ESIA of a proposed 50 MW Solar Power Project in Jalna District of Maharashtra, India

Final ESIA Report

8 November 2022

Project No.: 0591652

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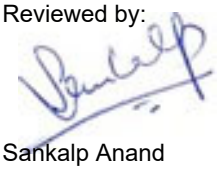	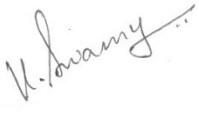
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Acronyms and Abbreviations

Name	Description
ASI	Archaeological Survey of India
BMTPC	Building Materials & Technology Promotion Council
CGWB	Central Groundwater Board
CPCB	Central Pollution Control Board
COD	Commercial Operations Date
EHS	Environment Health and Safety
ERM	Environment Resource Management
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
EC	Electrical Conductivity
EPC	Engineering, Procurement and Construction
GSS	Grid Sub Station
GW	Giga Watt
GGEF	Green Growth Equity Fund
Ha	Hectare
IFC	International Finance Corporation
IPP	Independent Power Producer
Km	Kilometre
NOC	No Objection Certificate
MW	Mega Watt
MSETCL	Maharashtra State Electricity Transmission Company Limited
MoEFCC	Ministry of Environment Forest and Climate Change
NAAQS	National Ambient Air Quality Standards
PS	Performance Standard
PSS	Pooling Substation
pH	Potential of Hydrogen
ROW	Right of Way
SECI	Solar Energy Corporation of India
SC	Schedule Caste
SRPL	Solenco Renewables Private Limited
ST	Schedule Tribe
TL	Transmission Line
TPD	Tonnes Per Day

1. INTRODUCTION

ERM India Private Limited (ERM) was commissioned by Radiance Renewables Private Limited (hereinafter referred to as 'Radiance' or 'Client') to conduct a rapid Environmental and Social Impact Assessment (ESIA) for a proposed 50 MW Solar Power Project at Dahalegaon- M.Chincholi Village, Ghansawangi Taluka, Jalna district of Maharashtra, India (hereinafter referred to as 'Project').

Radiance, incorporated in the year 2018, is a private equity owned developer of competitive renewable energy solutions for commercial, industrial and residential customers, and is a 100% subsidiary of Green Growth Equity Fund (GGEF). GGEF is an Alternate Investment Fund managed by Eversource Capital. Radiance intends to develop open access solar projects across various locations within India, with one such location being Dahalegaon- M.Chincholi Village, Ghansawangi Taluka, Jalna district of Maharashtra, India.

1.1 Overview of the Project

The 50 MW Solar Power Project will be developed over land measuring ~180 acres, by Solenco Renewables Private Limited (SRPL) as EPC followed by operation and maintenance of the same. The Land Aggregator is responsible for approaching the land owners,to buy the land from landowners to Radiance for development of the solar power Project.

Power from the Project will be evacuated to a 132/33 KV Ghansawangi Substation of MSETCL through a 7km transmission line.

It was understood during ERM site assessment that the Project is in final stages of planning. The construction phase timelines and commercial operations date (COD) for the Project have not been finalised, however, it was understood that the Project construction has been started since February 2022 including levelling of land and construction of the SCADA office. The project will be commissioned over the course of the next 6 to 8 months.

Table 1.1 50 MW Solar Power Project - Overview

Particulars	Description
Location of the Project	Dahalegaon- M.Chincholi Village, Ghansawangi Taluka, Jalna district of Maharashtra, India Coordinates for the site are 19°30'55.24"N, 76° 2'52.96"E
Power Evacuation Scenario	The power generated from the proposed solar power plant would be evacuated to 132/33 KV Ghansawangi Substation of MSETCL through a 7km transmission line. Power evacuation infrastructure to be provided by SRPL and evacuation of power from pooling substation to MSETCL substation is under the scope of ISPL.
Land Requirement	A total of 180 acres of land will be bought for the project, out of which 150 Acres has already been brought.
Present Project Status	At the time of ERM site visit, it was understood that the Project is in the final stages of planning, i.e., pre-construction stage.
Contractors	M/s Solenco Renewables Private Limited (SRPL) as has been appointed as EPC followed by operation and maintenance of the same
Commissioning Date	The construction phase timelines and commercial operations date (COD) for the Project are not known to ERM, however, it was understood that the Project project will be commissioned over the course of the next 6 to 8 months from the COD.

1.2 Objective of the Report

Objectives of the Rapid ESIA study are provided below.

- Understand the environmental and social baseline of the proposed site locations and identify significant impacts due to proposed project activities;
- Conduct limited consultations with the project influenced stakeholders to ensure that all key stakeholders are aware of the objectives and potential impacts of the proposed project; and
- Suggest mitigation measures and plans for implementation of the measures to minimize the identified impacts associated with the pre-construction, construction, operation and decommissioning phases of the Projects.

1.2.1 Scope of Work

Scope of work for the assignment comprised of following tasks:

- **Defining the Project/Project Description** - Providing a Project description with focus on understanding the environmental and social setting and sensitivities for the proposed solar power project;
- **Laying down 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. Reviewing the Social & Environmental compliance requirement with respect to the above;
- **Generating Baseline Data:** Collection and generation of relevant baseline social environmental data (primary & secondary). This data is relevant to decisions about project location, design, operation, or mitigation measures. The baseline data generation specifically focuses on issues around:
  - Water- its quality, availability and adequacy vis-à-vis the requirements during different phases of the project life cycle (mostly secondary);
  - Land and land use;
  - Ecology and biodiversity;
  - Physical or cultural heritage (if any) etc.;
  - Review of the land purchase/lease process to assess any legacy or current/existing issues (like informal settlers, livelihood dependence, other usage etc.) on the allotted land; and
  - Conduct stakeholder consultation including community meetings and meetings with other concerned institutions and determine that all stakeholder concerns have been addressed.
- **Assessing Social and Environmental Impacts and Mitigation Measures:** Assessing the Social and Environmental impacts (both positive and negative) of solar energy projects, with potential assessment of Cumulative impacts, if relevant and as appropriate. Identify mitigation measures and any residual negative impacts that cannot be mitigated. Also evaluate impacts and risks from associated facilities and other third-party activities.
- **Analysing the Alternatives:** Comparing reasonable alternatives to the proposed Project site, technology, design, and operation in terms of their potential E&S impacts; the feasibility of mitigating these impacts; their suitability under local conditions; and their institutional, training, and monitoring requirements. It also states the basis for selecting the site and Project design justifying recommended approaches to pollution prevention and abatement; and
- **Providing Management Plan:** Development of an Environmental and Social Management Plan (ESMP) consisting of the set of mitigation and management measures to be taken during implementation of the Project to avoid, reduce, mitigate, or compensate for adverse social and environmental impacts, in the order of priority, and their timelines.

1.2.2 Applicable Reference Framework

The reference framework for the ESIA is described below:

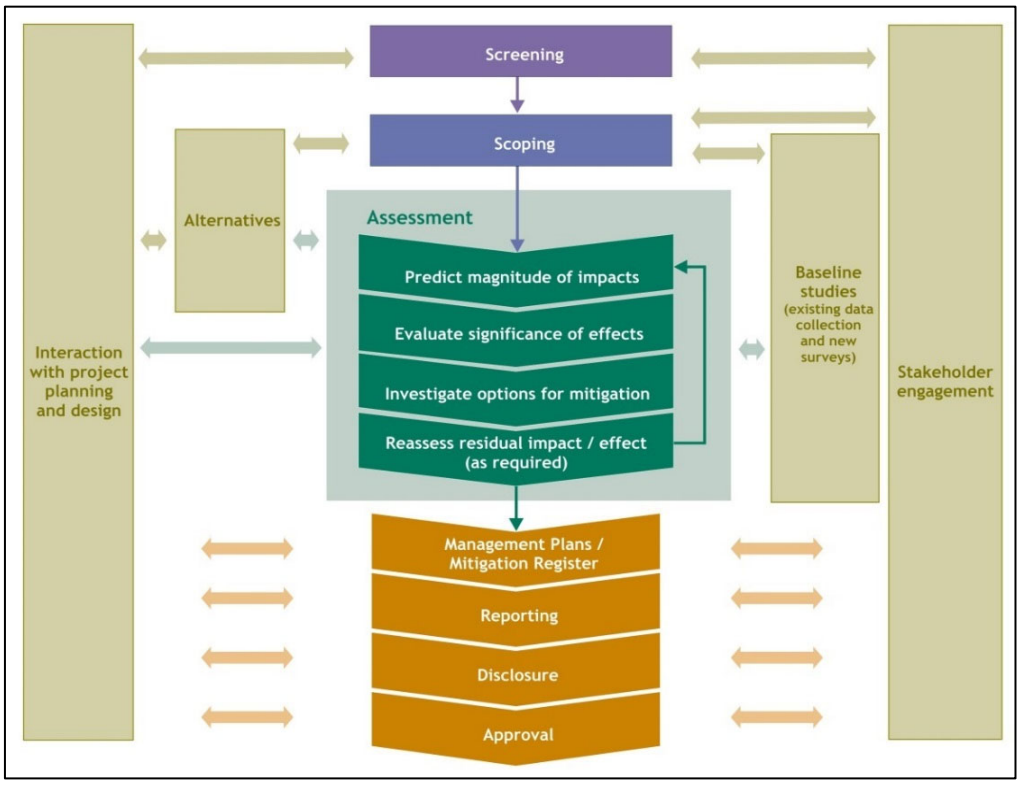
- Applicable local, national and international environmental and social (including occupational health and safety) legislations;
- IFC Performance Standards, 2012; and
- IFC/World Bank EHS General and relevant Sector Specific Guidelines as applicable.

1.3 ESIA Methodology

The ESIA methodology follows the overall ESIA approach illustrated in **Figure 1.1**. The ESIA has been undertaken following a systematic process that predicts and evaluates the impacts the Project could have on aspects of the physical, biological, socio-economic and cultural environment, and identifies measures that the project will take to avoid, minimise/reduce, mitigate, offset or compensate for adverse impacts and to enhance positive impacts where practicable. The stages of the ESIA process are described below and tasks undertaken are provided in

.

Figure 1.1 ESIA Methodology



1.4 Limitations

The Project is presently at the construction/planning stage and information with respect to water source, requirement and other resource requirements during construction and operational phases has not been shared with ERM, as well as information on the route and right of way of transmission line, exact break-up of the land required for solar panels, labour camp, storage yard and site office;

The ESIA study does not involve primary baseline data collection and monitoring. Assessment on water availability and quality scenario, ambient noise, air and soil quality, and traffic in the region has been done based on information provided by the Client and obtained from the public domain. The same will be elaborated in detail in the main ESIA report for the Project;

1.5 Use of this Report

ERM is not engaged in consulting or reporting for the purpose of advertising, sales promotion, or endorsement of any client interests, including raising investment capital, recommending investment decisions, or other publicity purposes. Client acknowledges this report has been prepared for their and their clients' exclusive use and agrees that ERM reports or correspondence will not be used or reproduced in full or in part for such purposes, and may not be used or relied upon in any prospectus or offering circular. Client also agrees that none of its advertising, sales promotion, or other publicity matter containing information obtained from this assessment and report will mention or imply the name of ERM.

Nothing contained in this report shall be construed as a warranty or affirmation by ERM that the site and property described in the report are suitable collateral for any loan or that acquisition of such property by any lender through foreclosure proceedings or otherwise will not expose the lender to potential environmental or social liability.

1.6 Structure of the Report

The structure of the report will as per the table below.

Table 1.2 Structure of ESIA report

Section No.	Title	Description
1.	Introduction	*(this section)* Introduction to the Project and ESIA scope and methodology adopted.
2.	Project Description	Technical description of the Project & related infrastructure and activities.
3.	Applicable Legal and Regulatory Framework	Discusses the applicable environmental and social regulatory framework and its relevance for the Project.
4.	Screening and Scoping	Discusses the project screening with respect to environmental and social risks and scoping outcomes undertaken as part of the ESIA process.
5.	Environmental, Ecology and Social Baseline	Outlines Environmental, Ecology and Social Baseline status in the study area of the Project.
6.	Stakeholder Engagement	Provides an overview of the stakeholder engagement activities undertaken during the ESIA.
7.	Impact Assessment and Mitigation Measures	This section includes details of identified environmental impacts and associated risks due to project activities, assessment of significance of impacts and presents mitigation measures for minimizing and /or offsetting adverse impacts identified.

Section No.	Title	Description
8.	Environmental and Social Management Plan	Outline of the ESMP taking into account identified impacts and planned mitigation measures and monitoring requirements.
9.	Conclusion	Summary of impacts identified for the project and conclusion of the study.

2. PROJECT DESCRIPTION

This section provides a description of the Project in terms of location, facilities and associated project infrastructure and activities during the Project lifecycle and facilitates a comprehensive identification of the potential impacts on resources and receptors that could result from Project activities during the pre-construction, construction, operation and decommissioning stages.

2.1 Location, Site Settings and Salient Features

The 50 MW Solar Power Project will be developed over land measuring ~180 acres, by Solenco Renewables Private Limited (SRPL) as EPC followed by operation and maintenance of the same. The land Aggregator is responsible for approaching the landowners, negotiating and signing the lease deed. The entire land has been bought by Radiance for development of the solar power Project.

Power from the Project will be evacuated to a 132/33 KV Ghansawangi Substation of MSETCL through a 7km transmission line. Power from the pooling substation will be evacuated via 33 KV transmission line to the substation in Ghansawangi village, Ghansawangi Taluka, Jalna district of Maharashtra.

The village road crosses the project site in the northern direction, the village road connects Dahalegaon and Pirgaibwadi village. A road also runs along the eastern boundary of the project site and the site is surrounded by agricultural land on the remaining sites. The site is largely flat terrain and can be accessed by the village road diverging out of the nearest state highway SH-143 at 3 km. Nearest residential settlement is present along the Residential settlements of Village Dhakepal is situated at an approximate aerial distance of 480 m west of the project site.

Basis the site visit, it was confirmed that there are three residential structures, a natural pond and a poultry farm is present within the project boundary. Also a two man-made agricultural ponds are present along project boundary, one along the north eastern boundary and second near the southern boundary of the site, which were observed to be dry during the site visit. There is also a mango fam inside the project boundary.

The Transmission Line (TL) route passes through agricultural landscape with a few scrubland patches. The TL route crosses a river at about 1.9 km west of the Project site. However during site visit it was observed that the river was dry. Three relatively large waterbodies are located at about 3 to 4 kms south of the transmission line alignment- Pazar Talav, Devi Dahegaon Talav (Dam) and Mandala Laghu Talan (dam).

The salient features of the Project are summarized in the table below.

