security guards will be deployed at site. Waste water from the toilets, floor cleaning and similar domestic works, if not channelized, collected and removed properly will lead to pollution of ground water. s

Mitigation Measures

- The plant site will be provided with adequate drainage facility to drain off washing wastewater and prevent any water-logging at site or in the surrounding areas. 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 shall 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.

- Adequate septic tanks and soak pits are to be provided at site and the Septic tanks should be maintained properly and cleaned at regular intervals.

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 minor impact without mitigation.

Table 6-5: 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**

6.3.1.4 Air Quality

The baseline air quality will not vary to a considerable extend as the operation of solar farms does not involve any significant air polluting activities and there are no direct emissions from the project during the operation phase. Hence, the overall impact on air quality during operation phase is expected to be negligible.

Significance of Impact

Table 6-6: Impact Significance - Air Quality

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

6.3.1.5 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 would be exposed to dehydration, heat exhaustion and heat stroke.

Mitigation Measures

CSPGPL will prepare and implement Occupational Health and Safety Plan (OHSP); it will clearly identify roles and responsibilities of the personnel involved within the project. The OHSP to include but not limited to the following: site specific safety plan, electrical safety, fire safety, heat stress, personnel protective equipment, emergency response plan, reporting and investigation and others.

Mitigation measures to be implemented shall include:

- 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/ incident 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 moderate 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 6-7: 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**

6.4 Ecology

6.4.1 Operation Phase

6.4.1.1 Habitat loss/ degradation/ disturbance

Physical Presence of Installations

The physical presence of the solar panels and related transmission line installations is likely to act as an obstacle and physically hinder or restrict faunal movement and ecological flows within and through the study area. This can lead to fragmentation of existing faunal habitats and effectively reduce faunal access to habitats. It is also likely to affect the habitat features such as roosts, feeding grounds, nest sites, tools and nesting materials. There is also a likelihood of death or injury to animals, especially aerially moving fauna, through electrocution with the project installations.

Project-site Illumination

Use of artificial lighting at the project site will lead to unnatural illumination in the area during the night. Interruption of the natural night period by light is known to disrupt the natural biological cycles of many floristic and faunal species.

Project-related Traffic

The movement of project-related vehicles and personnel to, from and around the project-site is apt to increase the ambient levels of vehicular emissions, dust, noise, vibrations and artificial illumination in and around the project site. These effects lead to pollution of natural resources and consequent degradation of habitats and ecosystem-services.

Mitigation Measures

- Electrocution of fauna through accidental contact with the project-installations could be mitigated by ensuring that all its electrical components are adequately insulated.
- The impact of artificial illumination could be mitigated by restricting project- operation activities to the daytime and avoiding use of artificial lighting in and around the project site as far as possible.
- The impacts caused due to movement of project-related vehicles could be mitigated by ensuring that vehicles and machinery used in the project activities comply with the prescribed emission standards and their movement is strictly restricted to pre-designated routes.

Impact Significance

Table 6-8: Impact Significance – Habitat loss/degradation/disturbance

Aspect	Scenario	Spread	Duration	Intensity	Overall
Habitat loss/degradation/ disturbance	Without Mitigation	Local	Medium	Moderate	**Minor**
	With Mitigation	Local	Medium	Low	**Minor**

6.4.1.2 Soil and Water Quality

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.

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 damage to the solar panels will led to spillage of these chemicals that are likely to cause degradation of food chains and could result into the contamination of the natural resources in the area.

Solar panels stored at the project site

Damaged solar panel at the project site

Waste Disposal

Construction debris including cement and plastic wastes generated during the construction phase were noted to be scattered in some parts of the project site. Dumping of these waste materials on bare soil is likely to damage the ground flora and micro-fauna in the area. These waste materials tend to get mixed with the waste water generated during solar panel cleaning, a key routine activity during the operational phase of the project. Accidental mixing of these waste materials into natural water resources in the area will result in contamination of the water bodies in the surroundings. As also, a few water-soluble chemicals are likely to get dissolved in the water flowing through the project area and likely to result in contamination of water sources and degradation of established food-chains in the area.

Construction waste dumped at the site

Mitigation Measures

- The 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.
- The impacts of leaching of hazardous chemicals could be effectively mitigated through institution of good operational practices and training to the staff and site workers to ensure prevention of such spillages and installation of effective containment systems to prevent any accidental spillage from leaching into the local environment. Waste materials generated and dumped on the project site should be disposed through the registered vendor.

Impact Significance

Table 6-9: Impact Significance – Soil and Water Quality

Aspect	Scenario	Spread	Duration	Intensity	Overall
Soil and Water Quality	Without Mitigation	High	Medium	Moderate	**Moderate**
	With Mitigation	Local	Medium	Low	**Minor**

6.5 Socio- Economic Impacts

6.5.1 Operation Phase

The socio-economic impacts during the operation phase have been provided below:

- Impact on Local Economy: During the operation phase, the impact on the local economy is anticipated to be positive. The local vendors and contractors are expected to get work orders for operation of the project. There is a likelihood of increase in employment opportunities of the local people as security personnel and house-keeping workforce.
- Upgradation of Local Infrastructure: With the coming of the project proponent to the area, it is expected that the project proponent will invest in the local infrastructure development such as existing village road and corporate social responsibilities (CSR) activities for the welfare of the local communities.

Mitigation Measures

The mitigation measures that can be adopted during this phase are:

- The project proponent should wherever possible engage the local workforce population for unskilled jobs. It was informed during site visit, that local employment in terms of unskilled workers where engaged at site in security services and civil works.

- The project proponent shall ensure that while engaging contractors and sub-contractors during the operation phase agreements on priority basis shall be made with local contractors and vendors.
- CSPGPL is to undertake a needs assessment of the local communities residing in the vicinity of the project area and develop and implement CSR activities for the welfare of the local communities.

Significance of Impact

The socio-economic impact value during the operation phase has been provided below,

Table 6-10: Socio Economic Impact during Operation Phase

Aspect	Scenario	Spread	Duration	Intensity	Overall Significance
Impact on Local Economy	Without Mitigation	Local	Long	Moderate	Moderate
	With Mitigation	Local	Long	Low	Minor
Upgradation of Local Infrastructure	Without Mitigation	Local	Long	Moderate	Moderate
	With Mitigation	Local	Long	Low	Minor
Implementation of CSR activities	Without Mitigation	Local	Long	Moderate	Moderate
	With Mitigation	Local	Long	Low	Beneficial

6.6 Decommissioning Phase

6.6.1 Environmental Impact

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, re-contouring the surface, and revegetation.

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 each type of item to keep the impact during the actual activity low. 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:

- 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:

- 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 6-11: Impact Significance – Decommissioning Phase

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

6.6.2 Socio-Economic Impacts

The decommissioning phase would involve the dismantling of the solar modules and all associated electrical infrastructure and site buildings. The impacts associated with the decommissioning phase are:

- Improper disposal of demolition waste and obsolete machinery may lead to contamination of soil which may cause discontentment amongst community members.
- Reduction of Workforce
- Demolition activity would lead to generation of dust which would be carried downward to the habitations.

Mitigation Measures

- Designated waste disposal sites should be marked for disposal of redundant and old solar panels;
- All waste generated from decommissioning shall be collected and disposed of at the nearest municipal disposal site. Structures that can be reused will be carried back by the contractors or sold to vendors;
- Reduction of workers shall be done phase wise and corresponding to completion of each activity;
- The local community members shall be intimated prior to the decommissioning phases and communicated about the anticipated dust generation; and
- The contractor shall inform workers and local community about the duration of work.

Significance of Impact

The socio-economic impact value for probable impacts during decommissioning phase has been presented below:

Table 6-12: Socio-Economic Impact during Decommissioning Phase

Aspect	Scenario	Spread	Duration	Intensity	Overall Significance
Waste Disposal	Without Mitigation	Local	Long	Moderate	Moderate
	With Mitigation	Local	Short	Low	Insignificant
Reduction of Workforce	Without Mitigation	Local	Medium	Moderate	Minor
	With Mitigation	Local	Short	Low	Insignificant

6.7 Cumulative Impacts

The 40 MW solar power plant is located in Jonnekeri Village in Aurad Taluka of Bidar district. Apart from this solar power project, there are two (02) solar power projects adjacent to the boundary of the operational 40 MW Solar project which are as follows:

1. 3.0 MW ground mounted solar power plant constructed by Enerparc Energy Private Limited for M/s Aurad Solar Private Limited[8]
2. 3.0 MW ground mounted solar power plant constructed by Enerparc Energy Private Limited for M/s ClearSky Solar Private Limited[9]

The cumulative impact assessment due to the development of the solar projects in the region has been discussed in the sub-sections below:

6.7.1 Impacts on Groundwater Resources

The dependence on the ground water resources for utilizing water for cleaning of solar panels and other domestic usage during operation phase of the three projects in the Jonnikere village will impact the ground water status of the overall area. Although, ground water can be utilized after obtaining due approval from the concerned authority, it is recommended to integrate other alternative water conservation measures such as rain water harvesting, treating and recycling of domestic waste water.

6.7.2 Impacts due to Improper Waste Management

Improper disposal of discarded wastes in the area may cause visual discontentment amongst local residents. Hazardous wastes such as discarded solar panel wastes (silicon tetrachloride – A Class C, Schedule II, corrosive characteristics) along with transformers/inverters containing spent/used oil will be generated which, if in contact can leach into the physical environmental aspects such as soil and water resource quality and cause severe hazardous impacts which are non-reversible.

It is essential that all the operational projects comply with all the storage, transportation and disposal rules as specified in the Office Memorandum issued by KSPCB on 30th March 2019 which exempts White Category industries to obtain Hazardous Waste Authorization. However, all the operational projects shall dispose the hazardous waste through a KSPCB approved vendor as per the requirements of the Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016 in order to mitigate the cumulative impacts.

6.7.3 Socio-Economic Impacts

There are certain socio-economic impacts anticipated with the existing operational solar power projects in the study area:

- Change in Livelihood Opportunities
- Upgradation of Local Infrastructure

Change in Livelihood Opportunities

With the existing operational solar power projects in the area, the land-use pattern of the area has changed from agricultural to industrial area thereby bringing about a change in the livelihood patterns in the area. There would be a diversification in the livelihood opportunities from primarily agriculturists and cultivators there could be a shift towards unskilled and skilled work as these solar projects require workforce during the operation and decommissioning phases.

Upgradation of Local Infrastructure

The existing operational solar power projects would most likely prepare Community Social Responsibility (CSR) activities for the benefit of the community members in the villages of Jonnekeri and Lingdahalli Jojna. This would lead to the development of existing infrastructure and possibilities of development of new infrastructure facilities in the area.

[8] https://enerparc.in/project/aurad/
[9] https://enerparc.in/project/clear-sky/

Change in Land Use Pattern

The land use of Jonnekeri and Lingdahalli villages is primarily agricultural land. With the existing operational solar power projects in the area, the land use pattern of the village has to a certain extent converted from agricultural land to industrial land.

7. Environment and Social Management Plan

7.1 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 (ESMP) is to ensure that social and environmental impacts, risks and liabilities identified during the ESIA process are effectively managed during the operation and closure of the operational solar power project. Impact due to construction phase is not considered as project is already in the operational phase. 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; and
- Provide a framework for the implementation of environmental and social management initiatives.

The ESMP is specified in order to describe the mitigation measures for all the impacts associated with the project during its operation and maintenance phase and decommissioning 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 related to the 40 MW Solar Power Project. This ESMP is applicable to all the employees of CSPGPL, Ritis Meera and the other sub-contractors if any, engaged during the project lifetime.

HFE has formulated an Occupational Health and Safety and Environment policy as part of their Corporate Environment and Social Management System (ESMS) which has been endorsed by CEO.

7.2 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 Environment Social Health & Safety (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 the Chief Operating Officer (CEO) who in turn is supported by the Head of Projects and Chief Engineer, O&M.

The Head of Projects and Chief Engineer, O&M will monitor and control the activities of the Health Safety & Environment (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 Engineer.

The project does not foresee any significant adverse social and environment impacts or risks as indicated in the previous sections of the report. The project footprint area is limited to its immediate vicinity and a particular range of stakeholders. 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.

CSPGPL has appointed M/s Ritis Meera as O& M contractor for the project. M/s Ritis Meera has dedicated EHS Officer for day to day monitoring of activities related to EHS and reports directly to the M/s Ritis Meera Site in Charge and HFE Engineer. The proposed organizational structure for project has been presented in ***Figure 7-1*** below,

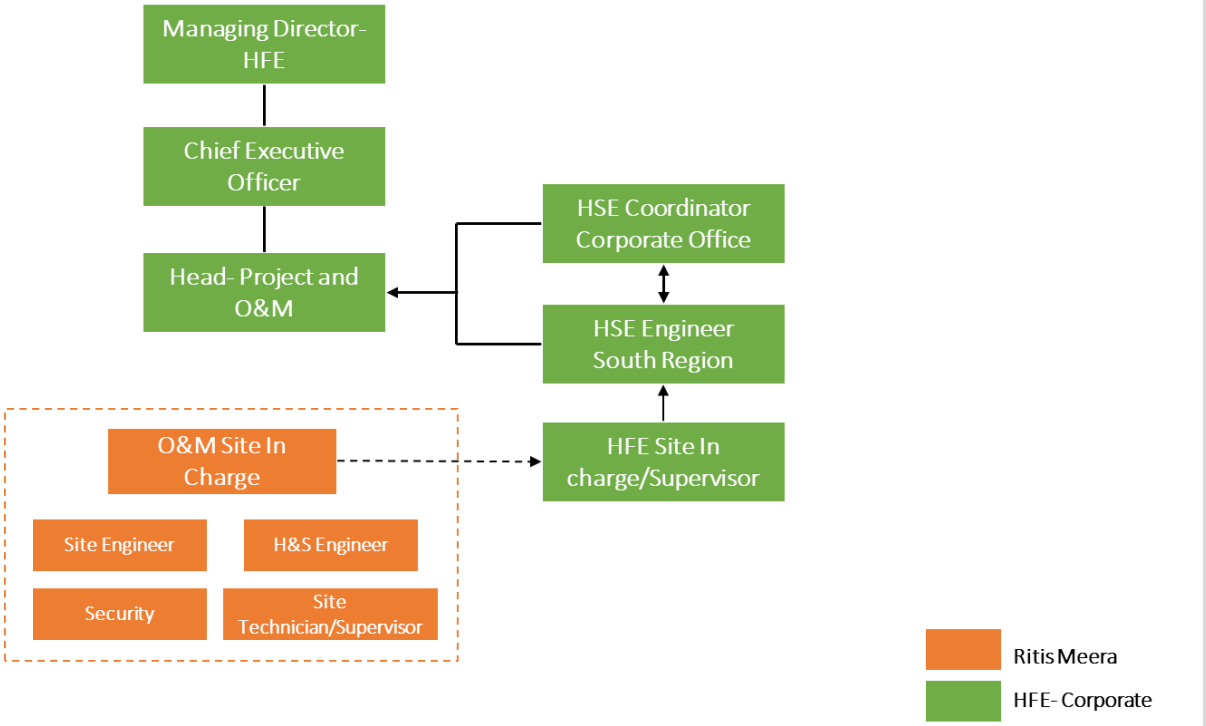


Figure 7-1: Project Organisation Structure

7.3 Roles and Responsibilities

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

CSPGPL will majorly play a role of supervisor to oversee the project performance pertaining to environment, health, safety and social issues. The O&M Contractor, i.e. M/s Ritis Meera will have a dedicated HSE department for the Project. The HSE department take the overall responsibility for coordination of the actions required for environment and social management and mitigation and for monitoring the progress of the proposed ESMP for the project. However, ultimate responsibility for implementing the provisions of the ESMP will lie with CSPGPL.

In general, the HSE department shall perform the following activities,

- Preparation of required documents on environmental and social management;
- Ensuring availability of resources and appropriate institutional arrangements for implementation of ESMP;
- Implementation of the health and safety measures;
- Collection of the statistics of health of workers;
- Providing support during routine medical check-ups of workers;
- Awareness and implementing safety programs;
- Providing job specific induction training;
- Compliance of regulatory requirements;
- Carrying out internal audits;
- Identify unsafe acts and conditions and suggest remedies;
- Develop safety culture and comply with company's HSE policy and standards requirements;
- Encourage and enforce the use of PPE's;
- Educate all employees for the use of PPE's & safe practices;
- Direct, coordinate and orient the safety activities;

- Promulgate the spread of policy, objectives, rules and/or regulations;
- Perform a thorough investigation of all accidents and review the recommendations to avoid any repetition;
- Monitoring the progress of implementation of ESMP; and
- Reviewing and updating the ESMP as and when required for its effective implementation.

The responsibilities of CSPGPL employees at Site Level have been listed below,

Site In-charge (CSPGPL)

The Site In-charge of CSPGPL is responsible for overall management of the project and ESMP implementation on site during 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 site against the ESMP; and
- Keeping a check on operation and maintenance services of solar panels required during operation phase.

HSE Engineer (CSPGPL)

The HSE Engineer will have the following responsibilities and will report to Site In-charge Head O&M of 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;
- Review and updating of ESMP for its effective implementation;
- Authority to issue the work permit system for undertaking electrical works 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; and
- Maintenance of records of hazardous waste generated on site on monthly basis and ensuring its proper disposal to authorized vendors of KSPCB only.

7.4 Monitoring and Audit

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

- CSPGPL will ensure that O&M Contractor 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 the O&M Contractor in the areas of concern; and
- The entire process of inspections and audits will be documented.

The 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.).

7.5 Documentation 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:

- Master Environment Management System document;
- Legal Register;
- Operation control procedures;
- Work instructions;
- Incident reports;
- Emergency preparedness and response procedures;
- Training records;
- Monitoring reports;
- Auditing reports;
- Stakeholder Engagement Activities undertaken; and
- Complaints register, and issues attended/closed.

7.6 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. M/s Ritis Meera is responsible for ensuring that their workers are provided HSE training as stipulated. A training register should be kept on site for all trainings conducted onsite.

An environmental and social management training programme shall be conducted to ensure effective implementation of the management and control measures during 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.

7.7 Environment and Social Management Plan and Procedures

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:

- Environment and Social Policy
- Occupational Health and Safety Policy
- Labour Management Plan
- Occupational Health and safety Plan
- Stakeholder Engagement Plan
- Construction Waste Management Plan
- Grievance Redressal Mechanism
- Resettlement Action Plan
- 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.

7.7.1 Environment and Social Management Plan

An Environment and Social Management Plan has been developed following the delineation of impacts and mitigation measures. Since project is already in operation phase, an Environment and Social Management Plan (ESMP) has been developed for operation and decommissioning phase of the project. These measures shall be adopted by CSPGPL and imposed as conditions of contract of the sub-contractor(s) employed for respective phases of the solar power project. The mitigation measures suggested during operation will be made part of the regular maintenance and monitoring schedule. The ESMP includes the following:

- Mitigations suggested for adverse environmental and social impacts and associated risks;
- Institutional arrangement - management tools and techniques for the implementation of environmental impacts and risk mitigations;
- Monitoring and reporting of requirements and mechanisms for the effective implementation of the suggested mitigations;
- Monitoring arrangements for effective implementation of suggested mitigations for the project; and
- Reporting requirement to the regulatory agencies and funding institutes.