Table 2.1 Project Site Salient Features

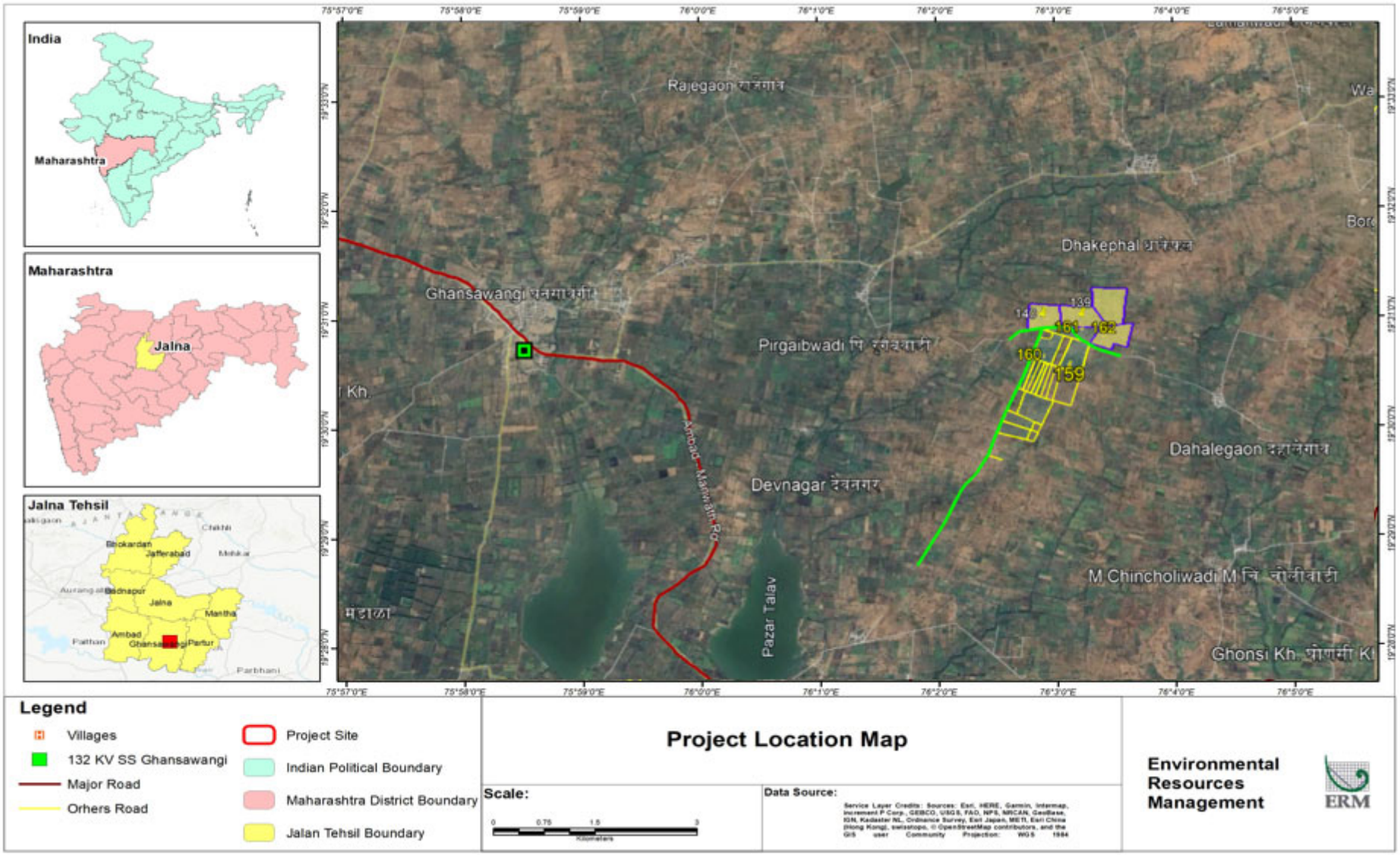
Features	Description
Type of land	Non irrigated agricultural waste land
Waterbodies	Three relatively large waterbodies are located at about 3 to 4 kms south of the transmission line alignment- Pazar Talav, Devi Dahegaon Talav (Dam) and Mandala Laghu Talan (dam).
Site Access	Primary access to the site is through Ambad Manwath Road, from where site can be accessed via multiple village road leading to the site. Observations to be added from the site visit, any particular local name of any village
Nearest town/city	Ghanaswangi town at an approximate aerial distance of 5.6 km west.
Structures within site	■ Three residential structures present within the site boundary at 19°30'47.99"N , 76° 2'44.85"E,

Features	Description
	■ A natural pond is present at 19°31'16.00"N , 76° 3'4.36"E ie near the northern boundary ■ A poultry farm at 19°31'19.86"N, 76° 3'15.93"E (near the north eastern boundary).
Structures within 500 m	■ Multiple residential settlements of village Dhakepal fall within the 500 m radius of the project site on the western side ■ Two residential settlements present along the eastern project boundary of the site ■ Multiple manmade ponds are present within the 500m radius of the project site ■ Multiple, yet isolated structures present in the vicinity can be a rest area within the agricultural field or a pump room or storage space.
Nearest Railway Station	Parthur railway station at an approximate aerial distance of 18 km northeast.
Nearest Airport	Aurangabad airport at an approximate distance of 85 km northwest.
Distance from the grid substation	Power from the pooling substation will be evacuated via 33 KV transmission line to the substation at 132/33 KV Ghansawangi Substation of MSETCL, Ghansawangi village, Ghansawangi Taluka, Jalna district of Maharashtra situated at an aerial distance of 5.78 km east.

Source: Information provided by Radiance and extracted from Google Earth Imagery.

Figure 2.1 below provides the location of the proposed 50 MW solar power Project.

Figure 2.1 Project Site Location



2.2 Description of Project Facilities, Components and Contractors

This section provides a description on the Project facilities, components and activities. With respect to components and facilities, solar power projects generally consist of the following:

- Key project components – (Solar panels; Switchyard; Inverters; Transformers; Main Control Room; and Pooling Substation);
- Key associated facilities – (Transmission line and towers; Access roads);
- Additional project infrastructure such as scrap yard, storage area, etc.

The proposed 50 MW solar power Project will be based on Monocrystalline Solar Photo Voltaic technology. Details of project components, associated facilities and other plant infrastructure, and contractors are as given in **Table 2.2**.

Table 2.2 Project Facilities, Components and Contractors

Feature	Description
Components	
The grid connected solar power plant main equipment and components	■ Solar PV Modules; ■ Panel mounting system; ■ Solar inverters; ■ DC Junction boxes (If required); ■ AC combiner boxes; ■ Cables & connectors; ■ SCADA/ Monitoring system; ■ Room for housing the electronics (If required); ■ Automatic panel cleaning system. (If required); ■ Grounding and lightning system.
Associated Facilities and other Plant Infrastructure	
Site office / Main Control Room	■ The site office will be present within the project site; ■ The site office will consist of emergency contact details, fire extinguishers, first aid kit, PPE room and the lock out/tag out station, etc.; ■ The SCADA control room will also be present within the Main Control Room.
Substation	Power from the Project will be evacuated via a 33 KV internal transmission line to the existing 132/33 KV substation.
Scrap yard	■ The scrap yard will also be present within the site; ■ The scrap yard will consist of discarded panels and other hardware components such as wood/steel, oil barrels, wires/cables and domestic components.
Storage yard	The storage area will be present within the site next to the sleeping quarters; The storage area consists of transformer oil barrels, herbicide bottles, new solar modules, unused wires/cables, hardware components, etc.
Transmission Line for Power Evacuation	Power to be evacuated to a 132/33 KV substation via a 33 KV transmission line to an existing MSETCL substation.
Contractors	

Feature	Description
EPC and other contractors	Information with respect to the name and number of contractors to be engaged for the Project was not shared with ERM. At the time of ERM's site visit, the Project was at pre-construction/planning stage, therefore the process of contractor identification had not finished and no contractors had been finalised. No further information on contractors to be hired for the Project was shared with ERM (post ERM site visit).

Source: ERM site visit and discussion with site representative.

2.3 Project Phases and Activities

The proposed solar power plant is currently at initial stages of planning. The activities for the project can be divided into the following phases/stages.

- Planning phase;
- Construction phase;
- Operation and maintenance phase; and
- Decommissioning phase.

The key activities for the above are as showcased in **Table 2.3**.

Table 2.3 Project Phase and Key activities

S. No.	Associated Facilities	Details
1.	Planning *(current phase of the Project)*	■ Identification of land area and site; ■ Site surveys as topographic, geo-technical investigations, solar radiation and yield study, electrical grid studies, etc.; ■ Obtaining all necessary approvals/clearances; and ■ Design and finalization of contractors.
2.	Construction	■ Contractor mobilization; ■ Site preparation including fencing, clearing of bushes, pit filling, levelling and grading; ■ Construction of site office and internal roads; ■ Construction of temporary storage facilities; ■ Foundation laying for ground mounted structures; ■ Storage of PV modules delivered and their installation; ■ Laying of internal electrical connections; ■ Construction of sub-station and office buildings; ■ Installation of inverter and transformers; ■ Excavation foundation and erection of transmission line towers; and ■ Stringing of transmission lines.
3.	Operation and Maintenance	■ Monthly cleaning of PV modules; ■ Control of vegetation viz. weeds, bushes etc. within the site;

S. No.	Associated Facilities	Details
		■ Routine inspection of all PV modules and associated structures viz. cables, transformers, inverters, mounting structures etc.; ■ Operation and maintenance of ancillary facilities, such as the switch yard; ■ Inspection and maintenance of transmission lines; and ■ Inspection and maintenance of internal pathways and access roads.
4.	Decommissioning	■ The average life span of the solar modules is 25 years; ■ At the end of this life cycle, the solar modules will either be revamped or replaced, or disposed as per the then applicable legislation; ■ If decommissioned, all components including foundations and internal roads of the project will be removed and the site will be restored to its pre-construction state; ■ The concrete pedestals of the ground mounted structure foundations will be demolished and removed from the sub-surface.

2.4 Resource Requirement

The resource requirement for construction and operation phases of the proposed Project have been provided based on information made available by Radiance and professional judgement. The resource requirement for the Project have been provided in **Table 2.4**.

Table 2.4 Resources Requirement

S. No	Resource Requirement	Area	Approximate Quantity	Source	Transportation
Land Requirement					
1	Land	Across the Project lifecycle	180 Acres	Land Aggregator, facilitates the process.	Not Applicable
Construction Phase					
1	Manpower	Construction activities	During the construction phase, it is estimated that the project will require approximately 274 skilled, semi-skilled and unskilled labourers.	Labourers will be hired through the Contractor and will include a mix of migrant and local labourers.	Vehicles
2	Water	Construction activities	Approximately 25,000 litres per MW of water will be required for civil works, dust suppression, drinking and domestic use.	Tanked Water, will be sourced from borewells if present within the land parcels. Source of water is not confirmed yet	NA
3	Cement	Construction activities	Approximately 300 tonnes per month.	Locally Sourced	Vehicles
4	Stone	Construction activities	Approximately 500 tonnes per month.	Locally Sourced	Vehicles
5	Steel	Construction activities	Approximately 60 tonnes per month.	Locally Sourced	Vehicles
6	Sand	Construction activities	Approximately 800 tonnes per month.	Locally Sourced	Vehicles
7	Bitumen	Construction activities	Approximately 15 tonnes per month.	Locally Sourced	Vehicles
8	Power	Construction activities	Information not available. Likelihood of diesel generator (DG) sets being used. Number and capacity of DG sets not known.	Locally Sourced	Vehicles
9.	Fuel	Construction activities	Approximately 300 litres of fuel will be required per month.	Nearby petrol pumps retail outlets and will be stored in the designated storage yard.	Vehicles
Operation Phase					
1	Manpower	Construction activities	During the operation phase, approximately 10 - 12 employees/technicians of O&M contractor would be deployed at site. Apart from these, there will be 3-4 staff who will be engaged in housekeeping and approximately	EPC contractor	Vehicles

S. No	Resource Requirement	Area	Approximate Quantity	Source	Transportation
			25 are envisaged to be employed as security guards during O&M stage.		
2	Fuel	Construction activities	Information not available.	NA	NA
3	Water	Operation Activities	It is estimated that approximately 3,000 litres per MW of water will be required for cleaning solar modules and for drinking/domestic purposes.	Borewells and Tanked Water, basis the availability. Source of water is not confirmed yet	NA
4	Power	Operation Activities	Power requirement during daytime would be met through auxiliary generation. During the night time power requirement would be met through State Electricity supply.	Auxiliary generation and State Electricity supply.	NA

Note: Estimation made on the basis of ERM's past experience on similar projects. Information pertaining to resource requirement during construction and O&M phases, except for water requirements, was not shared with ERM.

2.5 Land Procurement Process

The land procurement for the project is still in process. This section describes the identified process of land procurement for the project as confirmed by the client.

The project has consulted a local land aggregator to identify the suitable land options, more land area than the required land area. The suitable land parcels will be selected based on the desk-based analysis. A detailed site visit report will be prepared along with the KMZ file. A MoU is signed between the project and the land aggregator. It is not clear at this stage if the MoU has been signed for the project only. After the MoU, land aggregator proceeds to obtain consent letters/ sahmati patras from the farmers wherein they express their willingness to give their land on sale for the project at an agreed price. The land aggregator will also collect the other required documents of land for land due diligence. Once prima facie land DD is completed, Agreement to Sell (ATS) is done and lease rental payment is done to the land owners (net of advance). Final land DD is completed in the interim

2.5.1 Land requirement for the Project

The Project requires approximately 1800 acres of land for developing 50 MW solar power plant and its related components The proposed location for a 50 MW solar power plant is in Village Dahalegaon-M.Chincholi, Taluka–Ghansawangi, District Jalna ,Maharashtra. The project has been proposed in accordance with the policy outlined in Government of Maharashtra GR No. NCE-2015/C.R.49/Energy-7 dated 20/07/2015.

Per Google satellite imagery, it is observed that within 5 km radius of proposed project site, there are six villages namely Dhakepal village (towards North), Pirgaibwadi and Devnagar villages (towards West), Dahalegaon(toward East) and Machindranath Chincholi and Ghonsi Kh. villages (towards South).

According to census data 2011, the total number of households in the study area is 2271, with a total population of 10661. Furthermore, the nearest village settlements in the study area are Dhakephal Village and Pirgaibwadi Village, both of which are within a 2 Km radius of the study area.Detailed social baseline shall be included in the rapid ESIA report.

The project proposes to use the existing road running along the boundary of the proposed project site which is capable of carrying heavy loads. Hence, it is understood that there is no requirement for land for the access road. As per information available, the entire land required for project is comprised of private land belonging to 31 owners.

Table 2.5 Land procurement and specific issues

S. No.	Description	Total Land area	Total Land area for the 50MW Project (Acres)
1.	Solar Module Installation	Not Known	
2.	MCR & ICR	Not Known	
3.	Switchyard	Not Known	
4.	Temporary Labour Camp	Not Known	
5.	Stock / Storage Yard	Not Known	
6.	Other		
Total		**280**	

2.5.2 Past Land Use

As per the GIS analysis, the land has been used for agriculture. At present, it is not known if there is not any encroachment, any other land users such as sharecroppers and labour.

2.6 Project related land procurement and specific issues

Project related land procurement and specific issues are summarised in the table below.