Table 7-1: Environment and Social Management Plan

S. No	Potential Impact/ Activity	Proposed Mitigation Measures	Monitoring Requirement	Responsibility
A. Operation Phase				
1	Visual Aesthetics	• 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	• 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.	Ground water sample testing at the project site location. Details of rain water harvesting	CSPGPL
3	Ecology	• Restrict the movement of vehicles to the pre-designated routes to prevent the disturbance to the ecosystems. • Vehicular emission and spillage of fuel to be monitored regularly. • Creation of green-belt through plantations within and around the project site	Awareness and training to all project personnel and contractors to use pre-designated routes and avoid rerouting or laying new temporary routes and regulate the vehicular emission. Plantations to be done in areas along the boundary of the project site and other suitable areas within project site. Project manager to supervise the plantation and other related	CSPGPL

S. No	Potential Impact/ Activity	Proposed Mitigation Measures	Monitoring Requirement	Responsibility
			activities such as watering, pruning, etc.	
4	Soil Quality	• 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.	Awareness and training about the procedure for proper storage and disposal waste oil and how to act in case of accidental oil spillage; Buy Back agreements for defunct solar panels	CSPGPL
5	Health and Safety	• 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.	Workers to be trained for use of Personal Protection Equipment and its importance. All safety related incidents will be recorded and monitored. Training to be provided to the workers regarding health and safety procedures.	CSPGPL
6	Impacts on economy Upgradation of local Infrastructure	• Details of community development activities should be shared with the Panchayats of the respective villages. • Engage the local workforce population for unskilled jobs wherever possible. • Encourage engagement with local contractors and vendors.	Undertaking Community Development Activities as per the need assessment undertaken for the project Stakeholder Engagement and Grievances related activities and documentation	CSPGPL
B. Decommissioning Phase				
1	Impact on Air, Soil, Noise, Ecology and Socio-Economic Aspects	• 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	Information to workers/staffs of close down Training on safe handling of bulk hazardous wastes generated at site	CSPGPL

S. No	Potential Impact/ Activity	Proposed Mitigation Measures	Monitoring Requirement	Responsibility
		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.		

7.7.2 Environment and Social Monitoring Plan

Regular monitoring of environmental and social aspects is important to assess the status of environment and social components 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 and social 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 7-2.***

Table 7-2: Environmental and Social Performance Monitoring

S. No	Performance Indicator (PI)	Monitoring Parameter	Period & Frequency
Environment and Social Performance Monitoring			
1.	Fugitive emissions	• Visual observation of dust generated • Water sprinkling details viz. frequency and quantity	Daily during operational phase
2.	Domestic Waste generation, storage, handling and disposal	Quantity of waste generated and recycled	Monthly during operational phase
		Visual observation of waste segregation and storage conditions viz.	
		Usage of labelled and covered bins, insect repellents	
		Awareness level of operational workforce	
3.	Community health and safety	• Complaints registered by the local communities • Number of Accidents	Monthly during operational phase
4.	Occupational health and safety	Health surveillance of staffs and other workers	Monthly during operational phase
		Sanitation status of onsite office building and canteen	
		Potable nature of drinking water viz. coliform, pH, TSS, residual chlorine	
		Usage of proper PPEs	Daily during operational phase
		Safety performance indicators viz. Near misses, fatalities etc.	
Environment Quality Monitoring			
5.	Ground Water Quality	Depth of ground water table IS: 10500 parameters in nearby villages	Quarterly during Operational phase

7.7.3 Occupational Health and Safety Plan

The Occupational Health and Safety (OHS) of the employees and contractual laborers will be maintained at the work sites during the operation phase. The OHS Management measures shall comply with the Indian Regulatory requirements under OHSAS and the Factories Act.

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

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

An EHS coordinator will effectively implement and monitor the OHS Management System and ESMP.

7.7.4 Waste Management Plan

The Waste Management Plan (WMP) will be applicable to the wastes arising during operation of the solar power plant of CSPGPL. Major waste streams from the project include non-hazardous solid waste, wash water generated from panel washing and sewage.

WMP is intended to serve as a guideline for CSPGPL and the contractor(s) to manage wastes effectively during the project life cycle. The WMP describes how wastes will be managed during the project life cycle and how the project will:

- Minimize the potential to cause harm to human health and the environment.
- Comply with Indian Environmental Regulation and IFC Performance Standards.
- Reduce operational costs and reduce any potential liabilities which may arise from waste handling operations.

This plan also ensures that every waste stream and solid waste materials from the main plant site and bracketed facilities will be managed effectively. CSPGPL should implement the WMP throughout the operational phase.

7.7.4.1 Waste Characterisation

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

7.7.4.2 Waste Handling, Management and Disposal

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;
- 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 PPEs are provided to the workers handling the broken solar panels; and
- The workers at site are also on regular basis appraised about the potential health risks associated with handling of solar panels.

Detailed waste management plan should be prepared for decommissioning phase. However, following measures should be considered while preparing waste management plan for decommissioning of the solar farm.

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

7.7.5 Stakeholder Engagement Plan

Stakeholder Engagement is the process of engaging the stakeholders. 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 ability to influence its outcome either positively or negatively. Stakeholders may include locally affected communities or individuals and their formal and informal representatives, national or local government authorities, politicians, religious leaders, civil society organizations and groups with special interest, the academic community and other businesses.

Stakeholder Engagement Process can be described as a process which engages stakeholders with an aim to achieve certain outcomes. The process enables communication between the community members and the project proponent. Increased communication between them would lead to a favourable condition and would thereby increase the viability of a project.

To ensure the systematic implementation and execution of the stakeholder engagement process certain resources and frame work is required to be in place. Certain defined roles and responsibilities of designated personnel can assist in smooth implementation of the stakeholder engagement process. The following personnel shall be involved:

- ***Community Liaison Officer/CSR Officer/Grievance Officer at the Site level***: The Community Liaison Project Liaison Officer shall be responsible for the implementation of the stakeholder engagement and consultation activities. The Community Liaison Officer in consultation with the HSE Supervisor at the site level shall develop resources and plan for the consultation activities to be conducted. Documentation of all processes such as identification and engagement activities with stakeholders is imperative and shall be done by the Community Project Liaison Officer/CSR Officer.
- ***HSE Supervisor at the Site Level***: The HSE Supervisor shall assist the Community Liaison Officer/CSR Officer/Grievance Officer to develop stakeholder engagement activity plan for the financial year. The responsibility for assistance with the execution and implementation of the activity would also be the incumbent's responsibility.
- ***CSR Head/Human Resource (HR) Head at the corporate level:*** The CSR Head/HR Head shall be responsible for the overall budgeting and monitoring of the stakeholder engagement activities undertaken at the site level. Impact Assessment reports should be reviewed by the CSR Head/HR Head and shall determine the feasibility of the implementation of the activity.

To engage the stakeholders, certain process can be followed. The process includes the following procedures:

- Stakeholder Identification and Analysis.
- Stakeholders Engagement.
- Information Disclosure.
- Monitoring and Reporting.

7.7.5.1 Stakeholder Identification and Analysis

The first step involves the identification of all affected communities. They should be identified and classified according to the degree of their vulnerability to the impacts of the project. They can be classified into Direct and Indirect Stakeholders according to their degree of influence of the project and vice versa. The Community Liaison officer/CSR officer/Grievance officer shall be responsible in developing a list of stakeholders according to the degree of impact and will utilize the format provided in the ESMS of HFE to identify and classify the stakeholders.

7.7.5.2 Methods for Stakeholders Engagement

On identification and classification of Stakeholders, Community Liaison Officer/CSR/Grievance Officer will develop stakeholder engagement activities. These activities would be developed ensuring an effective engagement process with detailed objectives and platforms wherein the views, interests, concerns of different stakeholders are allowed to be communicated. The stakeholder engagement documentation can be done utilizing the format provided in HFE's ESMS. Communicated views and concerns should be taken into account while making project decisions and formulation of development benefits for affected communities. In order to increase and improve communication with the stakeholders certain communicative methods have been outlined below:

Communicative Methods

Communicative Methods are to be developed and adopted to ensure proper information dissemination and communication to the affected communities. These methods may vary according to the target audience and it can comprise of the following detailed out in the following table:

Table 7-3: Communicative Methods

Communicative Methods	Objective	Relevance
Community Meetings	To inform and consult with the local community members regarding the project and its anticipated risks and impacts.	When mass information dissemination is required To get feedback and collaborate with the community stakeholders for input of local knowledge and options.
Focus Group Discussions	To inform and consult a target group and take into account their views and make the project more inclusive in nature.	Relevant when the majority of the affected communities' population comprises of minorities or marginalized groups. When the relevant sub groups are not interactive and hesitant to participate in larger community meetings and there is a need to understand the needs, perception and concerns of the sub-group.
Participatory Workshops	To utilise local knowledge and use it as input to generate options related to the project activities. To increase the involvement of the stakeholders in the project.	Relevant when the stakeholders knowledge are keen in participating in the development of the project When there is a need to engage local people to analyse, share and enhance their knowledge to plan, manage and evaluate developmental projects.
Participatory Rural Appraisal (PRA)	To enable local people to make their own appraisal, analysis and plan. Decentralization and Empowerment of the local people.	Relevant when there is a need for identification of the community problems.

7.7.5.3 Information Disclosure

Information disclosure involves delivery of project related information to the community members and ensuring access to such information by other stakeholders. It is a means to communicate with the direct and indirect stakeholders of the project. The disclosure information should be done in the appropriate language (native), accessible and understandable. Disclosure of information can be done through various means such as display/information boards at local authorities' office, through audio-visual methods such as radio, pamphlets and relevant videos.

General Information of the Project: Information related to the entire project cycle should be made available to the project community members. The company website should be updated with the details of the project which should include the purpose, nature and scale of the project. It can also include the list of risks and impacts that are anticipated the project. The information related to the project can be displayed at information boards of the local authority's office as well as and the company website.

Detailed Information of the Project: Documents like the ESIA report, Environment and Social Management Plan, Stakeholder Engagement Plan etc. shall be made available for the stakeholders if asked for. The hard copies of the same should be placed at the project site office.

7.7.5.4 Monitoring and Reporting

Internal audits of the stakeholder engagement program should be done. The frequency of the internal audits should be decided upon at the corporate level. Review of the applicability, execution and feedback/response to the programme should to be done. At the site level, the Community Liaison Officer and the HSE Supervisor shall

be responsible for the monitoring of the stakeholder engagement activities that have been done and CSR Head/HR Head at the corporate level shall be updated on the stakeholder engagement activities at the site and shall review the stakeholder engagement activities and provide feedback on its implementation.

Record Keeping of the following should be done:

- Stakeholders Identified.
- Minutes of Meetings.
- Communicative methods used for stakeholders, participation during these engagement activities and feedback/responses received.

7.7.6 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.

7.7.6.1 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.

7.7.6.2 Stages of Grievance Redressal Mechanism

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

- *Development of Procedures:* CSPGPL shall 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.

- *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.

- *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 (Hindi) and English for wider outreach.

- *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.

- *Recording of Grievances:* After the dissemination of the provision of the Grievance Redressal Mechanism, CSPGPL shall start receiving and addressing the grievances. Required grievances boxes, record books and tracking form should be in order to address and record the grievances.
- *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.
- *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 CSPGPL in the appeal process is encouraged to maintain transparency and accountability.

7.7.6.3 Proposed Grievance Redressal Mechanism

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 following levels,

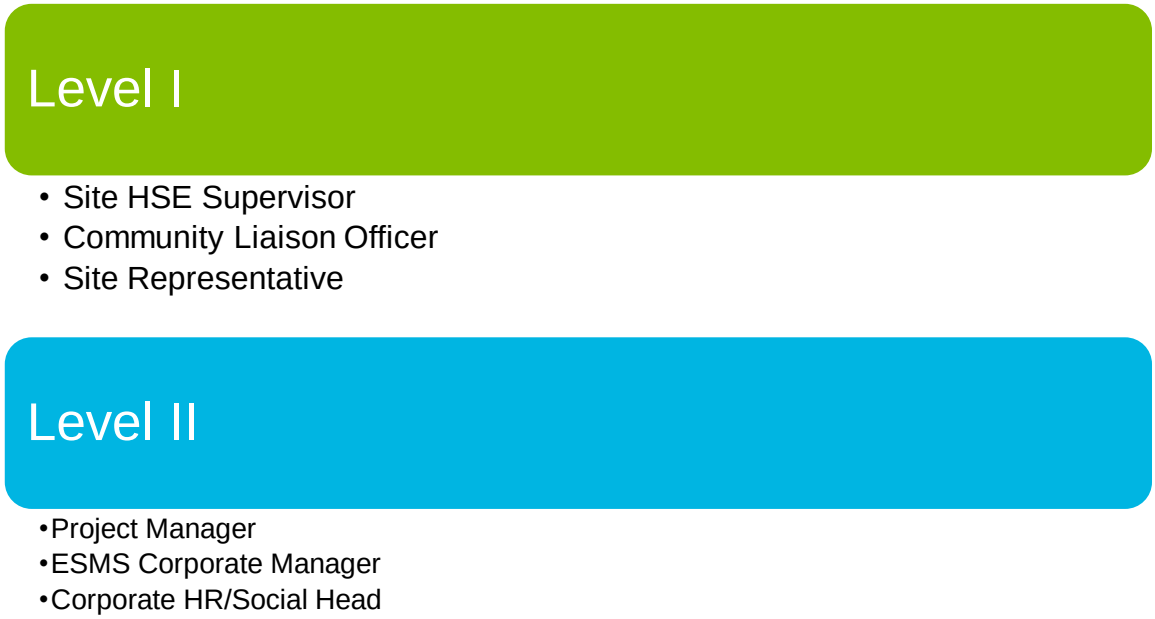


Figure 7-2: Levels of Grievance Redressal Committee

The 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.

7.7.6.4 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

- Installation of secured Grievance boxes at relevant sites (such as site office, substation) within the project area.
- 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.
- 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.
- The complainant may have the option of lodging complaints verbally as many may not have the ability to write.
- The complainant should have the option to remain anonymous while registering the complaint.
- Once received, a database in the form of a Grievance Register or computerised database should be maintained.

Assessment and Addressal of the Complaint

- The Community Liaison Officer is advised to check and open the grievance boxes every fifteen (15) days.
- 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.
- 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.
- If the grievance of cannot be resolved at Site (Level I), then the case will be referred/forwarded to the (Level II) for redressal.
- The solution for the grievance shall be devised in five (05) working days by the committee at Level II.
- On the event of no resolution at Level II, the complainant will have the option to approach the appropriate court of law for redressal.
- 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.

- *Grievance Tracking Form:* A Grievance Tracking Form should be prepared. It will enable the GRC to trace the grievances and present similar responses.
- *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:

  1. The Name of Complainant (optional in case anonymity is asked to be maintained)
  2. Date of the complaint
  3. Nature of the complaint
  4. Follow-up Action/Redressal of the complaint
  5. Date of communication to the complainant of the final result

6. Implementation of the decision

7. Appeals to higher levels (if any)

- *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.

7.7.6.5 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.

7.7.6.6 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 CSPGPL. 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 CSPGPL 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 in 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. 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. Conclusion

The Environmental and Social Impact Assessment study for the Operational 40 MW solar power project in Bidar 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 and social impacts associated with all aspects of the 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 minimal, site specific and has reversible impacts on the micro environment of the project site owing to the waste water generation from the solar panels.

The project is assessed to generate some environmental and social impacts due to operation of the project. Mitigation measures for potential impacts on air environment, water quality, land, soil, noise, traffic, ecology, and socio-economic have been specified through proper

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

The proposed ESMP describes the 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 operation 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 O&M 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:

- 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 operation of solar panels has limited environment and social impacts;
- There are no indigenous communities in the project area; and
- Any adverse environmental and social impacts may be readily addressed through mitigation measures as outlined in the ESMP.

Appendix A List of Mammals found in the Study Area

S. No.	Scientific Name	Common Name	IUCN Status*	WPA Schedule**
1	*Macaca radiata*	Bonnet Macaque	LC	II
2	*Semnopithecus dussumieri*	Southern Plains Gray Langur	LC	II
3	*Moschiola indica*	Indian Chevrotain	LC	I
4	*Muntiacus muntjak*	Indian or Red Muntjac	LC	III
5	*Rusa unicolor*	Sambar	VU	III
6	*Axis axis*	Spotted Deer	LC	III
7	*Boselaphus tragocamelus*	Nilgai	LC	III
8	*Tetracerus quadricornis*	Four-Horned Antelope	VU	I
9	*Antilope cervicapra*	Blackbuck	LC	I
10	*Sus scrofa*	Indian Wild Pig	LC	III
11	*Panthera pardus*	Common Leopard	VU	I
12	*Felis chaus*	Jungle Cat	LC	II
13	*Prionailurus rubiginosus*	Rusty Spotted Cat	NT	I
14	*Paradoxurus hermaphroditus*	Common Palm Civet	LC	II
15	*Viverricula indica*	Small Indian Civet	LC	II
16	*Herpestes edwardsii*	Grey Mongoose	LC	II
17	*Hyaena hyaena*	Striped Hyeana	NT	III
18	*Canis lupus*	Grey Wolf	LC	I
19	*Canis aureus*	Golden Jackal	LC	II
20	*Vulpes bengalensis*	Indian Fox	LC	II
21	*Mellivora capensis*	Honey Badger	LC	I
23	*Lepus nigricollis*	Indian Hare	LC	IV
24	*Manis crassicaudata*	Indian Pangolin	EN	I
25	*Anathana ellioti*	Southern Tree Shrew	LC	II
26	*Suncus murinus*	House Shrew	LC	II
27	*Hystrix indica*	Indian Crested Porcupine	LC	IV
28	*Funambulus palmarum*	Tree-striped Palm Squirrel	LC	-
29	*Tatera indica*	Indian Gerbil	LC	-
30	*Vandeleuria oleracea*	Indian Long-tailed Tree Mouse	LC	V
31	*Mus musculus*	House Mouse	LC	V
32	*Mus booduga*	Little Indian Field Mouse	LC	V
33	*Millardia meltada*	Soft-furred Field Rat	LC	V
34	*Madromys blanfordi*	White-tailed Wood Rat	LC	V

S. No.	Scientific Name	Common Name	IUCN Status*	WPA Schedule**
35	*Bandicota indica*	Large Bandicoot Rat	LC	V
36	*Bandicota bengalensis*	Indian Mole Rat	LC	V
37	*Rattus rattus*	House Rat	LC	V
38	*Pteropus giganteus*	Indian Flying Fox	LC	V
39	*Cynopterus sphinx*	Greater Short-nosed Fruit Bat	LC	V
40	*Taphozous longimanus*	Long-winged Tomb Bat	LC	-
41	*Rhinolophus lepidus*	Blyth's Horseshoe Bat	LC	-
42	*Hipposideros speoris*	Schneider's Leaf-nosed Bat	LC	-
43	*Hipposideros fulvus*	Fulvous Leaf-nosed Bat	LC	-
44	*Megaderma lyra*	Greater False Vampire	LC	-
45	*Scotophilus heathii*	Greater Asiatic Yellow Bat	LC	-
46	*Pipistrellus tenuis*	Indian Pygmy Bat	LC	-
47	*Pipistrellus ceylonicus*	Kelaart's Pipistrelle	LC	-
48	*Scotozous dormeri*	Dormer's Bat	LC	-

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

***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 (2019). The IUCN Red List of Threatened Species. Version 2019-1; Schedules I to VI: Indian Wildlife (Protection) Act, 1972.