Table 2.6 Land procurement and specific issues

Features	Description
Schedule V Area	The project area does not fall under designated Schedule V area[1].
Forest Land	As informed by the site representatives of Radiance, there is no forest land present In the project area.
Landlessness	No Landlessness
Encroachment and Squatting	No
NOC from Panchayat	Received
Cultural Heritage	No cultural heritage

2.7 Analysis of Alternatives

As per IFC Performance Standards, an analysis of probable alternatives for the chosen technology and location of project site along with other similar factors that contribute to the Project as a whole has been carried out. The following scenarios have been taken into consideration:

- Project vs No Project scenario;
- Alternate Source for Power Generation;
- Alternate Location for Project Site.

2.7.1 Project vs. No Project Scenario

Access to energy is a fundamental enabler for economic development and prosperity of any region. A survey conducted by the World Energy Council states that 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.

In order to meet the gap in demand and supply, renewable/non-conventional sources of power will be required to supplement the conventional sources. The Project, being renewable source of power generation, will contribute towards bridging the gap between demand and supply. The Project presents an opportunity to utilize the potential for solar 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.

[1] In the Constitution of India, the expression “Scheduled Areas” means such areas as the President may by order declare to be Scheduled Areas. The criteria followed for declaring an area as Scheduled Area are preponderance of tribal population; compactness and reasonable size of the area; under-developed nature of the area; and marked disparity in economic standard of the people. These criteria are not spelt out in the Constitution of India but have become well established. (Source: Official website of the Ministry of Tribal Affairs (MoTA), Government of India (GoI). URL: http://tribal.nic.in/Content/DefinitionofScheduledAreasProfiles.aspx. Accessed on 27.08.2016.

2.7.2 Alternate Source of Power Generation

India is a large and fast growing economy, and according to Planning Commission of India, the country's primary energy use is expected to increase by four to five times by 2031-32. Even though India's energy basket has a mix of all resources such as coal, lignite, oil, natural gas, LNG, nuclear, solar, hydro and wind power, the dominance of coal is conspicuous with a prominent share of approximately 50%.

Table 2.7 Life-cycle Emissions from Power Sources

LCA Emissions (g CO_2 equivalent/kWh)	Wind	Solar	Nuclear	Coal
Implementation	13.7	37.5	1.2	3.6
Operation	4.7	12.0	12.4	918.8
Decommissioning	0.6	0.5	0.4	52.2
Total	19	50	14	975.3

Source: Report on developmental impacts and sustainable governance aspects of renewable energy projects, Ministry of New and Renewable Energy.

As evident from the table above, the emission of CO2 per kWh of energy generated from a Coal based power plant is more than that of the emission from a solar based power plant. The only emissions from the Renewable energy technologies are the emissions from fossil sources used in the production and manufacturing of equipment, waste disposal during construction, recycling etc. These life-cycle emissions are significantly lower as indicated in the table above.

Further to the above mentioned reasons, it would be significant to conclude that:

- The Project is environment friendly with minimal greenhouse gas emissions; and
- It is the most feasible choice of power generation in the state.

2.7.3 Alternate Location for Project site

Solar projects are non-polluting energy generation projects which are site specific and dependent on the availability of solar irradiance resource. Solar irradiance mapping is done by Solar Energy Corporation of India (SECI) through National Renewable Energy Laboratory (NREL), based on which potential areas are notified by SECI. The current Project site selected is a high solar power potential site with irradiation of 5.5 - 6.0 kWh/m^2/day and availability of 250-300 sunny days (refer to **Appendix A** for India Solar Resource Map). The final selection of the project site depends upon availability of a contiguous patch of land that is willingly sold by land owners. Hence, the option of choosing an alternative area is not available to a Project developer.

The proposed Project site has the following location advantages:

- Site with high solar irradiation;
- No ecological sensitive receptor such as National Parks, Wildlife Sanctuary, within 10 km radius;
- No reserve or protected forest within 5 km radius;
- No cultural property of archaeological importance within 5 km radius;
- There exists no structural obstacles around the site, such as tall buildings, that could lead to near shading; and
- Existing power evacuation infrastructure will be utilised, consisting of a 132/33 KV substation of MSETCL, Ghansawangi village, Ghansawangi Taluka, Jalna district of Maharashtra situated at an aerial distance of 5.78 km east.

3. APPLICABLE REFERENCE FRAMEWORK

This section provides legal and regulatory framework along with institutional framework for the Project, covering national requirements as well as applicable international treaties and conventions, guidelines and standards. The intent of this section is to lay out the regulatory and non-regulatory performance requirements for all stages of the Project. The section broadly focuses on:

- Institutional Framework for the implementation of the regulations; and
- Applicable national and international environmental standards.

Approval from various regulatory agencies authorized by the central and state governments, in the form of licenses, permits, or authorizations, are required for the establishment and operation of proposed Project.

3.1 Permitting Status for the Project

3.1.1 EIA Notification (2006)

As per the EIA Notification (2006) and its amendments, the Project does not require any environmental clearance (EC) from the Ministry of Environment Forest and Climate Change (MoEFCC) or the State Environmental Impact Assessment Authority (SEIAA).

3.1.2 Central pollution Control Board

Based on the notification released by the Central Pollution Control Board (CPCB Ref No: B-29012/ ESS (CPA)/2015-2016), “Solar projects, wind power projects and mini hydro projects (less than 25 MW)” have been moved from “green category” to “white category” and there shall be no necessity of obtaining Consent to Operate, an intimation to SPCB/PCC shall suffice.

3.2 Unconventional Energy Generation Policy-2020, Maharashtra

Government of Maharashtra issued a Connected Non Conventional/ non-transmission Energy Generation Policy-2020 for power generation projects new and renewable (non-conventional) energy sources.

The policy is divided into two parts. In the first part of the policy, the state aims to implement 17,360 MW of transmission system-connected renewable power projects by 2025. This includes 12,930 MW of solar power projects, 2,500 MW of wind energy projects, 1,350 MW of co-generation projects, 380 MW of small hydro projects, and 200 MW of urban solid waste-based projects. The 12,930 MW of solar projects include 10 GW of standalone solar power projects, 2 GW of grid-connected rooftop solar projects, 500 MW of solar-based water supply projects, 250 MW of solar generation projects for farmers, among others.

Under the second part of the policy, the state plans to implement over ₹780 million ($10.5 million)/annum worth of transmission-free projects. A transmission-free project refers to power projects that are not connected to the grid. These include 100,000 agricultural solar pumps, 52,000 kV of rooftop solar systems, 2,000 solar water supply stations, the electrification of 10,000 rural homes, microgrid projects for 20 homes, 55,000 square feet of solar water/solar cooking systems, and 800 solar cold-storage projects

Objectives of the policy are:

- Need to set up environmentally friendly non-conventional energy generation projects and to help in increasing employment opportunities and investment through a policy that supports the investment made by the developer in the state while setting up such projects.
- To have a policy of the State Government to supplement the requirements of the Unconventional Energy Policy of the Central Government.

- Establishment of projects subject to the provisions of various Acts of the State Government and mainly the Electricity Act 2003 and the rules under it; rules, regulations, codes etc. fixed by the Maharashtra Electricity Regulatory Commission and improvements thereto from time to time.

3.3 National Environment Standards

The Central Pollution Control Board (CPCB) has stipulated different environmental standards w.r.t. ambient air quality, noise quality, water and waste water for the country as a whole under EP Act, 1986. Following standards are applicable to the project and need to be complied with during the project life cycle.

- National Ambient Air Quality Standards (NAAQ Standards), as prescribed by MoEFCC vide, Gazette Notification dated 16th November, 2009;
- Drinking water quality- Indian Drinking Water Standard (IS 10500: 2012);
- General standards for discharge as prescribed under the Environment Protection Rules, 1986 and amendments (G.S.R 422 (E) dated 19.05.1993 and G.S.R 801 (E) dated 31.12.1993 issued under the provisions of E (P) Act 1986);
- Noise standards specified by the MoEFCC vide Gazette notification dated 14th February, 2000 (Noise Pollution (Regulation and control) Rules, 2000); and
- Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016.

3.4 Applicable Regulatory and/Policy Framework

The applicable regulatory framework consisting of national, state and local environmental, health and safety and social rules and regulations across the Project life cycle has been summarized in **Table 3.1**. The table also provides an applicability to these rules and regulations and how the Client will need to comply with these requirements during the establishment and operation of the solar plant. The table can be used as a comprehensive legal register for the Project, which will then need to be regularly monitored for compliance, as well as updated to reflect changes/amendments to the regulations, policies and standards across the Project life cycle.

Table 3.1 Applicability of Key Legislations in India and Reference Framework in the different phases of life cycle of Project

Applicable Indian Legislation/Guidelines	Pre-construction	Construction	Operations	Decommissioning	Agency Responsible	Remark/ Status
Environment Protection						
Environment Protection Act, 1986 and as amended	√	√	√	√	Maharashtra Pollution Control Board (MPCB); CPCB; MoEFCC	Permissible limits for ambient air quality, water quality, noise limits has been laid down by CPCB under EP Act, 1986, which requires to be complied with by the project.
The Water (Prevention and Control of Pollution) Act, 1974, as amended	X	√	√	√	MPCB	The Air and Water Acts and as subsequently amended had required that all projects obtain a consent from the State Pollution Control Board (SPCB) prior to starting construction and operation of a project. CPCB has exempted solar projects from the requirement to obtain a Consent to Establish (CTE) and Consent to Operate (CTO) from the State Pollution Control Boards in their revised directions released in March 07, 2016. The solar projects have been classified as “white category” industries and therefore are only required to intimate the SPCB about the start of construction and operations. The requirements of the acts including recording and reporting any accidents that may occur during construction and operation as well as permissibility for inspections would still be applicable to the project.
The Air (Prevention and Control of Pollution) Act 1981, as amended	X	√	√	√	MPCB	
The Noise (Regulation & Control) Rules, 2000 and as amended up to 2010	√	√	√	√	MPCB	As per the rules, ambient noise levels are to be maintained as stipulated in the rules for different categories of areas such as residential, commercial, industrial and silence zones. Considering the context of the Project, Radiance will need to abide by the

Applicable Indian Legislation/Guidelines	Pre-construction	Construction	Operations	Decommissioning	Agency Responsible	Remark/ Status
						limits prescribed for industrial zones. Due to presence of residential settlements and village, schools, medical centre etc. located within 1 km of the Project site. Construction and Operations of the solar project may affect the ambient noise environment in the area, especially during construction phase of project.
Ecology						
Forest Conservation Act 1980	X	X	X	X	State Forest Department	As informed by the site representatives of Radiance, there is no forest land present in the project area, hence not applicable.
Wild Life (Protection) Act, 1972	X	X	X	X	State Forest Department (Wildlife)	There are no protected areas within 10kms of the project radius. Hence, not applicable.
Waste Management						
Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016. as amended	X	√	√	√	MPCB	Generation of used/slop oil, discarded containers with oil residue, empty paint cans and waste transformer oil at site attracts the provisions of Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016. The hazardous wastes have to be disposed through approved recyclers only or discarded through an authorized transportation, storage and disposal facility (TSDF). The Hazardous and Other Wastes (Management and Transboundary Movement) Amendment Rules, 2019 was released on 1st March 2019 that exempts white category industries from obtaining a hazardous waste authorization. The requirement to obtain a hazardous waste authorization is therefore no longer applicable for the Project but the requirements for storage, transportation and disposal in the 2016 rules need to

Applicable Indian Legislation/Guidelines	Pre-construction	Construction	Operations	Decommissioning	Agency Responsible	Remark/ Status
						be complied. However, the maintenance of waste records indicated in the Hazardous and Other Wastes Rules, 2016 needs to be developed by the Project.
Construction and Demolition Waste Management Rules, 2016	X	√	√	√	MPCB	The storage, handling and disposal of construction and demolition waste would need to be followed during any construction and decommissioning activities that occur during the Project life cycle.
Biomedical Waste Management Rules, 2016	X	√	√	√	MPCB	The generation of small amounts of biomedical waste from the maintained first aid kits stored at site has been identified for the Project. The biomedical waste should be collected and disposed through authorized CPCB/MPCB vendors.
Batteries (Management and Handling) Rules, 2001	X	X	√	√	MPCB	The generation of small amount of used industrial-scale batteries from the operational PSS/SCADA room has been identified for the Project. The Project will need to establish a buyback policy with the distributor to collect used batteries.
Storage of hazardous chemicals						
Manufacture, storage and import of hazardous chemicals (MSIHC) Rules, 1989 and as amended	X	√	√	√	MPCB	Rules will be applicable during construction and operation stages if chemicals stored at site satisfy the criteria laid down in the Rules
Labour and Working Conditions						
Maharashtra Factories Rules 1969	X	√	√	X	Deputy Chief Inspector of Factories	
■ Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996; ■ Inter-state Migrant Workmen (Regulation of Employment and Condition of Service) Act, 1979; ■ Contract Labour Act, 1970;	X	√	√	√	State Department of Labour	

Applicable Indian Legislation/Guidelines	Pre-construction	Construction	Operations	Decommissioning	Agency Responsible	Remark/ Status
■ The Child Labour (Prohibition and Regulation) Act, 1986; ■ The Bonded Labour System (Abolition) Act 1976; ■ Minimum Wages Act, 1948; ■ Equal Remuneration Act 1976; ■ Workmen's Compensation Act, 1923; and ■ Maternity Benefit Act, 2016 ■ The Sexual Harassment of Women at Workplace (Prevention, Prohibition and Redressal) Act, 2013 ■ Private Security Agencies (Regulation) Act, 2005. Including all amendments to the above acts and regulations.						
Companies Act, 2013	X	X	√	X	Ministry of Corporate Affairs	
Applicable International Conventions						
Conventions on the Conservation of Migratory Species of wild animals and migratory species (CMS)	√	√	√	√	State Forest Department	The CMS identifies migratory bird species in its appendices that are accorded protection by signatories of the convention. As India is a signatory party, it would have to identify protection of the migratory species and dependent habitats.
Kyoto Protocol: 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.	√	√	√	√	Initial National Communication (NATCOM) to the United Nations Framework Convention on Climate Change	The Project being a solar power generation project becomes the basis for qualifying for Clean Development Mechanism.
Permission regarding abstraction of ground water						

Applicable Indian Legislation/Guidelines	Pre-construction	Construction	Operations	Decommissioning	Agency Responsible	Remark/ Status
Ground water may be extracted for fulfilling water demand of the project. Hence, ground water extraction permission will be required	X	√	√	√	Gram Panchayat/CGWA	Main source of water in the area is ground water. If the Project plans to install bore wells at Site and use ground water for construction and cleaning of solar module during operation phase, it needs to obtain NOC/ permission from village Gram Panchayat or Central Groundwater Authority. Please note that as per Central Groundwater Authority (CGWA), Ministry of Jal Shakti, Notification dated 24 September 2020[2], in Over-exploited assessment units, No Objection Certificate shall not be granted for ground water abstraction to any new industry except those falling in the category of Micro, Small and Medium Enterprises (MSME)

[2] Central Groundwater Authority (CGWA), Ministry of Jal Shakti ((Department Of Water Resources, River Development and Ganga Rejuvenation), Notification dated 24 September 2020. Link: http://jalshakti-dowr.gov.in/sites/default/files/CGWA_GWExtraction_Notification_24-09-2020.pdf

3.5 International Safeguard Requirements

3.5.1 IFC Performance Standards

IFC applies the Performance Standards (3) to manage social and environmental risks and impacts and to enhance development opportunities in its private sector financing in its member countries eligible for financing. The Performance Standards may also be applied by other financial institutions choosing to support them in the proposed project. 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.