Appendix B List of Resident Birds found in the Study Area

S. No.	Scientific Name	Common Name	IUCN Status*	WPA Schedule**
1	*Francolinus pictus*	Painted Frankolin	LC	IV
2	*Francolinus pondecerianus*	Grey Francolin	LC	IV
3	*Coturnix chinensis*	King Quail	LC	IV
4	*Perdicula asiatica*	Jungle Bush Quail	LC	IV
5	*Perdicula argoondah*	Rock Bush Quail	LC	IV
6	*Galloperdix spadicea*	Red Spurfowl	LC	IV
7	*Galloperdix lunulata*	Painted Spurfowl	LC	IV
8	*Gallus sonneratii*	Grey Junglefowl	LC	IV
9	*Pavo cristatus*	Indian Peafowl	LC	I
10	*Dendrocygna javanica*	Lesser Whistling-duck	LC	IV
11	*Nettapus coromandelianus*	Cotton Pygmy-goose	LC	IV
12	*Anas poecilorhyncha*	Indian Spot-billed Duck	LC	IV
13	*Tachybaptus ruficollis*	Little Grebe	LC	IV
14	*Mycteria leucocephala*	Painted Stork	NT	IV
15	*Anastomus oscitans*	Asian Openbill	LC	IV
16	*Ciconia episcopus*	Woolly-necked Stork	VU	IV
17	***Threskiornis melanocephalus***	**Black-headed Ibis**	**NT**	**IV**
18	*Pseudibis papillosa*	Red-naped Ibis	LC	IV
19	*Platalea leucorodia*	Eurasian Spoonbill	LC	I
20	***Butorides striata***	**Striated Heron**	**LC**	**IV**
21	*Nycticorax nycticorax*	Black-crowned Night Heron	LC	IV
22	***Ardeola grayii***	**Indian Pond Heron**	**LC**	**IV**
23	*Ardea purpurea*	Purple Heron	LC	IV
24	***Bubulcus ibis***	**Cattle Egret**	**LC**	**IV**
25	*Casmerodius albus*	Great Egret	LC	IV
26	***Mesophoyx intermedia***	**Intermediate Egret**	**LC**	**IV**
27	*Egretta garzetta*	Little Egret	LC	IV
28	***Microcarbo niger***	**Little Cormorant**	**LC**	**-**
29	*Falco chicquera*	Red-necked Falcon	NT	I
30	*Falco jugger*	Laggar Falcon	NT	I
31	***Elanus caeruleus***	**Black-winged Kite**	**LC**	**IV**
32	***Milvus migrans***	**Black Kite**	**LC**	**IV**
33	***Haliastur indus***	**Brahminy Kite**	**LC**	**IV**

S. No.	Scientific Name	Common Name	IUCN Status*	WPA Schedule**
34	*Pernis ptilorhynchus*	Oriental Honey Buzzard	LC	IV
35	*Neophron percnopterus*	Egyptian Vulture	EN	IV
36	*Gyps bengalensis*	White-rumped Vulture	CR	I
37	*Gyps indicus*	Indian Vulture	CR	I
38	*Sarcogyps calvus*	Red-headed Vulture	CR	IV
39	*Circaetus gallicus*	Short-toed Snake Eagle	LC	IV
40	*Spilornis cheela*	Crested Serpent Eagle	LC	IV
41	*Accipiter badius*	Shikra	LC	I
42	*Butastur teesa*	White-eyed Buzzard	LC	IV
43	*Aquila rapax*	Tawny Eagle	LC	IV
44	*Aquila fasciata*	Bonelli's Eagle	LC	IV
45	*Nisaetus cirrhatus*	Crested Hawk Eagle	LC	IV
46	*Sypheotides indicus*	Lesser Florican	EN	I
47	*Amaurornis phoenicurus*	White-breasted Waterhen	LC	IV
48	*Amaurornis akool*	Brown Crake	LC	IV
49	*Turnix sylvaticus*	Small Buttonquail	LC	IV
50	*Turnix suscitator*	Barred Buttonquail	LC	IV
51	*Porphyrio porphyrio*	Purple Swamphen	LC	IV
52	*Gallinula chloropus*	Common Moorhen	LC	IV
53	***Fulica atra***	**Eurasian Coot**	**LC**	**IV**
54	*Burhinus indicus*	Indian Thick-knee	LC	-
55	*Esacus recurvirostris*	Great Thick-knee	NT	-
56	*Hydrophasianus chirurgus*	Pheasant-tailed Jacana	LC	IV
57	*Metopidius indicus*	Bronze-winged Jacana	LC	IV
58	***Vanellus malabaricus***	**Yellow-wattled Lapwing**	**LC**	**IV**
59	***Vanellus indicus***	**Red-wattled Lapwing**	**LC**	**IV**
60	***Charadrius dubius***	**Little Ringed Plover**	**LC**	**IV**
61	*Rostratula benghalensis*	Greater Painted-snipe	LC	IV
62	*Cursorius coromandelicus*	Indian Courser	LC	-
63	*Glareola lactea*	Small Pratincole	LC	-
64	*Sterna aurantia*	River Tern	NT	-
65	*Pterocles exustus*	Chestnut-bellied Sandgrouse	LC	IV
66	*Pterocles indicus*	Painted Sandgrouse	LC	IV
67	*Columba livia*	Common Pigeon	LC	-
68	*Streptopelia orientalis*	Oriental Turtle Dove	LC	IV
69	*Streptopelia decaocto*	Eurasian Collared Dove	LC	IV
70	*Streptopelia tranquebarica*	Red Collared Dove	LC	IV
71	***Stigmatopelia chinensis***	**Spotted Dove**	**LC**	**IV**

S. No.	Scientific Name	Common Name	IUCN Status*	WPA Schedule**
72	***Stigmatopelia senegalensis***	**Laughing Dove**	**LC**	**IV**
73	*Treron phoenicopterus*	Yellow-footed Green Pigeon	LC	IV
74	*Psittacula krameri*	Rose-ringed Parakeet	LC	IV
75	*Psittacula cyanocephala*	Plum-headed Parakeet	LC	IV
76	*Clamator jacobinus*	Jacobin Cuckoo	LC	IV
77	*Hierococcyx varius*	Common Hawk Cuckoo	LC	IV
78	*Cacomantis passerinus*	Grey-bellied Cuckoo	LC	IV
79	*Eudynamys scolopaceus*	Asian Koel	LC	IV
80	*Taccocua leschenaultii*	Sirkeer Malkoha	LC	IV
81	*Centropus (sinensis) parroti*	Southern Coucal	LC	IV
82	*Tyto alba*	Barn Owl	LC	IV
83	*Otus bakkamoena*	Indian Scops Owl	LC	IV
84	*Glaucidium radiatum*	Jungle Owlet	LC	IV
85	*Athene brama*	Spotted Owlet	LC	IV
86	*Bubo bubo*	Eurasian Eagle Owl	LC	IV
87	*Ketupa zeylonensis*	Brown Fish Owl	LC	IV
88	*Strix ocellata*	Mottled Wood Owl	LC	IV
89	*Caprimulgus asiaticus*	Indian Nightjar	LC	IV
90	*Caprimulgus affinis*	Savanna Nightjar	LC	IV
91	*Cypsiurus balasiensis*	Asian Palm Swift	LC	-
92	***Apus affinis***	**Little Swift**	**LC**	**-**
93	*Upupa epops*	Common Hoopoe	LC	IV
94	***Coracias benghalensis***	**Indian Roller**	**LC**	**IV**
95	***Halcyon smyrnensis***	**White-throated Kingfisher**	**LC**	**IV**
96	*Alcedo atthis*	Common Kingfisher	LC	IV
97	*Ceryle rudis*	Pied Kingfisher	LC	IV
98	***Merops orientalis***	**Green Bee-eater**	**LC**	**-**
99	*Ocyceros birostris*	Indian Grey Hornbill	LC	-
100	*Megalaima zeylanica*	Brown-headed Barbet	LC	IV
101	*Megalaima haemacephala*	Coppersmith Barbet	LC	IV
102	*Dendrocopos nanus*	Brown-capped Pygmy Woodpecker	LC	IV
103	*Dendrocopos mahrattensis*	Yellow-crowned Woodpecker	LC	IV
104	*Dinopium benghalense*	Lesser Goldenback	LC	IV
105	*Tephrodornis pondicerianus*	Common Woodshrike	LC	IV
106	*Artamus fuscus*	Ashy Woodswallow	LC	
107	*Coracina macei*	Large Cuckooshrike	LC	IV
108	*Aegithina tiphia*	Common Iora	LC	IV
109	*Pericrocotus cinnamomeus*	Small Minivet	LC	IV