Together, the Client is required to meet the stipulations of all the eight Performance Standards throughout the life of an investment in the case such an investment is being sought either form IFC or any other institution which follows IFC standards.

Table 3.2 IFC Performance Standards and their Applicability

IFC PS	Description	Objectives and Applicability to the Project
IFC PS 1	Assessment and Management of Environmental and Social Risks and Impacts	**Applicable** This PS aims to assesses the existing social and environmental management systems of Radiance and to identify the gaps with respect to their functioning, existence and implementation of an environmental and social management plan (ESMP), a defined EHS Policy, organization chart with defined roles and responsibilities, risk identification and management procedures as well as processes like stakeholder engagement and grievance management..
IFC PS 2	Labour and Working Conditions	**Applicable** This PS is guided by a number of international conventions and instruments on labour and workers' rights. It recognises that the pursuit of economic growth through employment creation and income generation should be accompanied by following themes: human resource policy and management, workers' organization, non-discrimination and equal opportunity, retrenchment, protecting the workforce and occupational health and safety. The project activities will involve hiring of skilled, semi-skilled and unskilled labourers during the construction phase and solar plant staff during the operation phase. The project will have to develop a human resource policy and ensure non-discrimination and equal opportunity, protection of the workforce and occupational health and safety. Therefore, PS 2 is applicable to the Project.
IFC PS 3	Resource Efficiency and Pollution Prevention	**Applicable** PS-3 covers the use resources and materials as inputs and wastes that could affect human health. The objective of PS-3 are: to avoid or minimize adverse impacts on human health and the environment by avoiding or minimizing pollution from

(3) http://www.ifc.org/ifcext/sustainability.nsf/Content/PerformanceStandards

IFC PS	Description	Objectives and Applicability to the Project
		project activities; to promote more sustainable use of resources, including energy and water, and to reduce project related GHG emissions. Key themes covered under PS-3 are: pollution prevention, resource conservation and energy efficiency, wastes, hazardous materials, emergency preparedness and response, greenhouse emissions, pesticide use and management. This PS will assess how Radiance intends to minimize pollution related impacts, what management plans and systems are in place, and what measures it plans to take to conserve and use resources more efficiently. The Project construction activities will lead to increased fugitive dust emissions, especially in the area it is being developed due site clearance and excavation related activities. The Project activities will also lead to increase in ambient noise level during the construction phase, which may impact the nearest villages. Furthermore, the Project activities will involve generation of waste and will involve abstraction of groundwater. Therefore, PS 3 is applicable to the Project.
IFC PS4	Community Health, Safety and Security	**Applicable** This PS-4 requires due diligence to anticipate and avoid adverse impacts on the health and safety of the affected community during the project life from both routine and non-routine circumstances. It also requires 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. Key areas of compliance screened under PS-4 includes: infrastructure/equipment safety, hazardous material safety, natural resource issues, exposure to disease, emergency preparedness and response, and security personnel requirements. The project would affect the health and safety of the communities adjacent to it during construction phase. Transportation of equipment and increased traffic in the area may lead to accidents and other threats on community health and safety, therefore PS 4 is applicable to the Project.
IFC PS 5	Land Acquisition and Involuntary Resettlement	**Not Applicable/Applicable** PS-5 requires project proponents to anticipate and avoid, or where avoidance is not possible, minimize adverse social and economic impacts from land acquisition or restrictions on land use. The key themes covered under this are: compensation and benefits for displaced persons, consultation and grievance mechanism, resettlement planning and implementation, physical displacement, economic displacement. The PS-5 also prescribes private sector responsibility to supplement government actions and

IFC PS	Description	Objectives and Applicability to the Project
		bridge the gap between governments assigned entitlements and procedures and the requirements of PS-5. The total land undertaken for the proposed 50 MW solar plant project is estimated to be approximately 180 acres private agricultural land. In the case of projects involving economic displacement only, the client will develop a Livelihood Restoration Plan to compensate affected persons and/or communities and offer other assistance that meet the objectives of this Performance Standard. The Livelihood Restoration Plan will establish the entitlements of affected persons and/or communities and will ensure that these are provided in a transparent, consistent, and equitable manner. The mitigation of economic displacement will be considered complete when affected persons or communities have received compensation and other assistance according to the requirements of the Livelihood Restoration Plan and this Performance Standard, and are deemed to have been provided with adequate opportunity to re-establish their livelihoods.
IFC PS 6	Biodiversity Conservation and Sustainable Management of Living Natural Resources	**Applicable** The requirements of this Performance Standard are applied to projects (i) located in modified, natural, and critical habitats; (ii) that potentially impact on or are dependent on ecosystem services over which the client has direct management control or significant influence; or (iii) that include the production of living natural resources (e.g., agriculture, animal husbandry, fisheries, forestry). PS-6 screens relevant threats to biodiversity and ecosystem services, especially focusing on habitat loss, degradation and fragmentation, invasive alien species, overexploitation, hydrological changes, nutrient loading, and pollution. The key themes covered under PS-6 are: natural habitat, critical habitat, legally protected areas, international introduction of alien species, and living natural resources (natural and plantation forest, aquatic resources etc.) are sustainably managed. Impact on habitats and species may result from vegetation clearance, construction of site and access roads. Impact to avifauna may also occur due to collision and electrocution with the transmission lines. Vegetation clearance has been carried out for the project site. 4 kms from the site migratory species have been observed at the three large waterbodies. The movement of these migratory species towards the smaller water bodies made in the adjoining fields cannot be completely ignored. Impact to avifauna may also occur due to collision and electrocution with the transmission line. With proper mitigations like putting bird diverters closer to waterbodies

IFC PS	Description	Objectives and Applicability to the Project
		will lower the risk of collisions. The transmission line is yet to be finalised and incase it passes between these large waterbodies –Pazar Talav, Mandala Laghu Talan and Devi Dahegaon Talav, collision risk may occur during peak migratory season. Therefore, IFC PS-6 is applicable to the Project.
IFC PS 7	Indigenous Peoples	**Not Applicable** This Performance Standard applies to communities or groups of Indigenous Peoples who maintain a collective attachment, i.e., whose identity as a group or community is linked, to distinct habitats or ancestral territories and the natural resources therein. PS-7 endeavor to ensure that the development process fosters full respect for the human rights, dignity, aspirations, culture, and natural resource-based livelihoods of Indigenous People. Key themes covered under PS-7 are: avoidance of adverse impacts, consultation and informed participation, impacts on traditional or customary land under use, relocation of IPs from traditional or customary lands, and cultural resources. Based on the information available in public domain it is understood that project land doesn't fall with the Schedule V area. Therefore, PS.7 is **Not Applicable** to the Project
IFC PS 8	Cultural Heritage	**Not Applicable** For the purposes of PS-8, cultural heritage refers to (i) tangible forms of cultural heritage; (ii) unique natural features or tangible objects that embody cultural values; and (iii) certain instances of intangible forms of culture that are proposed to be used for commercial purposes. The requirements of PS-8 apply to cultural heritage regardless of whether or not it has been legally protected or previously disturbed. As per the information available in public domain, no cultural heritage or archaeological sites was observed within 1km or beyond on the proposed project site. Therefore, PS 8 is **Not Applicable** to the Project

3.5.2 International Safeguard Requirements

International Finance Corporation (IFC) has formulated various international standards and guidelines standards w.r.t. ambient air quality, noise quality, waste, wastewater discharge and health & safety. They are as follows:

- IFC General EHS Guidelines, 2007;
- IFC EHS Guidelines for Power Transmission and Distribution, 2007;
- IFC/WB Air Emissions and Ambient Air Quality Standards;
- IFC/WB Guidelines for treated sanitary sewage discharges; and

IFC/WB Noise Standards.

4. SCREENING AND SCOPING

4.1 Screening Methodology

For the screening exercise, ERM undertook discussions with the Project team and a review of the documents available. The following sub sections provide an understanding of the methodology followed.

4.1.1 Project Kick-off

ERM team had a brief kick-off discussion with Radiance prior to site reconnaissance visit. The discussion was also held with regard to the expectations from this assessment in terms of scope of work, deliverables, timeline and the methodology to be followed for the same.

4.1.2 Document Review

Desk based review of the relevant documents/information pertaining to the Project and its surroundings, such Project site boundary, KMZ file for the Project site and tentative TL route was reviewed to have a clear understanding of the Project and its potential impacts. Further review of the secondary information available on the project areas, the administrative block, the district and the state was undertaken to substantiate the primary data.

4.2 Project Categorisation

4.2.1 IFC Project Category

IFC's Environmental and Social Review Procedure Manual[4] has provided a provisional categorization tool for projects. The tool assigns an E&S category based on risk inherent to the particular sector, as well as on the likelihood of a development taking place and on what can be reasonably ascertained about the environmental and social characterization of the Project's likely geographical setting. The categories are defined as follows:

- **Category A**: Projects with potential significant adverse environmental or social risks and/or impacts that is diverse, irreversible or unprecedented.
- **Category B**: Projects with potential limited adverse environmental or social risks and/or impacts that is few in number, generally site-specific, largely irreversible and readily addressed through mitigation measures.
- **Category C**: Projects with minimal or no adverse environmental or social risks and/or impacts.

The proposed Project has been categorized as falling under **Category B** as per the guidelines.

4.2.2 Category Justification

Selection of **Category B** is based on similar reasoning:

- Environmental and social impacts of the project are anticipated during the construction phase and will encompass changes in land-use, increased noise levels, changes in air quality, use and changes in water quality, impacts on terrestrial ecology, occupational health & safety, etc;
- Development of solar power projects is occurring in large numbers in the last decade and therefore several such projects are located across India. A solar power project can therefore not be considered an unprecedented activity;

4 Environmental and Social Review Procedures Manual: Environment, Social and Governance Department (2012): http://www.ifc.org/wps/wcm/connect/190d25804886582fb47ef66a6515bb18/ESRP%2BManual.pdf?MOD=AJPERES.

- Solar based energy development is a non-polluting source of energy and thus is not likely to lead to any adverse impacts on the baseline environment during the operation phase;
- Migratory species have been observed at the three large waterbodies - Pazar Talav, Mandala Laghu Talan and Devi Dahegaon Talav. The movement of these migratory species towards the smaller water bodies made in the adjoining fields cannot be completely ignored. Impact to avifauna may also occur due to collision and electrocution with the transmission line. With proper mitigations like putting bird diverters closer to waterbodies will lower the risk of collisions.
- There exists no structural obstacles around the site, such as tall buildings, that could lead to near shading.

4.3 Scoping Methodology

For this ESIA study, scoping has been undertaken to identify the potential Area of Influence for the project to identify potential interactions between the project and resources/receptors in the Area of Influence and the impacts that could result from these interactions, and to prioritize these impacts in terms of their likely significance. This stage is intended to ensure that the impact assessment focuses on issues that are most important decision-making and stakeholder interest.

The scoping exercise was undertaken on the basis of the information available on the project and the prior understanding of ERM of solar power projects. Potential impacts have been identified through a systematic process whereby the features and activities (both planned and unplanned) associated with the operation and maintenance and decommissioning phases of the project have been considered with respect to their potential to interact with resources/ receptors. Potential impacts have each been classified in one of three categories:

- **No interaction**: where the project is unlikely to interact with the resource/ receptor (e.g., wholly terrestrial projects may have no interaction with the marine environment);
- **Interaction likely, but not likely to be significant**: where there is likely to be an interaction, but the resultant impact is unlikely to change baseline conditions in an appreciable/detectable way; and
- **Significant interaction**: where there is likely to be an interaction, and the resultant impact has a reasonable potential to cause a significant effect on the resource/receptor.

As a tool for conducting scoping, the various project features and activities that could reasonably act as a source of impact were identified, and these have been listed down the vertical axis of a Potential Interactions Matrix. The resources/receptors relevant to the Baseline environment have been listed across the horizontal axis of the matrix.

Each resulting cell on the Potential Interactions Matrix thus represents a potential interaction between a project feature/activity and a resource/ receptor.

The solar power project will involve key activities during its life cycle which will include planning and pre-construction, construction, operation & maintenance and decommissioning phases as detailed in **Section 2** of this report.

4.3.1 Scoping Matrix

All environmental and social impacts and risks described in IFC's Performance Standards and E&S Guidelines have been considered for the interaction matrix. The Potential Interactions Matrix for Project activities and likely impacted resources/ receptors is presented in **Table 4.1**.

The interaction matrix has been colour coded to indicate those interactions that are relevant to the Project (coloured in black), possible (coloured in grey) or scoped-out (coloured in white). Those interactions that are white are 'scoped out' and this ESIA report includes a discussion that presents the evidence base (e.g., past experience, documented data, etc.) used to justify the basis upon which this decision was made.

Interactions that are likely to lead to significant impacts are presented in **Table 4.2** and will be the focus of the impact assessment. Owing to site conditions there are certain possible interactions that will not take place. As a result these interactions have been “scoped out” and are presented in **Table 4.3**.

Table 4.1 Activity-Impact Interaction Matrix for Planning, Construction, Operation & Maintenance and Decommissioning Phases

Project Activity/ Hazards \ Environmental and Social Resources/Receptors	Topography and Drainage	Land Environment	Land scape – Visual Impact	Soil Environment	Groundwater resources	Surface Water	Air Environment	Noise Environment	Terrestrial Ecology	Aquatic Ecology	Loss of land base livelihood	Employment Opportunity	Infrastructure and services	Occupational Health and safety	Community Health and safety
Pre-construction phase															
Land procurement		■									■				
Construction Phase															
Site clearance and site preparation	▒	▒	▒	▒	▒		▒	▒	▒			▒		▒	
Transportation of construction materials				▒			▒	▒						▒	▒
Mobilising and operating construction equipment, machinery and DG sets				▒			▒	▒						▒	
Transportation of solar modules and ancillary facilities							▒	▒						▒	▒
Foundation excavation, piling and construction for solar mounts, site office, Transformer	▒		▒	▒	▒		▒	▒	▒			▒		▒	▒
Electrical cable laying and installation of PV module			▒	▒				▒				▒		▒	
Set-up and use of camps for overnight accommodation by labourers			▒		▒		▒	▒				▒			
Operation and Maintenance Phase															
Washing of solar modules					■							▒		▒	
Grass cutting/vegetation clearance				▒			▒		▒			▒		▒	
Regular Inspection and Maintenance of equipment								▒						▒	▒
Decommissioning															
Removal of PV Module			▒					▒				▒		▒	
Removal of ground mounted structures, ancillary facilities		▒	▒	▒			▒	▒				▒		▒	

□ = Represents “no” interactions is reasonably expected.
▒ = Represents interactions reasonably possible but none of the outcome will lead to significant impacts and/or may lead to positive impacts.
■ = Represents interactions reasonably possible with one of the outcomes leading to potential significant impact.