S. No.	Scientific Name	Common Name	IUCN Status*	WPA Schedule**
110	*Lanius vittatus*	Bay-backed Shrike	LC	-
111	*Lanius schach*	Long-tailed Shrike	LC	-
112	*Lanius meridionalis*	Southern Grey Shrike	VU	-
113	***Dicrurus macrocercus***	**Black Drongo**	**LC**	**IV**
114	*Dicrurus caerulescens*	White-bellied Drongo	LC	IV
115	*Oriolus xanthornus*	Black-hooded Oriole	LC	
116	*Rhipidura (albicollis) albogularis*	White-spotted Fantail	LC	-
117	*Rhipidura aureola*	White-browed Fantail	LC	-
118	*Dendrocitta vagabunda*	Rufous Treepie	LC	IV
119	*Corvus (macrorhynchos) culminatus*	Indian Jungle Crow	LC	IV
120	***Corvus splendens***	**House Crow**	**LC**	**V**
121	*Ptyonoprogne concolor*	Dusky Crag Martin	LC	-
122	*Petrochelidon fluvicola*	Streak-throated Swallow	LC	-
123	***Hirundo smithii***	**Wire-tailed Swallow**	**LC**	**-**
124	*Mirafra cantillans*	Singing Bushlark	LC	IV
125	*Ammomanes phoenicura*	Rufous-tailed Lark	LC	IV
126	*Eremopterix griseus*	Ashy-crowned Sparrow Lark	LC	IV
127	*Alauda gulgula*	Oriental Skylark	LC	IV
128	*Pycnonotus jacosus*	Red-whiskered Bulbul	LC	IV
129	***Pycnonotus cafer***	**Red-vented Bulbul**	**LC**	**IV**
130	*Pycnonotus luteolus*	White-browed Bulbul	LC	IV
131	*Prinia hodgsonii*	Grey-breasted Prinia	LC	-
132	*Prinia sylvatica*	Jungle Prinia	LC	-
133	*Prinia socialis*	Ashy Prinia	LC	-
134	*Prinia inornata*	Plain Prinia	LC	-
135	*Cisticola juncidis*	Zitting Cisticola	LC	-
136	*Orthotomus sutorius*	Common Tailorbird	LC	-
137	*Dumetia hyperythra*	Twany-bellied Babbler	LC	-
138	*Turdoides caudata*	Common Babbler	LC	IV
139	*Turdoides malcolmi*	Large Grey Babbler	LC	IV
140	*Turdoides striata*	Jungle Babbler	LC	IV
141	*Turdoides affinis*	Yellow-billed Babbler	LC	IV
142	*Chrysomma sinense*	Yellow-eyed Babbler	LC	IV
143	*Zosterops palpebrosus*	Oriental White-eye	LC	IV
144	***Acridotheres tristis***	**Common Myna**	**LC**	**-**
145	*Sturnia pagodarum*	Brahminy Starling	LC	IV
146	*Zoothera citrina*	Orange-headed Thrush	LC	
147	***Copsychus saularis***	**Oriental Magpie Robin**	**LC**	**IV**

S. No.	Scientific Name	Common Name	IUCN Status*	WPA Schedule**
148	*Saxicoloides fulicatus*	Indian Robin	LC	IV
149	*Saxicola caprata*	Pied Bushchat	LC	IV
150	*Chloropsis jerdoni*	Jerdon's Leafbird	LC	IV
151	*Dicaeum agile*	Thick-billed Flowerpecker	LC	IV
152	*Dicaeum erythrorhynchos*	Pale-billed Flowerpecker	LC	IV
153	*Leptocoma zeylonica*	Purple-rumped Sunbird	LC	IV
154	*Cinnyris asiaticus*	Purple Sunbird	LC	IV
155	*Passer domesticus*	House Sparrow	LC	-
156	*Gymnoris xanthocollis*	Chestnut-shouldered Petronia	LC	-
157	***Ploceus philippinus***	**Baya Weaver**	**LC**	**IV**
158	*Euodice malabarica*	Indian Silverbill	LC	IV
159	*Amandava amandava*	Red Avadavat	LC	IV
160	*Lonchura striata*	White-rumped Munia	LC	IV
161	*Lonchura punctulata*	Scaly-breasted Munia	LC	IV
162	*Lonchura malacca*	Black-headed Munia	LC	IV
163	*Motacilla maderaspatensis*	White-browed Wagtail	LC	-
164	***Anthus rufulus***	**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; VU – Vulnerable and 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 (2019). The IUCN Red List of Threatened Species. Version 2019-1; Schedules I to VI: Indian Wildlife (Protection) Act, 1972.

Appendix C List of Migratory Birds found in the Study Area

S. No.	Scientific Name	Common Name	Season of migration	IUCN Status*	WPA Schedule**
1	*Coturnix coturnix*	Common Quail	Winter	LC	IV
2	*Coturnix coromandelica*	Rain Quail	Winter	LC	IV
3	*Anser indicus*	Bar-headed Goose	Winter	LC	
4	*Tadorna ferruginea*	Ruddy Shelduck	Winter	LC	IV
5	*Anas strepera*	Gadwall	Winter	LC	-
6	*Anas clypeata*	Northern Shoveler	Winter	LC	-
7	*Anas acuta*	Northern Pintail	Winter	LC	-
8	*Anas querquedula*	Garganey	Winter	LC	-
9	*Anas crecca*	Common Teal	Winter	LC	-
10	*Aythya ferina*	Common Pochard	Winter	VU	-
11	*Plegadis falcinellus*	Glossy Ibis	Winter	LC	-
12	***Ardea cinerea***	**Grey Heron**	**Winter**	**LC**	**IV**
13	*Anhinga melanogaster*	Darter	Winter	NT	IV
14	*Phalacrocorax fuscicollis*	Indian Cormorant	Winter	LC	IV
15	*Phalacrocorax carbo*	Great Cormorant	Passage Migrant	LC	IV
16	*Falco tinnunculus*	Common Kestrel	Winter	LC	IV
17	*Falco peregrinus*	Peregrine Falcon	Winter	LC	-
18	*Pandion haliaetus*	Osprey	Winter	LC	I
19	*Circus aeruginosus*	Eurasian Marsh Harrier	Winter	LC	IV
20	*Circus macrourus*	Pallid Harrier	Winter	NT	IV
21	*Hieraaetus pennatus*	Booted Eagle	Winter	LC	IV
22	*Porzana pusilla*	Baillon's Crake	Winter	LC	IV
23	*Turnix tanki*	Yellow-legged Buttonquail	Winter	LC	-
24	*Himantopus himantopus*	Black-winged Stilt	Winter	LC	IV
25	*Philomachus pugnax*	Ruff	Winter	LC	
26	*Gallinago stenura*	Pin-tailed Snipe	Winter	LC	IV
27	*Gallinago gallinago*	Common Snipe	Winter	LC	IV
28	*Limosa limosa*	Black-tailed Godwit	Winter	NT	-
29	*Numenius arquata*	Eurasian Curlew	Winter	NT	
30	*Tringa erythropus*	Spotted Redshank	Winter	LC	-
31	*Tringa totanus*	Common Redshank	Winter	LC	-
32	*Tringa stagnatilis*	Marsh Sandpiper	Winter	LC	IV
33	*Tringa nebularia*	Common Greenshank	Winter	LC	IV

S. No.	Scientific Name	Common Name	Season of migration	IUCN Status*	WPA Schedule**
34	*Tringa ochropus*	Green Sandpiper	Winter	LC	IV
35	*Tringa glareola*	Wood Sandpiper	Winter	LC	IV
36	***Actitis hypoleucos***	**Common Sandpiper**	**Winter**	**LC**	**IV**
37	*Calidris minuta*	Little Stint	Winter	LC	IV
38	*Calidris temminckii*	Temminck's Stint	Winter	LC	IV
39	*Chlidonias hybrida*	Whiskered Tern	Winter	LC	-
40	*Asio flammeus*	Short-eared Owl	Winter	LC	IV
41	*Merops philippinus*	Blue-tailed Bee-eater	Winter	LC	-
42	*Jynx torquilla*	Eurasian Wryneck	Winter	LC	IV
43	*Coracina melanoptera*	Black-headed Cuckooshrike	Passage Migrant	LC	IV
44	*Lanius cristatus*	Brown Shrike	Winter	LC	-
45	*Dicrurus leucophaeus*	Ashy Drongo	Winter	LC	IV
46	*Oriolus (oriolus) kundoo*	Indian Golden Oriole	Winter	LC	IV
47	*Terpsiphone paradisi*	Asian Paradise-flycatcher	Winter	LC	IV
48	*Hirundo rustica*	Barn Swallow	Winter	LC	IV
49	*Cecropis daurica*	Red-rumped Swallow	Winter	LC	IV
50	*Acrocephalus dumetorum*	Blyth's Reed Warbler	Winter	LC	-
51	*Phylloscopus humei*	Hume's Leaf Warbler	Winter	LC	-
52	*Phylloscopus trochiloides*	Greenish Warbler	Passage Migrant	LC	-
53	*Sylvia curruca*	Lesser Whitethroat	Winter	LC	-
54	*Sylvia althaea*	Hume's Whitethroat	Passage	LC	-
55	*Sturnia malabarica*	Chestnut-tailed Starling	Winter	LC	-
56	*Pastor roseus*	Rosy Starling	Winter	LC	IV
57	*Luscinia svecica*	Bluethroat	Winter	LC	IV
58	*Phoenicurus ochruros*	Black Redstart	Winter	LC	IV
59	*Saxicola torquatus*	Common Stonechat	Winter	LC	IV
60	*Monticola solitarius*	Blue Rock Thrush	Winter	LC	IV
61	*Monticola cinclorhynchus*	Blue-capped Rock Thrush	Winter	LC	IV
62	*Muscicapa dauurica*	Asian Brown Flycatcher	Winter	LC	IV
63	*Ficedula superciliaris*	Ultramarine Flycatcher	Winter	LC	IV
64	*Eumyias thalassinus*	Verditer Flycatcher	Winter	LC	IV
65	***Motacilla flava***	**Yellow Wagtail**	**Winter**	**LC**	**-**
66	*Motacilla cinerea*	Grey Wagtail	Winter	LC	-
67	*Motacilla alba*	White Wagtail	Winter	LC	-
68	*Anthus godlewskii*	Blyth's Pipit	Winter	LC	IV
69	*Anthus trivialis*	Tree Pipit	Winter	LC	IV
70	*Anthus hodgsoni*	Olive-backed Pipit	Winter	LC	IV

S. No.	Scientific Name	Common Name	Season of migration	IUCN Status*	WPA Schedule**
71	*Carpodacus erythrinus*	Common Rosefinch	Winter	LC	IV

*****Status assigned by the International Union for Conservation of Nature and Natural Resources, where –VU – Vulnerable; NT-Near Threatened and 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 (2019). The IUCN Red List of Threatened Species. Version 2019-1; Schedules I to VI: Indian Wildlife (Protection) Act, 1972.