Table 4.2 Identified interactions with potential significant impacts

S. No	Interaction (between project activity and Resource/Receptor)	Justification for Expectation of Potentially Significant Impacts
1.	Changes in Land Use	Agricultural land will be utilized for the Project and therefore there will be a change in land use from non-agriculture to land meant for industrial purposes.
2.	Alteration of Topography and drainage	Study area of the project site exhibits slight undulation with some natural drainage, as natural ponds are present in the vicinity of the project site. Project activities (e.g., site development, construction of access roads) may lead to alteration of the topography and drainage of this area.
3.	Impact on Soil / Land Environment	Vegetation clearance and construction can change the soil properties and negatively affect soil stability in the area. Vehicle movement can compact or erode soil further. Improper waste disposal can contaminate soil and groundwater.
4.	Impact on Air Quality	Operation of DG sets, vehicular movement and construction activities can cause fugitive and point source emission. The loss of vegetation cover because of site preparation can also contribute to a deterioration of air quality.
5.	Impact on Water Environment	Construction of the Project will require water from local sources, such as groundwater, to carry out its activities. Further, PV module cleaning will require large quantity of water. Therefore, there will be impact on surface/ground water resources. Surface and ground water quality can also be impacted due to improper waste disposal or leaks/spills and runoff.
6.	Increased Ambient Noise Levels	Operation of construction equipment, machinery, piling, DG sets, vehicular movement and maintenance activities would increase the ambient noise levels. Local communities may be disturbed due to higher than anticipated noise.
7.	Vegetation clearance, construction activities & Habitat loss and modification and wildlife access to project compound	There could be likely impact on habitats and species may result from vegetation clearance, construction of site and access roads during the construction phase of the project.
8.	Collision and Electrical Hazards and Transmission Infrastructure	There could be likely impact to avifauna may also occur due to collision and electrocution with the transmission lines during operation phase
9.	Occupational Health and Safety	Occupational health and safety hazards can include construction machinery, handling of electrical, noise pollution and dust pollution. In the case of spills/leaks there is a potential for fire hazards and some hazardous substances.
11.	Land Based Livelihoods	Land based livelihood may be hampered due to land purchase for the project
12.	Economy and Livelihood	Solar Power Plant will generate employment opportunity for local people mostly during construction phase as well as for module cleaning, grass cutting and security related works during operation phase.

S. No	Interaction (between project activity and Resource/Receptor)	Justification for Expectation of Potentially Significant Impacts
13.	Community Health and Safety	Community health and safety hazards can include noise pollution, increased traffic, dust pollution and any effects due to structural damage. In the case of spills/leaks, there is a potential for fire hazards and soil/water contamination. The health and safety of nearby community, especially of Dhakepal village and the residential settlements in the vicinity of the project site, may be adversely affected.

Table 4.3 Scoped-out Interactions

S. No.	Impact Title	Reason for Scoping-Out
1.	Impact on ambient air quality during operation phase	The power generation process will not have any air emissions. The site activities will mainly be scheduled maintenance work and cleaning of solar PV modules.
2.	Cultural Heritage	No structures bearing cultural, historical, religious or spiritual significance were observed upon reviewing information available in public domain, within the vicinity of the project or on the land identified of the project.
3.	Demography (Influx and Displacement)	EPC Contractor will bring migrant labour during construction phase for very limited time and most of unskilled and semi-skilled works will be given to local people. Displacement of local people is not envisaged for the proposed solar power plant.
4.	Indigenous People	Based on the assessment of information available in public domain it is understood that proposed project area doesn't fall under the Schedule V area[5].

[5] http://tribal.cg.gov.in/scheduled-areas

5. BASELINE SETTINGS – ENVIRONMENT, ECOLOGY AND SOCIAL

This section establishes the baseline environmental and socio economic status of the Project site and surrounding area to provide a context within which the impacts of the Project are to be assessed.

Establishing baseline helps in understanding the prevailing environmental and socio economic status of the study area. It provides the background environmental and social conditions for prediction of the future environmental characteristics of the area based on the operation of the new/ expansion activity of the Project during its life cycle. It also helps in environmental and social management planning and strategy to minimise any potential impact due to the Project activities on surrounding environment.

5.1 Project Study Area

The area of up to 5 km radius from the Project boundary (solar plant area) has been demarcated as study area for the Project by considering the extent of impacts in terms of noise, water resources, human settlement, cultural heritage sites, location of labour sites, location of the access roads besides considering the actual land area which is required for the project and its utilities footprints.

5.1.1 Project Footprint Area

The Project Footprint is the area that may reasonably be expected to be physically touched by Project activities, across all phases. Project Footprint for the Project includes land used for setting up the Solar PV's, transformer rooms, storage of materials, site office, access roads, and internal and external transmission lines.

5.1.2 Project Area of Influence

The effects of the Project and Project activities on a particular resource or receptor will have spatial (distance) and temporal (time) dimensions, the scale of which is dependent on a number of factors. These factors are incorporated in the definition of the Project's Area of Influence (AoI).

The AoI considered for the existing Project with respect to the environmental and social resources was based on the following reach of impacts:

- **Environmental parameters:** Project site boundary, immediate vicinity, access road and surroundings, i.e. a study area of approximately 1 km (hereafter referred to as the AoI) distance from project line has been used to depict these parameters;
  - Air Quality: Dust emissions, fugitive dust- typically up to 500 m from a construction area and 100 m from operations and maintenance area;
  - Noise: Noise impact area (defined as the area over which an increase in environmental noise levels due to the Project can be detected) –typically 500 m to 1 km from operations;
  - Land environment: The impacts on soil and land- typically up to 100 m from project foot print area;
- **Ecological Environment (Terrestrial and Aquatic):** This includes: (a) the direct footprint of the project comprising the solar plant; (b) the areas immediately adjacent to the project footprint within which a zone of ecological disturbance is created through increased dust, human presence and project related activities (e.g., trampling, transportation activities); and
- **Social and Cultural:** The AoI of the Project for social and cultural aspects is identified as the area within a 5 km radius from the Project footprint area and/or area identified beyond Project footprint area that may be directly impacted by Project activities.

5.1.3 Core and Buffer Zones

This AoI is in turn, divided into a core and buffer zone. This division of the AoI into two zones is based on the understanding that the majority of the impacts from the Project (during the project lifecycle) would be contained within a 2 km radius (core zone) from the Project Footprint in terms of spread and intensity, with the buffer zone (5 km radius) appearing to have limited interaction with the Project.

The Buffer Zone is the area which does not have direct impact on land or environment, however it is demarcated in case the impact on core zone are sometimes/often extended to near-by areas. Usually the impact on buffer zone are more inclined towards, noise, air and water pollution. In cases it also has impact over labour, land ownership, migration and accessibility to any natural resources.

5.2 Environment Baseline

5.2.1 Land use and Land cover

Land use/cover inventories are an essential component in land resource evaluation and environmental studies due to the changing nature of land use patterns in the AoI. Based on the discussion with site representatives, observations made during ERM site visit and observations from satellite images, it was understood that the current land use of the Project site is recognized as “agricultural land”.

The predominant land use/cover of the study area within 5 km radius includes agricultural land followed by open scrub land, residential settlement, roads and natural water bodies. The study area consists of settlements as well which include the village Machindranath Chincholi, Ghinsi, Masegaon, Pirgaibwadi, Ghansawangi, and Dhakepal.

5.2.2 Topography

The 5 km study area consists of largely flat land The topography of the study area indicates presence of drainage channels, which are active during monsoon season and lead to formation of seasonal waterbodies.

5.2.3 Geology and Hydrogeology

The proposed Project sites lies in Jalna Taluk of Jalna District of Maharashtra. The geology and hydrology of the area is provided at a district-level based on secondary data in the subsequent sections.

5.2.3.1 Geology of Jalna District[6]

The entire district of Jalna is occupied by basaltic lava flows of the Deccan traps of Upper Cretaceous to Lower Eocene age. However, Alluvium, belonging to the Quaternary period occurs along the major rivers in the district and consists of Clay, Silt, Sand, Gravel, Kanker etc. In Basalt, the individual flow thickness ranges between 20 to 30 m and has two distinct units. The upper part is vesicular in nature and vesicles are filled with secondary minerals like zeolite and quartz (e.g. Moss Agate, Zebra Agate and Green Agate). The lower part of the lava flow forms the massive basalt. The alluvial deposits along the major rivers Godavari, Purna, Dudhna etc., overlie the Deccan traps. The alluvium consists of clay, silt and sand. The thickness ranges between 10 to 20 m. The alluvium forms a very fertile land.

[6] Source: http://cgwb.gov.in/AQM/NAQUIM_REPORT/Maharshtra/jalna.pdf

5.2.3.2 Hydrogeology

Groundwater occurrence and movement in the area is influenced by its rock formations. Groundwater potentially depends upon porosity and permeability (both primary and secondary) of rock formations.

Jalna district is underlain by basaltic lava flows and alluvium only. The regional Static water level in the area varies from 20 to 25 mbgl. Ground water extraction in the area is done mainly through dug wells and bore wells. The average depth range of dug wells in the area is from 15.00 to 30.00 m. The average depth range of bore wells in the area is from 60.00 to 80.00 m[7].

Deccan Trap Basalt

The basaltic lava flows belonging to the Deccan Traps occupy about 98% of the area of the district. The formation is very thick and comprises scores of lava flows of 5 to 25 meters individual thickness. Each flow comprises a lower zone of 40 to 70% hard, massive basalt which is devoid of primary porosity and permeability. The upper zone of 30 to 60% is vesicular basalt which has limited primary porosity. However, the formation generally has secondary porosity and permeability acquired due to weathering, jointing, shearing, fracturing etc. When the thickness of these zones are appreciable (30 to 60% of a flow), the flow forms an aquifer of moderate potential. The structural and composite characteristics described above are repeated in all the lava flows of an area and they thus form a multiple aquifer system which generally extends to depths of 150 to 250 meters.

Apart from the inherent properties of lava flows cited above, topography also plays an important role in groundwater potential of basaltic area. Hills and higher grounds stood out as their rocks are hard, compact and resistant to weathering. The steep gradient causes rain water to run off rapidly without much infiltration. In contrast, the valleys depressions and areas of lower elevations are formed where rocks were weaker, prone to weathering due to joints, fractures etc. In addition, rain water runoff is less and infiltration is more in such areas.

Groundwater in Deccan traps occur under water table condition in weathered, jointed, fractured and vesicular zones of the flow exposed at the surface. Groundwater occurs under confined conditions in Jointed, brecciated or fractured and vesicular zones of lower flows. The vesicular and zeolitic basalts are highly susceptible to weathering as interconnected vesicles form conduits from weatherin a ents. It is enerally seen that “Pahoehoe” flows contains uniformly distributed vesicles and have good porosity and permeability and constitute potentials aquifersGroundwater Flow Direction.

Alluvium

It occurs as small patches along banks, flood plains and meanders of main rivers. These have individual extent from 1 to 20 Km2 and 5 to 30m thickness. It comprises beds and lenses of sands, gravels and boulders in a matrix of clays. These granular zones form aquifers in which groundwater occurs under Phreatic and semi confined conditions. The porosity of these granular zones ranges from 10 to 15 %.

Groundwater Status

The groundwater resources are typically assessed by CGWB and categorized for groundwater development based on two (2) criteria:

- Stage of groundwater development; and
- Long-term trend of pre- and post-monsoon water levels.

The long-term groundwater level trends are computed generally for a period of ten (10) years. Based on the above, groundwater resource units are typically divided into ‘Notified’ and ‘Non-notified’ areas. The Non-notified areas are further divided into the following categories:

[7] http://cgwb.gov.in/District_Profile/Maharashtra/Jalna.pdf

- 'Safe' areas which have ground water potential for development;
- 'Semi-critical' areas where cautious groundwater development is recommended;
- 'Critical' areas and 'Over-exploited' areas, where there should be intensive monitoring, evaluation, and future ground development will be linked with water conservation measures.

The details of criteria for categorization of assessment units are provided below:

S. No.	Stage of Groundwater Development	Significant Long-term Decline		Categorization
		Pre-monsoon	Post-monsoon	
1.	<= 70%	No	No	Safe (S)
2.	>70% and <=90%	No	No	Safe
		Yes/No	No/Yes	Semi-critical (SC)
3.	>90% and <=100%	Yes/No	No/ Yes	Semi-critical
		Yes	Yes	Critical (C)
4.	>100%	Yes/No	No/Yes	Over-Exploited(OE)
		Yes	Yes	Over-Exploited

Source: CGWB ground water brochures

As per ground water information published for 2009[8] and 2013[9] the statistics and categorization is given below. The latest published data indicates that Ghanaswangi taluka falls under Safe Category. Hence there is further potential for ground water development.

Table 5.1 Ghanaswangi ground water resources

Block	Total Annual GW Availability		Groundwater Draft (HAM)		Stage of Development (%)		Categorization	
	2009	2013	2009	2013	2009	2013	2009	2013
Ghanaswangi	13165.78	11948.42	6961.45	6534.55	53.58	54.69	Safe	Safe

Source: CGWB Jalna district ground water brochure and NAQUIM Report

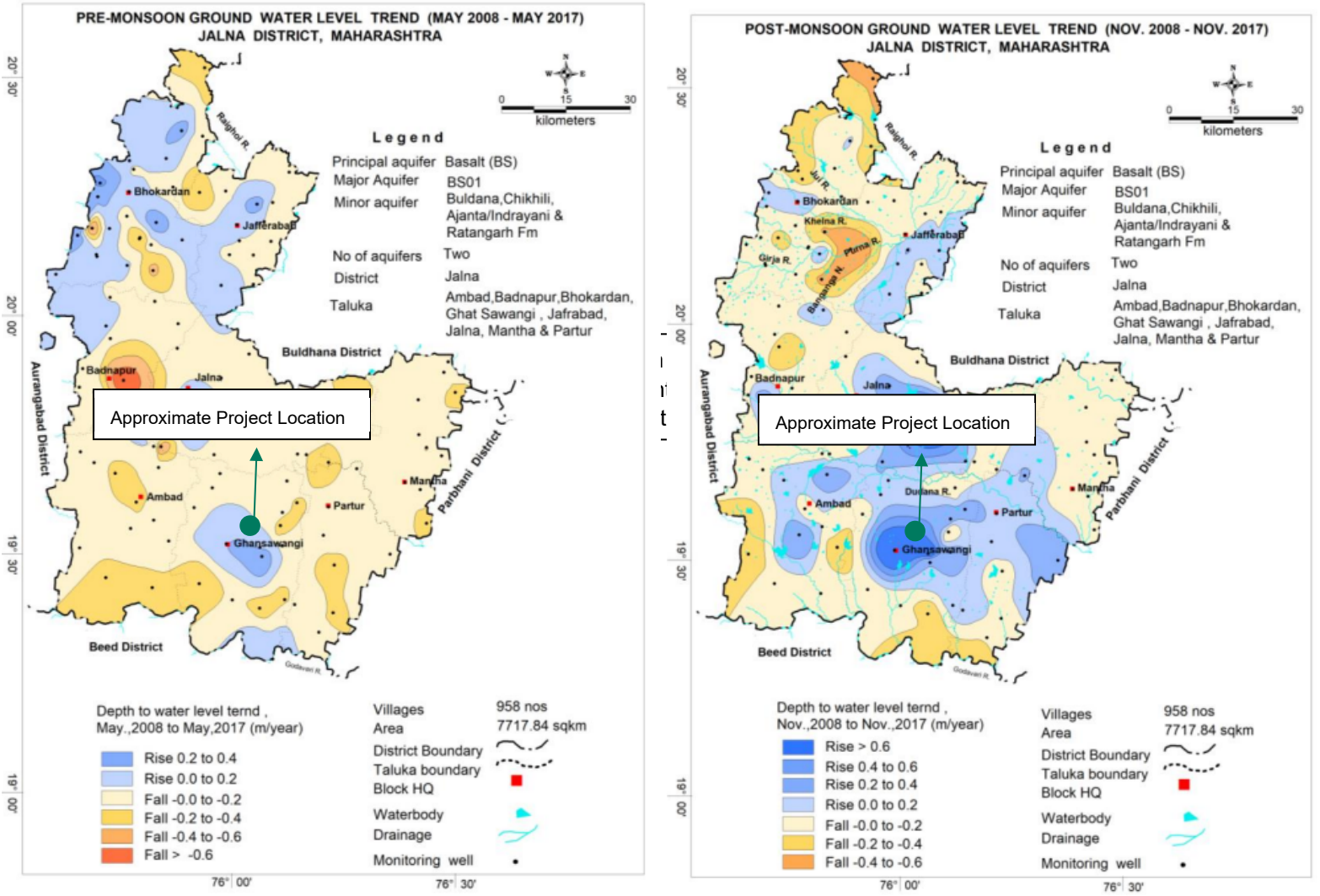
Groundwater Levels

Central Ground Water Board periodically monitors National Hydrograph Network Stations (NHNS) stations in the Jalna district, four times a year i.e. in January, May (premonsoon), August and November (postmonsoon). The data on pre-monsoon and post-monsoon water levels and decadal fluctuations for Jalna district has been presented in **Figure 5.1**.