Appendix D List of Reptiles found in the Study Area

S. No.	Scientific Name	Common Name	IUCN Status*	WPA Schedule**
1	*Indotyphlops braminus*	Bootlace Snake, Brahminy Blindsnake	NA	IV
2	*Grypotyphlops acutus*	Beaked Worm Snake	NA	IV
3	*Python molurus molurus*	Indian Python	NA	I
4	*Gongylophis conicus*	Common Sand Boa	NA	IV
5	*Eryx johnii*	Red Sand Boa	NA	IV
6	*Coelognathus helena helena*	Common Trinket Snake	NA	IV
7	*Ptyas mucosa*	Indian Rat Snake	NA	II
8	*Argyrogena fasciolata*	Banded Racer	NA	IV
9	*Oligodon taeniolatus*	Russel Kukari Snake	LC	-
10	*Oligodon arnensis*	Common Kukri Snake	NA	-
11	*Dendrelaphis tristis*	Common Bronzeback Tree Snake	NA	-
12	*Lycodon striatus*	Barred Wolf Snake	NA	IV
13	*Sibynophis subpunctatus*	Dumeril's Black-headed Snake	NA	-
14	*Xenochrophis piscator*	Checkered Keelback	NA	II
15	*Amphiesma stolatum*	Striped Keelback	NA	-
16	*Macropisthodon plumbicolor*	Green Keelback	NA	-
17	*Ahaetulla nasuta*	Common Vine Snake	NA	IV
18	*Bungarus caeruleus*	Common Krait	NA	IV
19	*Calliophis melanurus*	Indian Coral Snake	NA	
20	*Naja naja*	Spectacled Cobra	NA	II
21	*Daboia russelii*	Russell's Viper	LC	II
22	*Echis carinatus*	Saw-scaled Viper	NA	IV
23	*Varanus bengalensis*	Indian Monitor Lizard	LC	-
24	*Chamaeleo zeylanicus*	Asian Chameleon	LC	-
25	*Sitana ponticeriana*	Fan-throated Lizard	LC	-
26	*Hemidactylus leschenaultii*	Bark Gecko	NA	-
27	*Hemidactylus flaviviridis*	Yellow-Green House Gecko	NA	-

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

***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; IUCN (2019). The IUCN Red List of Threatened Species. Version 2019-1; Schedules I to VI: Indian Wildlife (Protection) Act, 1972.

Appendix E List of Amphibians found in the Study Area

S. No.	Scientific Name	Common Name	IUCN Status *	WPA Schedule**
1	*Bufo melanostictus*	Common Indian Toad	LC	-
2	*Bufo scaber*	Ferguson's Toad	LC	-
3	*Bufo stomaticus*	Marbled Toad	LC	-
4	*Kaloula taprobanica*	Indian Painted Frog	LC	-
5	*Ramanella variegata*	Marbled Narrow Mouth Frog	LC	-
6	*Uperodon globulosus*	Balloon Frog	LC	-
7	*Uperodon systoma*	Marbled Balloon Frog	LC	-
8	*Polypedates maculatus*	Common Tree Frog	LC	-
9	*Euphlyctis cyanophlyctis*	Skipper Frog	LC	-
10	*Haplobatrachus tigerinus*	Indian Bullfrog	NA	IV
11	*Limnonectes limnocharis*	Paddyfield Frog	NA	-
12	*Haplobatrachus crassus*	Jerdon's Bullfrog	LC	IV

***Status assigned by the International Union for Conservation of Nature and Natural Resources, where – LC – Least Concern, 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 (2019). The IUCN Red List of Threatened Species. Version 2019-1; Schedules I to VI: Indian Wildlife (Protection) Act, 1972.

Appendix F List of Fishes found in the Study Area

S. No.	Scientific Name	Common Name	IUCN Status*	WPA Schedule**
1	*Anguilla bengalensis*	Indian Long-fin Eel	NA	-
2	*Cirrhinus reba*	Reba Carp	LC	-
3	*Labeo calbasu*	Kalbasu	LC	-
4	*Labeo rohita*	Rohu	LC	-
5	*Hypselobarbus kolus*	Kolus	VU	-
6	*Puntius conchonius*	Rosy Barb	LC	-
7	*Puntius dorsalis*	Long-snouted Barb	LC	-
8	*Puntius sarana subnasutus*	Peninsular Olive Barb	NA	-
9	*Puntius sophore*	Spotfin Barb	LC	-
10	*Puntius ticto*	Ticto Barb	LC	-
11	*Puntius vittatus*	Kooli Barb	LC	-
12	*Tor khudree*	Yellow Mahseer	EN	-
13	*Barilius bendelisis*	Hamilton's Baril	NA	-
14	Brachydanio rerio	Zebra Fish	NA	-
15	*Esomus danrica*	Flying Barb	LC	-
16	*Parluciosoma daniconius*	Blackline Rasbora	LC	-
17	*Nemacheilus denisoni*	Day's Loach	LC	-
18	*Lepidocephalus thermalis*	Malabar Loach	LC	-
19	*Aorichthys seenghala*	Giant River Catfish	NA	-
20	*Rita rita*	Rita	LC	-
21	*Ompok bimaculatus*	Indian Butter-Catfish	NT	-
22	*Wallago attu*	Shark Catfish	NT	-
23	*Pangasius pangasius*	Pungas	LC	-
24	*Aplocheilus lineatus*	Striped Panchax	LC	-
25	*Gambusia affinis*	Mosquito Fish	LC	-
26	*Pseudambassis ranga*	Glassfish	LC	-
27	*Nandus nandus*	Mottled Nandus	LC	-
28	*Oreochromis mossambica*	Egyptian Mouth Breeder	NA	-
29	*Glossogobius giurus*	Goby	NA	-
30	*Anabas testudineus*	Climbing Perch	DD	-
31	*Pseudosphromenus cupanus*	Indian Paradise Fish	LC	-
32	*Channa marulius*	Giant Snakehead	LC	-
33	*Channa punctatus*	Spotted Snakehead	NA	-

34	*Channa striatus*	Striped Snakehead	NA	-
35	*Mastacembelus armatus*	Tyre-track Spiny Eel	LC	-

***Status assigned by the International Union for Conservation of Nature and Natural Resources, where – EN – Endangered; NT – Near Threatened; LC – Least Concern; DD – Data Deficient and NA – Not Assessed.*

***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 (2019). The IUCN Red List of Threatened Species. Version 2019-1; Schedules I to VI: Indian Wildlife (Protection) Act, 1972.

Appendix G Signature List of Stakeholders Consulted

AECOM
Built to deliver a better world

Participant List

	S.No.	Name	Address	Signature
28/2/2019	1	Mallikarjun (member representative of Santhapur G Panchayat)	Jonnekeri	[illegible]
Aurad (40 MW)	2	Sanjay Kumar	Jonnekeri	
	3	Jyotish Gundappa	Jonnekeri	[illegible]
2/3/2019	1	Chandrakant	Nagoori	[illegible]
Maragutti (40 MW)	2	Hanumant Raya	Nagoori	[illegible]
	3	Sandip (Local Aggregator)	Kamlapur	[illegible]
4/3/2019	1	Nirpal	Talukhant	[illegible]
Sindhanoor (40 MW)	2	Vira bhadaram	Gaudrahatgi	
	3	Anuresh Gounda (Local Aggregator)	"	[illegible]

Date: ....

Appendix H No Objection Certificate (NOC) obtained for the Project from Jojna Gram Panchayat

ಗ್ರಾಮ ಪಂಚಾಯತ್ ಕಾರ್ಯಾಲಯ, ಜೋಜನಾ
ತಾ:ಔರಾದ (ಖಾ) ಜಿ. ಬೀದರ

ಸಂ:ಗ್ರಾ.ಪಂ.ಜೋ/ನಿರಾಕ್ಷೇಪಣಾ/ಸೊ.ಪ.ಪ್ರೂ /2017-18 ದಿನಾಂಕ: 16/10/2017

ಇವರಿಗೆ

M/s. Clean Solar Power (Gulbarga) Pvt.Ltd.
Registered office at: No.212,
Ground Floor, Okhla Industrial Estate, Phase-III,
New Delhi-110020,India.

ವಿಷಯ:- ನಿರಕ್ಷೇಪಣಾ ಪತ್ರ ನೀಡುವ ಬಗ್ಗೆ.
ಉಲ್ಲೇಖ:- ತಮ್ಮ ಅರ್ಜಿ ದಿನಾಂಕ : 04-09-2017.