[8] CGWB 2013: http://cgwb.gov.in/District_Profile/Maharashtra/Jalna.pdf

[9] http://cgwb.gov.in/AQM/NAQUIM_REPORT/Maharshtra/jalna.pdf

Figure 5.1 Decadal mean ground water fluctuation (2008- 2017)



Source: Aquifer Maps and Ground Water Management Plan, Maharashtra

Groundwater Quality

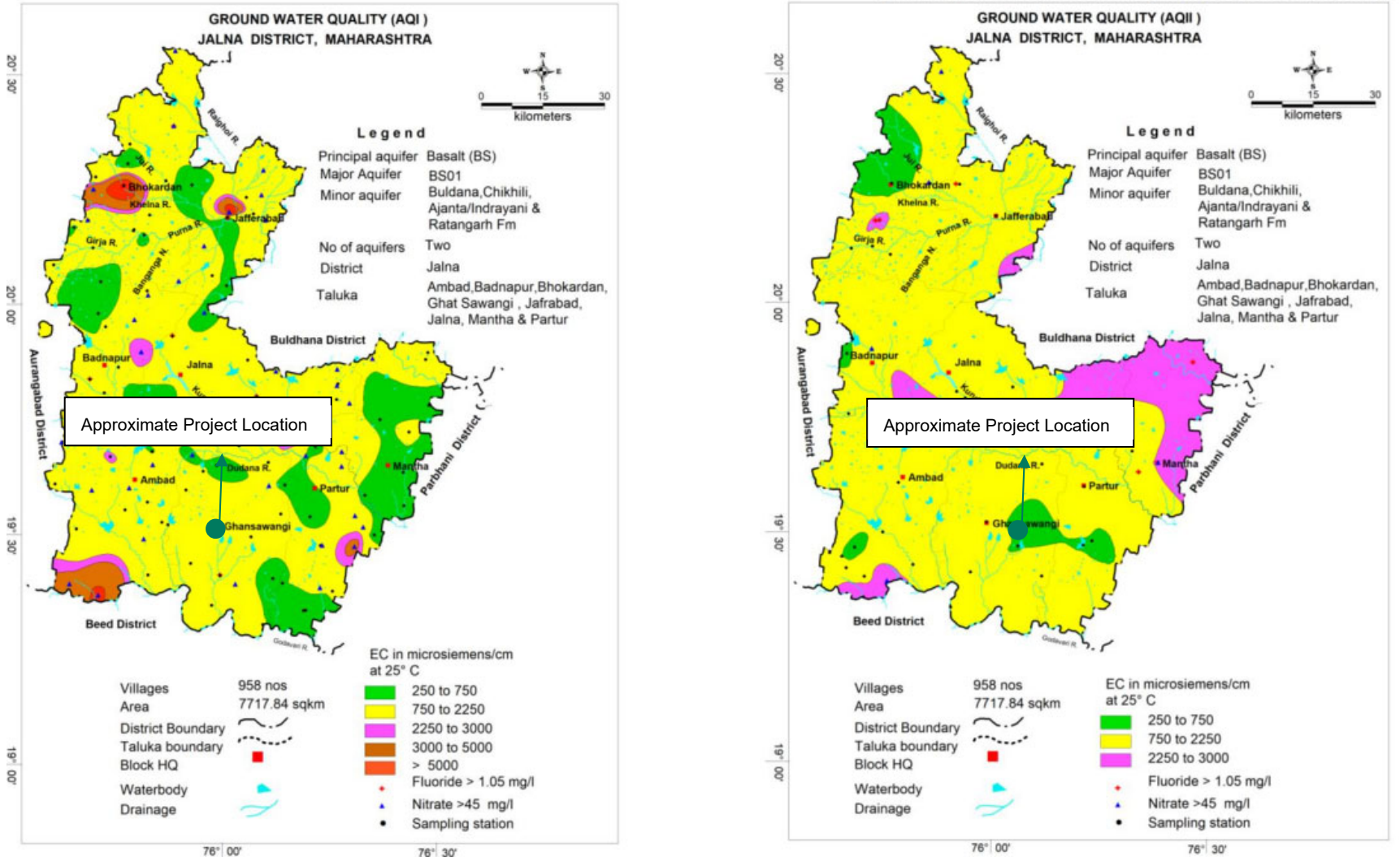
As per the review of CGWB NAQUIM Report, the ground water in the district has Ca, Mg & TDS beyond the maximum permissible limit while most of the parameters as within Maximum permissible limits. The water from such area is not fit for drinking purpose if directly consumed without treatment. For rest of the area ground water quality is good and fit for drinking purpose except few locations.

Electrical Conductivity was present in range of 3000 to 6866 µS/cm. It has been observed in 1184 sq km area and covering 446.12 sq km area in major parts of Ambad, Bhokardan and Jafrabad blocks and small parts of Partur, Jalna & Badnapur blocks.

Nitrogen in the form of dissolved nitrate nutrient for vegetation, and the element is essential to all life. The major contribution in ground water is from sewage, waste disposal, nitrate fertilizer and decaying of organic matter. As per BIS (2012) the desirable limit is 45 mg/l. For shallow aquifer, nitrate concentration varies between 0.59 to 1482 mg/l. The high concentration of Nitrate may be due to domestic waste and sewage in the urban and rural parts of district. In deeper aquifer, nitrate concentration varies between BDL to 109 mg/l. The deeper aquifer are also affected by nitrate contamination, it may be due to percolation of nitrate contaminants from the ground surface as there are no other reasons for nitrate contamination in deeper aquifers.

In shallow aquifer, concentration of fluoride ranges from 0.1 to 2.0 mg/l. The highest concentration of fluoride is found in Pimpargaon Khed BK village, Ghansawangi block (2 mg/l). In deeper Aquifer, concentration of fluoride ranges from 0.1 to 12.24 mg/l. The highest concentration of fluoride is found in Mahora (12.24 mg/l), it may due to the lithological reason only. Ground water quality has been presented in Figure 5.2.

Figure 5.2 Groundwater Quality Map



Source: NAQUIM Report, CGWB

5.2.4 Surface Water and Drainage Pattern

5.2.4.1 Regional Drainage

Drainage of the district is controlled by Godavati river. Godavari forms southern boundary of the district flowing neary 60 km from Ambad and Ghansawangi blocks. Dudhana, Galhati are the tributaries draining the central part while Khelna, Girja tributaries draining the northern part of the district. Purna river controls the drain in northern part of the district covering Bhokardhan and Mantha taluka. Kundalika river, a tributary of Dudhana, runs from Jalna city. A very small part of the area located in North Eastern part of Bhokardhan taluka falls under the Tapi basin. The general slope of the area is towards Southeast. The drainage pattern in the area is sub-dendritic to dendritic. Depending on the drainage and geomorphology, this blocks has been divided into 52 watersheds.

5.2.4.2 Study Area Drainage

The Project study area consists of micro-drainage channels that especially become active during the monsoon season. These micro-drainages feed into small waterbodies within the study area, these small waterbodies are seasonal in nature. There are no major waterbodies present within the study area.

Per the google earth imagery, a canal from Nath Sagar dam is flowing at an aerial distance of ~9 kms from proposed project site in south direction. There are number of artificial ponds and small irrigation channels present within the study area.

5.2.5 Climate

The district has dry and tropical climate with very hot summer and mild winter with humid SW monsoon season of moderate rainfall. The climate can be divided into three main seasons viz; a) Hot to warm humid monsoon season from June to September; b) Cool dry winter season from October to February and c) Hot dry summer season from March to June.

Temperature during rainy season ranges from 21 to 30 C. In winter season, temperature fall appreciably and range from 10 to 25 C. In nights temperature range is 20 to 25 C with privilege of cool breeze. The air is generally high over the district except during the southwest monsoon when the relative humidity is high. The summer months are the driest when the relative humidity is generally between 20 and 25 percent in the afternoon.

Winds are generally light to moderate with increase in speed during the latter half of the hot season and in monsoon season. The winds blow predominantly from directions between west and north during the hot season. They are mostly from directions between southwest and northwest during the southwest monsoon season.

5.2.6 Natural Hazards

Classification of Project study area with respect to natural hazards is provided in **Table 5.2**. Hazard zonation maps of the state for earthquake, cyclone, and landslide are presented in **Appendix B** of this report.

Table 5.2 Natural Hazards Details

Characteristics	Details
Earthquake	As per the data released by the Building Materials & Technology Promotion Council (BMTPC) of Government of India, the Project is located in an area that is designated as Zone II that corresponds to MSK VI or less. This zone is a low damage risk zone.

Characteristics	Details
Cyclone/Wind	As per the data released by the Building Materials & Technology Promotion Council (BMTPC) of Government of India, the Project site is located in an area that experiences moderate wind velocities and therefore is an area of moderare damage risk zone (V_b= 39 m/s). Furthermore, the Project site is located in an area not prone to occurrence of a cyclone.
Land Slide	As per the data released by the Building Materials & Technology Promotion Council (BMTPC) of Government of India, the Project site is located in an area not liable to landslide.
Flood	As per the data released by the prepared by Building Materials & Technology Promotion Council (BMTPC) of Government of India, the Project site falls in an area not liable to floods.

Source: BMTPC Vulnerability Atlas (3rd Edition)

5.3 Socio-Economic Baseline

This section provides an understanding of the administrative set up of the district, the demographic profile of the villages in the Project AoI, the social groups present, the land use patterns in the area, the livelihood profile of the community and the social and physical infrastructure available. The social and physical infrastructure includes education and health infrastructure, the water supply for irrigation and drinking purposes, sanitation facilities and connectivity. The purpose of this section is to allow for an increased understanding of the key issues identified as well as identify areas of intervention in future scenarios.

5.3.1 State Profile

Maharashtra occupies the western and central part of the country and has a long coastline stretching 720 kilometres along the Arabian Sea. It is bordered by the Arabian Sea to the west, the Indian states of Karnataka and Goa to the south, Telangana to the southeast and Chhattisgarh to the east, Gujarat and Madhya Pradesh to the north, and the Indian union territory of Dadra and Nagar Haveli and Daman and Diu to the northwest. Maharashtra is the third largest state by area in India. Maharashtra is divided into five geographic regions. The state is divided into 6 divisions and 36 districts, with the state capital being Mumbai, also the most populous urban area in India and Nagpur serving as the winter capital. The state administers 307,713 km^2 of area which is 9.36% of the total geographical area of the country and its accounts for 9.28% population of India, according to the provisional data of Census 2011.

The state comprises of a population of 112,374,333 individuals. The decadal population growth has reduced to 6.74% in 2001-11. The sex ratio in the state is 929, which has increased from 922 in the past decade; however, it is still lower than the sex ratio of India, being 929 females per 1000 males. The population density of India is 382 persons/sq. km. while that of Maharashtra is 365 persons/sq. km., which is considerably lower for a state with third largest geographical area in the country. The working population of Maharashtra is 40.4 percentage.

5.3.1.1 Demographic Profile

Table 5.3 Demographic profile of Maharshtra

Attribute	Number
Area (sq. km)	307,713
Total population	112,374,333
Males	58,243,056
Females	54,131,277
Sex ratio	929
Percentage of rural Population	54.78
Percentage of urban population	45.22
Population density	370
Percentage of SC population	11.81
Percentage of ST population	9.35
Total literacy rate	82.34
Male Literacy rate	88.38
Female Literacy Rate	69.87
Rural Literacy	77.01

Source: Census of India, 2011

5.3.2 District Profile -

Jalna pronunciation (help·info) is a city in Jalna district in the Aurangabad Division, or Marathwada region, of the Indian state of Maharashtra. It was part of Hyderabad State as a tehsil of Aurangabad district, before Jalna district was formed effective 1 May 1981. As of 2011 census, Jalna had a population of 285,577. The total population constitute, 147,029 males and 138,485 females —a sex ratio of 942 females per 1000 males. 38,834 children are in the age group of 0–6 years, of which 20,338 are boys and 18,496 are girls. The average literacy rate stands at 81.80% with 201,829 literates.

Table 5.4 Demographic profile of Jalna

Attribute	Maharashtra	Jalna
Population	112,374,333	19,58,483
Population Density	370sq/km	206sq/km
% of SC population	11.81	13.9
% of ST population	9.35	2,16
Sex Ratio	929	937
% total literacy rate	82.34	71.52
% female literacy rate	69.87	76.2
% rural population	48.76	

Source: Census of India, 2011

5.3.3 Study Area

According to census data 2011, the total number of households in the study area is 2271, with a total population of 10661. Furthermore, the nearest village settlements in the study area are Dhakephal Village and Pirgaibwadi Village, both of which are within a 2 Km radius of the study area, Per Google satellite imagery, it is observed that within 5 km radius of proposed project site, there are six villages namely Dhakepal village (towards North), Pirgaibwadi and Devnagar villages (towards West), Dahalegaon(toward East) and Machindranath Chincholi and Ghonsi Kh. villages (towards South).