* * * * *

ಈ ಮೇಲ್ಕಂಡ ವಿಷಯಕ್ಕೆ ಸಂಬಂಧಿಸಿದಂತೆ, ಉಲ್ಲೇಖ ಪತ್ರದಲ್ಲಿ ತಿಳಿಸಿರುವ ಜೋಜನಾ ಗ್ರಾಮ ಪಂಚಾಯತ ವ್ಯಾಪ್ತಿಯ ಲಿಂಗದಳ್ಳಿ ಗ್ರಾಮದ ಸ. ನಂ. 44,34/1,35/ಎ,35/ಡಿ, 36, 43/2ಬಿಎ,42/1,43/1,33/1,41, 42/2ಕೆಎ, 42/2ಎ,41/ಬ, 41/ಡ, 41/ಕ ಮತ್ತು 47/ಅ-2ಗಳ ಹೋಲದಲ್ಲಿ 40M.W. ಸೌರಶಕ್ತಿ ವಿದ್ಯುತ ಉತ್ಪದನಾ ಕೇಂದ್ರ ನಿರ್ಮಿಸಲು **M/s. Clean Solar Power (Gulbraga) Pvt.Ltd** ಪರವಾಗಿ **Mr.T.N Santhosh kumar S/o Late.T Nehru** ಕಂಪನಿಯ ಪರವಾಗಿ ರವರು ನಮ್ಮ ಗ್ರಾಮ ಪಂಚಾಯತ ವತಿಯಿಮದ ನಿರಕ್ಷೇಪಣಾ ಪತ್ರ ನೀಡಲು ಕೋರಿದ್ದು, ಅದಕ್ಕಾಗಿ ದಿನಾಂಕ 11-09-2017.ರಂದು ಸಾರ್ವಜನಿಕ ನೋಟಿಸ್ ಜಾರಿಗೋಳಿಸಿ ಸಾರ್ವಜನಿಕರಿಂದ ಆಕ್ಷೇಪಣೆಗಳು ಅಹ್ವಾನಿಸಲಾಗಿತ್ತು. ಸದರಿ ವಿಷಯದ ಕುರಿತು ಯಾವುದೆ ಆಕ್ಷೇಪಣೆಗಳು ಇರುವದಿಲ್ಲಾ ಪ್ರಯುಕ್ತ ಸಾರ್ವಜನಿಕರಿಗೆ ಮುಂದೆ ಯಾವುದೇ ತರಹದ ಸಮಸ್ಯೆಗಳು ಉದ್ಭವಿಸದ ರೀತಿಯಲ್ಲಿ ಹಾಗೂ ಸಂಬಂಧಪಟ್ಟ ಪ್ರಧಿಕಾರಗಳಿಂದ ಪೂರ್ವಾನುಮತಿ ಪಡೆದುಕೋಂಡು. ಸರಕಾರದ ನಿಯಮದನುಸಾರ ಸದರಿ ಸ್ಥಳದಲ್ಲಿ 40 ಮೆ.ವ್ಯಾ. ಸಾಮರ್ಥ್ಯದ ಸೌರಶಕ್ತಿ ವಿದ್ಯುತ ಉಪ್ಪಾದನಾ ಘಟಕ ಸ್ಥಪಿಸಲು ಗ್ರಾಮ ಪಂಚಾಯತ ವತಿಯಿಂದ ನಿರಕ್ಷೇಪಣಾ ಪತ್ರ ನೀಡಿದೆ.

ಅಧ್ಯಕ್ಷರು
ಗ್ರಾಮ ಪಂಚಾಯತ್, ಜೋಜನಾ
ತಾ|| ಔರಾದ (ಖಾ) ಜಿ|| ಬೀದರ

ಪಂಚಾಯತ ಅಭಿವೃದ್ಧಿ ಅಧಿಕಾರಿಗಳು
ಗ್ರಾಮ ಪಂಚಾಯತ ಜೋಜನಾ
ತಾ ಔರಾದ (ಖಾ) ಜಿ ಬೀದರ

Appendix I Grievance Redress Mechanism

HERO FUTURE ENERGIES

HERO FUTURE ENERGIES PVT. LTD.

GRIEVANCE PROCEDURE

			Bhawna		
0	22.12.2015	First Issue	Bhawna Kirpal Mittal	Sunil Jain	Rahul Munjal
Rev.	Date	Description	Prepared By	Checked and Approved By	Approved By

HERO FUTURE ENERGIES

HERO FUTURE ENERGIES PVT. LTD.

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1.0 OBJECTIVE

1.1 To provide a platform for fair assessment of employee grievances and their timely redressal.

2.0 APPLICABILITY

2.1 This Procedure is applicable to all employees on permanent rolls of HFE and its Holdco/SPVs irrespective of their posting at Delhi Office or Site/Regional Offices.

3.0 COVERAGE

3.1 This Procedure lays down process for registering a grievance, role of HR, Grievance Committee and redressal mechanism.

4.0 RESPONSIBILITY AND AUTHORITY

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

4.2 Monitoring and Implementation of this Policy is the responsibility of the HR and Grievance Committee.

5.0 REFERENCE

5.1 HR Department Manual – HFE/HR01.

6.0 EFFECTIVE DATE

6.1 This Policy comes into force w.e.f December 22, 2015 and will be valid till next Revision is announced.

7.0 DEFINITIONS

Grievance	Specific complaint of an employee by any other employee related to case of breach of Code of Conduct, Ethics Policy, Negligence, misconduct, employee complaint against Reporting Manager/other employees, complaint by a male employee of sexual harassment by a male or a female employee
Grievance Committee	Committee appointed for conducting enquiry and resolving complaints filed under Grievance Procedure

8.0 REGISTERING A GRIEVANCE

8.1 An aggrieved employee shall first raise his/her grievance to his/her Reporting Manager. Grievance may first be discussed verbally and then put in writing (either thru' mail or hard copy) or either way.

9.0 RESOLVING THE GRIEVANCE

9.1 It is the responsibility of the Reporting Manager to try and resolve the grievance in a prompt manner.

9.1.1 In case, the grievance is solved by the Reporting Manager in a time frame of two weeks and aggrieved employee is satisfied with the solution, then Reporting Manager will inform HR in writing (either thru' mail or hard copy) about the grievance and its solution and acceptance by the aggrieved employee.

9.1.2 In case, the Reporting Manager is not able to solve the grievance or if the solution provided by the Reporting Manager is not acceptable to the aggrieved employee or if the Reporting Manager has exceeded the time limit of two weeks, then both the parties can take the matter to HR.

9.2 Once the matter is escalated to HR, then HR will try to resolve the grievance and if the same is not resolved in a week's time, then the case will be referred to the Grievance Committee by HR keeping the Reporting Manager and the second level supervisor in loop.

9.3 Grievance Committee shall review the employee's grievance and will ask for producing any/all information/evidence deemed pertinent for the grievance and ensure its early resolution. Decision of Grievance Committee shall be considered as the final decision rendered by the Company regarding the employee's grievance.

9.4 Grievance Committee will have to complete all the proceedings and come up with a solution within one month from the time the grievance is handed over to them.

9.5 It is understood that any employee who avails the mechanism will be treated courteously and that the case will be handled as the circumstances permit.

9.6 The aggrieved employee can file for an appeal in the office of CEO or MD against the verdict of Grievance Committee, if required. The appeal filing has to be based on levels.

10.0 GRIEVANCE COMMITTEE

10.1 The Grievance Committee will comprise of 3 members. HR acts as an observer and facilitator.

10.2 Committee members will meet at least once in three months. However, if necessary, it may meet more frequently at the instance of the Convener or at the request of the other members to discuss the various issues received.

10.3 It is important that all three members of the Grievance Committee are present in the meeting.

11.0 ROLE OF GRIEVANCE COMMITTEE

11.1 The Committee shall carry on its proceedings by conducting meetings, discussions with the aggrieved person and the party involved. They will refer to all the relevant documents/information/evidence as deemed pertinent.

11.2 Aggrieved party will be given justifiable time to give a reply to the cause.

11.3 Committee will then give its recommendation based on the proceedings, but within a maximum period of 1 month from the date of petition.

11.4 Recommendations of the Committee will be sent to the CEO for Approval.

11.5 In case there is a deadlock on the verdict between the Committee members, the decision of Chairman of the Committee will be considered final and binding.

11.6 If a member of the Grievance Committee is connected with the grievance of the aggrieved individual, the concerned member of the Grievance Committee will not participate in the proceedings and HR/CEO may nominate any other person as Grievance Committee for specially that case.

11.7 If the aggrieved person happens to be a member of the Grievance Committee, he/she will not participate in the proceedings as Committee member. In such a case, HR/CEO may nominate any other person as Grievance Committee for specially that case.

11.8 The Grievance Committee shall not consider any grievance of general applicability or of collective nature of raised collectively by more than one employee

11.9 The Grievance Committee shall not be affected by any biases towards any party involved in the matter.

12.0 TENURE OF GRIEVANCE COMMITTEE

12.1 Grievance Committee will hold the Office for a tenure of three years.

12.2 Committee members can be changed before completion of their tenure, if it is deemed compulsory, but the same shall take place after Approval of the CEO and the MD.

13.0 DOCUMENTATION

13.1 Grievance Committee will keep all documents related to all the cases. They will give a duplicate copy of all documents to HR for recording in employee personal file.

14.0 ATTACHMENTS

Description	Format No.
Form for Grievance Review	HFE/HR16/F1
Grievance Committee	HFE/HR16/F2

15.0 AMENDMENT

This Policy is subject to change at the sole discretion of the Management.

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