5.3.3.1 Demographic Profile

This section provides a demographic overview of the study area to provide an understanding of the socio-economic and cultural context within which the project is located

Table 5.5 Demographic profile of the study area villages

Village	Households	Population	Sex Ratio	SC (%)	ST (%)	Literacy Profile (%)	Female Literacy Profile (%)
Dahkephal	507	2368	929	19.34	12,03	67.67	55.66
Pirgaibwadi	147	611	1057	41.4	0	92.91	90.56
Dahalegaon	437	2038	928	14.08	1,37	54.17	53.19
Machindranath Chincholi	230	4322	928		1.08	66.03	53.11
Ghonsi Kh	218	1036	849	6.8	1.2	64.57	37.26
Study Area Total	**1539**	**10375**	**938.2**	**20.4**	3.57	**69.07**	**57.95**

Source: Census of India, 2011

5.3.3.2 Social Stratification

The study area has a total population of 10375 and total household is 1539 and through the table it has been observed that the ST population is 3.57% which is comparatively very low than the SC Population 20.4% of the study area. It can be observed from table that average sex ratio in the study area is 938 per 1000 males which is similar as the sex ratio in Jalna having 937 females per 1000 males.

5.3.3.3 Education Profile

The literacy rate in the study area is 69.07% which is lower than the literacy rate of 71.52% at the district level. From the above mentioned table, it could also be understood that the literacy among female is very poor; having a female literacy rate of only 57.95.

Farm Base Livelihood

The farm based activities comprise of cultivators, agricultural labour and livestock rearing. The primary crops grown in the region comprise of rice, jowar, bajra, wheat and pulses. During the initial consultation it was understood that the villagers do their own farming and the women help them out. During peak season, nearby villagers might work in the field as marginal farmers. Through consultation with the local community it has been understood the crops are mainly grown for self-consumption as well are sold.

Livestock based livelihood

In addition to agriculture, livestock holding plays an important role in the livelihood of the community in terms of providing extra income in addition to meeting the nutritional intake of the household; nearly all of the total households in the study area rear livestock. The main livestock holdings in the area comprises of cows, buffaloes and goats. During the consultation it has been understood that the milk of cow and buffalo is used for self as well as for the commercial purpose. The cow milk and buffalo milk is sold in the nearby villages and it is one their primary sources of income.

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Non-Farm based livelihood

Though agriculture and allied activities form an important source of livelihood, with engaged in farm based livelihood; it is not entirely sufficient for sustenance of livelihoods in the study area. In particular, across a diverse base of social groups and communities, the land holding pattern and livelihood dependence patterns also vary.

During the initial consultation with local communities in villages it was informed that few youths from the villages work as construction labourers in Mumbai and other big cities and nearby areas at the wage of INR 400-500/ day. This engagement of work depends on the availability of work and usually carries out in non-agricultural seasons. As per information, no households in the study area have migrated recently and there is a very low/ minimal trend of migration

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5.3.3.4 Social and Physical Infrastructure

Drinking Water and Sanitation

Through consultation with local community it has been understood that for drinking purpose the facilities of tap water and hand-pump and well is available in the study area.

Electricity

Electricity is available in the study area as understood from the consultation in all the households.

Health Facilities and Health Seeking Behaviour

As per the review of census data, 2011, there are health infrastructures such as primary health centres, primary health sub-centres etc. in the study area; the same was confirmed during community consultations. The village community from the study area usually go to Boisar for any serious illness or hospitalisation while for minor illness they depend on home remedies/ their *primitive Ayurveda medicines made of herbs* and village level quacks. There are Anganwadi centres/ Nutritional centres in every village of the study area which has 1 ASHA worker for each village.

5.4 Ecology Baseline

An ecological survey was undertaken at the project site on 26th & 27th February 2022. The purpose of the survey was to establish an ecological baseline of the study area, which helps to understand the impacts of the project on species and habitats in the surrounding areas and finally in the management strategy and mitigation. Along with baseline ecological survey consultations were carried out with locals to understand the habitat through year, cropping patterns and the faunal movements observed in the area.

The ecological surveys were conducted with the following objectives:

5.4.1 Objective

The ecological surveys were undertaken with the following objectives:

5.4.1.1 Flora

- Identification of sensitive habitats, and forest land falling within the determined study areas (core + buffer zone);
- Classification of flora for any threatened, protected or endemic floral species prevailing in the study areas (including wind farm) based on field surveys; and
- Identification of areas protected under international conventions, national or local legislation and those recognized nationally and internationally for their ecological, landscape, cultural or other related value.

5.4.1.2 Fauna

- Identification of fauna (specifically amphibians, birds, mammals and reptiles) based on direct sightings, calls, pug marks, droppings, nests, etc.;
- Identification and classification of any species recognized as threatened (in accordance with the IUCN Red List v 2021-2 and according to the schedules of the Indian Wildlife (Protection) Act 1972 and amendments; and
- Identification of areas which are important or sensitive for ecological reasons including their breeding, nesting, foraging, resting, over wintering areas including wildlife migratory corridors /avian migratory routes;

5.4.2 Approach and Methodology

5.4.2.1 Determining study area

To conduct the survey, a core and buffer zone was delineated, so that ecological receptors and impacts on them can be established during the ESIA process. The core and buffer zone is as follows:

- Core Zone: as the proposed boundary of Solar project; and
- Buffer Zone: 5 km radius from the proposed Solar project boundary.

The above core and buffer zones were established based on sensitivities identified during desktop review and experience gathered from multiple wind farm ecological assessments carried out by ERM in the last few years.

5.4.3 Baseline ecological survey

A baseline survey was carried out to determine the existing ecological conditions and to facilitate an adequate assessment of the project's impacts upon ecology and development of appropriate mitigation measures. The baseline survey has two parts: (i) Secondary data collection and (ii) Primary data collection.

5.4.3.1 Secondary data collection

The secondary baseline data for the ESIA has been compiled through the following data sources:

Sr. No.	Source	Purpose	Version	Link
1	WII Envis Centre	To identify list of National Parks [NP], Wildlife Sanctuaries [WLS], Conservation Reserves, Biosphere Reserves and Community Reserves in the District/State	-	http://wiienvis.nic.in/
2	Important Bird and Biodiversity Areas (IBAs)	To identify locations and purpose of various IBAs across the country.	-	http://datazone.birdlife.org/home
3	IUCN Red List	To determine the IUCN Red List (threatened) status of various flora and fauna, research more details about the behavior, location and habitat of the species and for spatial distribution maps of the species based on the latest available research information.	2021-2	https://www.iucnredlist.org/

Sr. No.	Source	Purpose	Version	Link
4	Ebird.org India	To obtain distribution of key avifaunal species based on confirmed sightings of the species provided in the form of spatial grids across India on the ebird.org database. The database also provides seasonality of species recording to ascertain presence of certain migratory and congregatory bird species in the surrounding region.	-	https://ebird.org/india/home
5	Consultations with local community and ERM's previous experience of working in this landscape	To confirm the presence of key faunal species in the landscape	-	-

5.4.3.2 Primary data collection and survey

Habitat survey

Different habitats identified by the desktop review were visited. Data regarding the type and quality of habitat with reference to flora and fauna supported were collected.

Floral Survey

The floral diversity of the study area was recorded by visual observation during the site visit and identified using published manuals. The information (Scientific publications) dealing with the floristic diversity of the related area available in the public domain were also considered in the survey.

Faunal Survey

Faunal species from the study area were recorded based on direct sightings, indirect evidences such as dung, droppings, scats, pugmarks, scratch signs, burrows, nests etc. Consultations with local communities were carried out by displaying pictorial representations of species anticipated in the area to confirm whether there have been any recent sightings. The pictorial representation of the species was typically obtained from the authentic sources[10, 11]. The species occurring within the study area were surveyed using the below methods:

Amphibians

Amphibians are often restricted to natural and constructed ponds during the hottest parts of the day[12]. All such water bodies were visited during the hottest parts of the day to determine the presence of amphibians along the shaded ledges of the water body.

[10] Grewal, B., Sen, S., Singh, S., Devasar, N. & Bhatia G. (2016) A pictoril Field Guide to Birds of India, Pakistan, Nepal, Bhutan, Sri Lanka and Bangladesh. Om Books International, Noida, Uttar Pradesh, India.

[11] Menon, V., (2014), Indian Mammals: A Field Guide. Hachette, India

[12] Knutson et. al. 2004. Agricultural ponds support amphibian populations. Ecological Applications. 14 (3): 669-684

Reptiles

Reptile presence were determined through the use of Intensive Time Constrained Search Methods[13] [14]. The method is adapted for the terrain by targeting rocks and logs located around water bodies or recently dried streams, hedges and along the trunks of higher vegetation.

Avifauna

An adapted avifaunal survey method for onshore wind farm assessments was utilized for the purpose of this study[15]. The adapted survey method focuses on key habitat features, preferred time of day to ensure maximum bird activity. The birds were surveyed around ponds during the coolest parts of the day (morning and evening); along motorable roads and in high-density vegetation areas during the hottest parts of the day. Binoculars and standard field guides[16, 17] were used for avifaunal identification.

Water body survey: As part of primary survey, major water bodies in a radius of 5 km of the solar project were identified and visited during the site reconnaissance. The water bodies were visited to determine presence of water and identify activity of the water birds.

Mammals

Mammal surveys were conducted along motorable roads, near water bodies, agricultural lands and in Open scrubs. Individuals will be identified through direct (visual sighting) and indirect (pellets, tracks, paw marks and scat) methods. Species were then identified using standard literature[18, 19].

5.4.4 Results of Baseline Survey

5.4.4.1 Habitat Assessment

As part of the site visit, a site reconnaissance of the Project site and 5 km study area was undertaken to determine the types of habitat that are found.

Photo-documentation of different habitats has been presented in ***Figure 5.3.***

[13] Welsh, H.H., jr. 1987. Monitoring herpetofauna in woodlands of north western California and south west Oregon: a comparative strategy. Pp. 203-213. In. Multiple – Use Management of Califirnia's hardwood resources. T.R. Plumb, N.H. Pillisbury (eds. Gen. Tech. Regional Environmental Planning. PSW – 100) US Department of Agriculture, Forest Service

[14] Welsh, H.H. Jr. and Lind, A. 1991. The structure of the herpetofaunal assemblage in the Douglas-fir/hardwood forests of northwestern California and south western Oregon. Pp: 395-411. In: Wildlife and vegetation of unmanaged Douglas-fir forests. (Tech. Coords). L.F. Ruggiero, K.B. Aubry, A.B. Carey and M.H. Huff. Ge. Tech. Rep. PNW-GTR-285. Portland, OR: US. Department of Agriculture, Forest Service.

[15] Scottish Natural Heritage (SNH). 2014. Recommended bird survey methods to inform impact assessment of onshore wind farms.

[16] Grewal, B., Sen, S., Singh, S., Devasar, N. & Bhatia G. (2016) A pictoril Field Guide to Birds of India, Pakistan, Nepal, Bhutan, Sri Lanka and Bangladesh. Om Books International, Noida, Uttar Pradesh, India.

[17] Grimmet, R. Inskipp, C. and Inskipp, T. (2013). Birds of the Indian Subcontinent - Second Edition. Published by Christopher Helm, 49-51 Bedford Square, London

[18] Prater, S.H. 2005. The Book of Indian Animals. Bombay Natural History Society and Oxford University Press - 12th Edition. pp 316

[19] Menon, V. 2003. A field guide to Indian Mammals. Dorling Kindersley (India) Ltd. New Delhi

Figure 5.3 Photo-documentation of habitats in the Study area

Agricultural fields in the adjoining land parcels of the project site – sugarcane field.

Fruit orchards in the adjoining land parcels of the project site – pomegranate saplings

Devi Dahegaon Talav

Mandala Laghu Talan

Pazar Talav

Agricultural Profile

The site visit for the project area was conducted in March which is the onset of summer season. The vegetation in the vicinity of the project area comprises of fruiting trees like Mango, Guava, Coconut along with Neem (Azadirachta Indica) , Gulmohar (Delonix regia) and Rain Tree (Samanea saman). These have been planted by the locals on the boundaries of their agricultural fields. During the site visit it was observed that the project site was devoid of any vegetation as the construction for the site had been started. As per the discussion with the locals the project site comprised majorly of agricultural land. There is one single Neem (Azadirachta Indica) tree on site which will be retained as per the discussion with the site team. In the neighbouring land parcels wheat, fruit orchards, sugarcane, cotton and castor is being cultivated.

Water body

Three relatively large waterbodies are located at about 3 to 4 kms south of the project area- Pazar Talav, Devi Dahegaon Talav (Dam) and Mandala Laghu Talan (dam). Even though the site visit was carried out in Summer season plenty of water was observed in these waterbdodies. As per the discussion with the locals, the water from these water bodies is used for agricultural and domestic purposes.

5.4.5 Floral Assessment

The vegetation profile of the region has been presented in ***Table 5.6.***

Table 5.6 Vegetation Profile of the Study area

Classification Scheme	Classification
Biogeographical Province of India[20]	6D- Deccan Peninsula – Central Plateau
Agro Ecological Sub Region (ICAR)[21]	Deccan Peninsula
Agro-Climatic Region (Planning Commission)[22]	Central Plateau
Champion and Seth forest classification[23]	Tropical Thorn Forests

The floral species around the Study area has been presented in ***Figure 5.4.***

Figure 5.4 Some herpetofauna observed in the study area

Neem (*Azadirachta Indica*) observed close to project area

[20] http://wiienvis.nic.in/database/htmlpages/bioprovincemap.htm

[21] http://iasri.res.in/agridata//12data%5Cchapter1%5Cdb2012tb1_3.pdf

[22] http://iasri.res.in/agridata//12data%5Cchapter1%5Cdb2012tb1_2.pdf

[23] Champion, H. G. and Seth, S. K. (1968). A Revised Survey of Forest Types of India, Govt. of India Press, New Delhi, p. 404.

Table 5.7 Flora in the Study area

Sr. No.	Scientific Name	Family	Life Form
1	*Abutilon indicum* (L.) Sweet	Malvaceae	Herb
2	*Acacia nilotica* (L.) Delile	Fabaceae	Tree
3	*Acacia catechu* (L.f.) Willd.	Fabaceae	Tree
4	*Acacia leucophloea* (Roxb.) Willd.	Fabaceae	Tree
5	*Acacia senegal* (L.) Willd.	Fabaceae	Tree
6	*Capparis decidua* (Forssk.) Edgew.	Capparaceae	Shrub
7	*Cassia fistula* L.	Fabaceae	Tree
8	*Celosia argentea* L.	Amaranthaceae	Herb
9	*Cocos nucifera* L.	Arecaceae	Tree
10	*Cyperus difformis* L.	Cyperaceae	Herb
11	*Dactyloctenium aegyptium* (L.) Willd.	Poaceae	Grass
12	*Dalbergia sissoo* DC.	Fabaceae	Tree
13	*Datura metel* L.	Solanaceae	Herb
14	*Dicliptera paniculata* (Forssk.) I.Darbysh.	Acanthaceae	Herb
15	*Eucalyptus* sp.	Myrtaceae	Tree
16	*Euphorbia hirta* L.	Euphorbiaceae	Herb
17	*Euphorbia tirucalli* L.	Euphorbiaceae	Tree
18	*Ficus benghalensis* L.	Moraceae	Tree
19	*Ficus racemosa* L.	Moraceae	Tree
20	*Opuntia stricta* (Haw.) Haw.	Cactaceae	Shrub
21	*Panicum brevifolium* L.	Poaceae	Grass
22	*Parkinsonia aculeata* L.	Fabaceae	Tree
23	*Parthenium hysterophorus* L.	Asteraceae	Herb
24	*Phoenix sylvestris* (L.) Roxb.	Arecaceae	Tree
25	*Pongamia pinnata* (L.) Pierre	Fabaceae	Tree
26	*Prosopis juliflora* (Sw.) DC.	Fabaceae	Tree
27	*Ricinus communis* L.	Euphorbiaceae	Tree
28	*Senna auriculata* (L.) Roxb.	Fabaceae	Tree
29	*Senna occidentalis* (L.) Link	Fabaceae	Herb
30	*Senna tora* (L.) Roxb.	Fabaceae	Shrub
31	*Sida cordifolia* L.	Malvaceae	Herb
32	*Solanum virginianum* L.	Solanaceae	Herb
33	*Tamarindus indica* L.	Fabaceae	Tree

Sr. No.	Scientific Name	Family	Life Form
34	*Tridax procumbens* (L.) L.	Asteraceae	Herb
35	*Ziziphus jujuba* Mill.	Rhamnaceae	Tree
36	*Ziziphus nummularia* (Burm. f.) Wight & Arn.	Rhamnaceae	Shrub

5.4.6 Faunal Assessment

The faunal assessment was undertaken based on the primary survey and secondary resources including scientific publications, reports, etc. The subsequent sections describe the faunal diversity found in the landscape of Study area.

5.4.6.1 Herpetofauna

. The list of species has been presented in ***Table 5.8.***

Table 5.8 Herpetofaun reported and recorded fromthe Study area

Sr. No.	Common Name	Scientific Name	IUCN Red List Status (v 2021-2)	IWPA 1972 Schedule	Observed/ Reported
1	Brooks house gecko	*Hemidactylus brookii Gray1845*	LC	-	Reported
2	Yellow green house gecko	*Hemidactylus flaviviridis Rüppell, 1835*	LC	-	Reported
3	Common sand boa	*Gongylophis conicus (Schneider,1801)*	-	-	Reported
4	Checkered keelback	*Xenochrophis piscator (Schneider,1799)*	NA	-	Observed

Note: LC: Least Concern, NA: Not Assessed
Source: ERM Primary Survey, https://www.ijcmas.com/vol-3-6/Omkar%20V.%20Yadav.pdf

5.4.6.2 Avifauna

A total of twety three (23) bird species were observed in and around the study area of the proposed solar power plant. The observed and reported species have been provided in ***Figure 5.5*** and Table 5.9. All the species expect 2 – Indian River Tern which is classified as Vulnerable as per the latest IUCN Red List (Online Version 2019-3) and Black headed Ibis (Online Version 2019-3) which is classified as Near Threatened., have been classified as 'Least Concern' as per the latest IUCN Red List (Online Version 2021-3). One (01) species reported and observed from the study area viz. Black Kite (*Milvus migrans*) is protected and categorized under Schedule I as per the Indian Wildlife Protection Act, 1972.

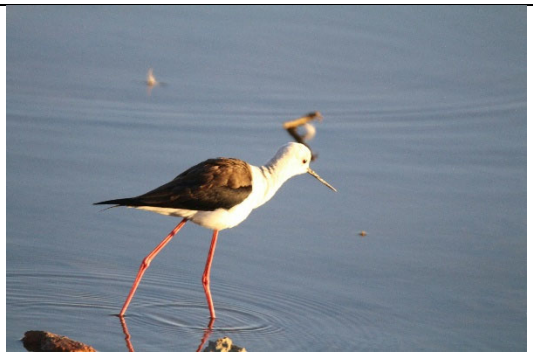
Two (02) migratory species namely Eurasian spoonbill (*Platalea leucorodia*) and Black Necked Stork (*Ciconia nigra*), were observed within the 5 km buffer of the project area at Mandala Laghu Tal. Since the site visit was carried out in summer season the migratory species observed in the area were very low. But as per the consultations carried out with the locals, migratory species have been observed at all three large water bodies that are present close to the project site.

Thirteen (13) migratory species namely, Asian Openbill (*Anastomus oscitans*), Black Stork (*Ciconia nigra*), Booted Eagle (*Hieraaetus pennatus*), Common Kestrel (*Falco tinnunculus*), Common Sandpiper (*Actitis hypoleucos*), Common Teal (*Anas crecca*), Eurasian Sparrowhawk (*Accipiter nisus*), Grey Heron (*Ardea cinerea*), Grey Wagtail (*Motacilla cinerea*), Montagu's Harrier (*Circus*

pygargus), Northern Pintail (*Anas acuta*), Northern Shoveler (*Anas clypeata*) and Pallid Harrier (*Circus macrourus*) were reported from the 5 km buffer[24,25].

The list of avifaunal species observed and reported in the study area has been presented in ***Figure 5.5.***

Figure 5.5 Some avifaunal species observed in the study area

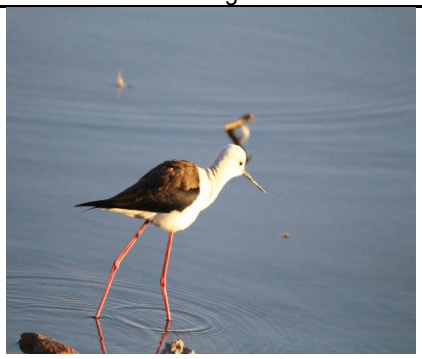


Black Winged Stilt

Black Necked Stork

Little Egret

Grey Heron



Black Winged Stilt

Black Necked Stork

[24] eBird Database: https://ebird.org/hotspot/L4832325; https://ebird.org/hotspot/L2694927; https://ebird.org/hotspot/L2620581; https://ebird.org/hotspot/L14129802; https://ebird.org/hotspot/L14129802; https://ebird.org/hotspot/L9930491

[25] *Based on our (ERM's) previous experience of working in that landscape.*

Little Egret	Grey Heron
	
Glossy Ibis	Eurasian Spoonbill

Table 5.9 Avifauna recorded and reported from the Study area

Sr. No.	Common Name	Scientific Name	Migratory Status	IUCN Red List Status (v. 2021-2)	IWPA 1972 Schedule	Observed/Reported
1	Black Drongo	*Dicrurus macrocercus*	R	Least Concern	IV	Observed
2	Black Kite	*Milvus migrans*	R	Least Concern	I	Observed
3	Cattle Egret	*Bubulcus ibis*	R	Least Concern	IV	Observed
4	Common Myna	*Acridotheres tristis*	R	Least Concern	IV	Observed
5	Green Bee-eater	*Merops orientalis*	R	Least Concern	IV	Observed
6	House Sparrow	*Passer domesticus*	R	Least Concern	IV	Observed
7	Indian Pond Heron	*Ardeola grayii*	R	Least Concern	IV	Observed
8	Jungle Babbler	*Argya striata*	R	Least Concern	IV	Observed/ Heard
9	Little Cormorant	*Microcarbo niger*	R	Least Concern	IV	Observed
10	Little Egret	*Egretta garzetta*	R	Least Concern	IV	Observed
11	Red-wattled Lapwing	*Vanellus indicus*	R	Least Concern	IV	Observed
12	Eurasian spoonbill	*Platalea leucorodia*	M	Least Concern	IV	Observed
13	Black Necked Stork	*Ciconia nigra*	M	Least Concern	IV	Observed
14	Indian river tern	*Sterna aurantia*	R	Vulnerable	-	Observed
15	Black-winged stilt	*Himantopus himantopus*	R	Least Concern	IV	Observed
16	Grey Heron	*Ardea cinerea*	R	Least Concern	IV	Observed
17	Little Egret	*Egretta garzetta*	R	Least Concern	IV	Observed

Sr. No.	Common Name	Scientific Name	Migratory Status	IUCN Red List Status (v. 2021-2)	IWPA 1972 Schedule	Observed/Reported
18	Glossy Ibis	*Plegadis falcinellus*	M	Least Concern	IV	Observed
19	Black Headed Ibis	*Threskiornis melanocephalus*	R	Near Threatned	IV	Observed
20	Cotton Pygmy-goose	*Nettapus coromandelianus*	R	Least Concern	IV	Observed
21	White Throated Kingfisher	*Halcyon smyrnensis*	R	Least Concern	IV	Observed
22	Indian Spot-billed Duck	*Anas poecilorhyncha*	R	Least Concern	IV	Observed
23	Pied Kingfisher	*Ceryle rudis*	R	Least Concern	IV	Observed

Note: M: Migratory, R: Resident

Source: ERM Primary Survey , ebird.org

5.4.6.3 Mammals

Total two (02) species; Indian Grey Mongoose and Nilgai, were reported from the 5 km study area of the proposed project area. Both the species were reported by villagers. Both the species are classified as Least Concern as per the latest IUCN Red List (Online Version 2022-2). The Indian Grey Mongoose is protected and categorized under Schedule II as per the Indian Wildlife Protection Act, 1972.

The list of mammalian species recorded or reported from the landscape of Study area has been presented in ***Table 5.10.***

Table 5.10 Mammals recorded and reported from the Study area

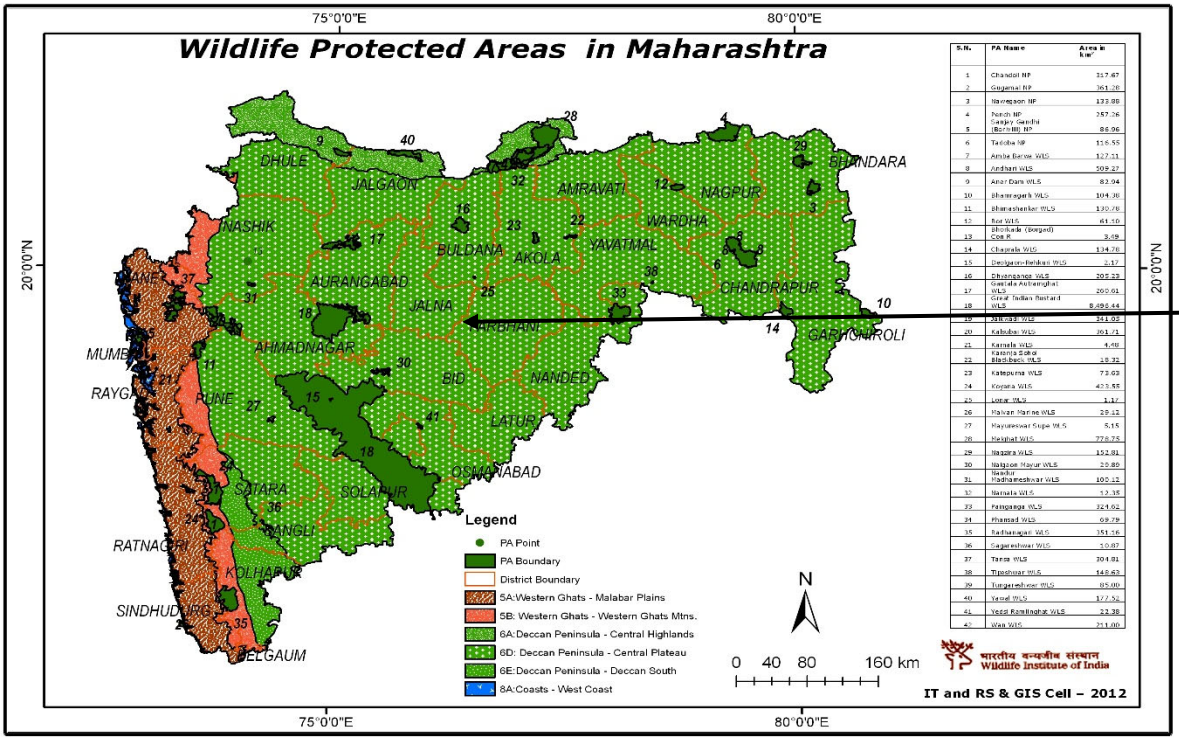
Sr. No.	Common Name	Scientific Name	IUCN Red List Status (v 2021-2)	IWPA 1972 Schedule	Observed/ Reported
1	Indian Grey Mongoose	*Herpestes Edwardsii*	Least Concern	SCHEDULE II	Observed/ Reported
2	Nilgai	*Boselaphus tragocamelus*	Least Concern	SCHEDULE III	Reported*

Source: ERM Primary Survey,

5.4.7 Proximity to Nationally Protected Areas and Internationally Recognized Biodiversity Areas

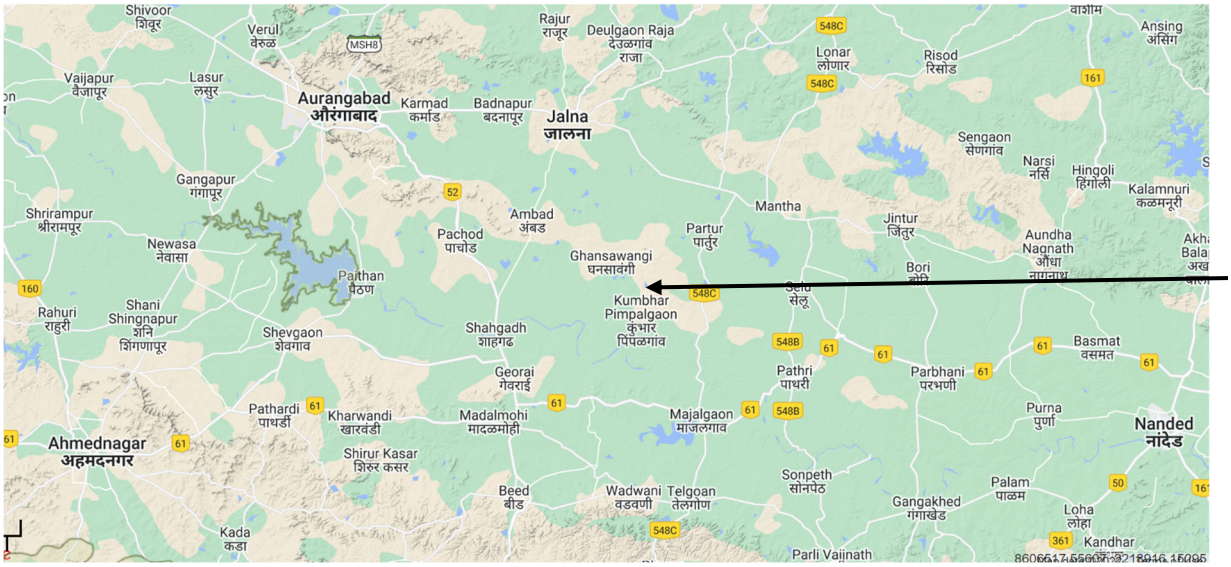
The Project site does not have any National Parks or Wildlife Sanctuaries or areas of conservatory importance within a 10 km radius. (Figure 5 6) *(*

Figure 5-6 Protected Areas in Maharashtra



Source: Wildlife Research Institute of India (WRI)

Figure 5-7 Map of nearest IBA- Important Bird Area



Source: http://datazone.birdlife.org/site/mapsearch

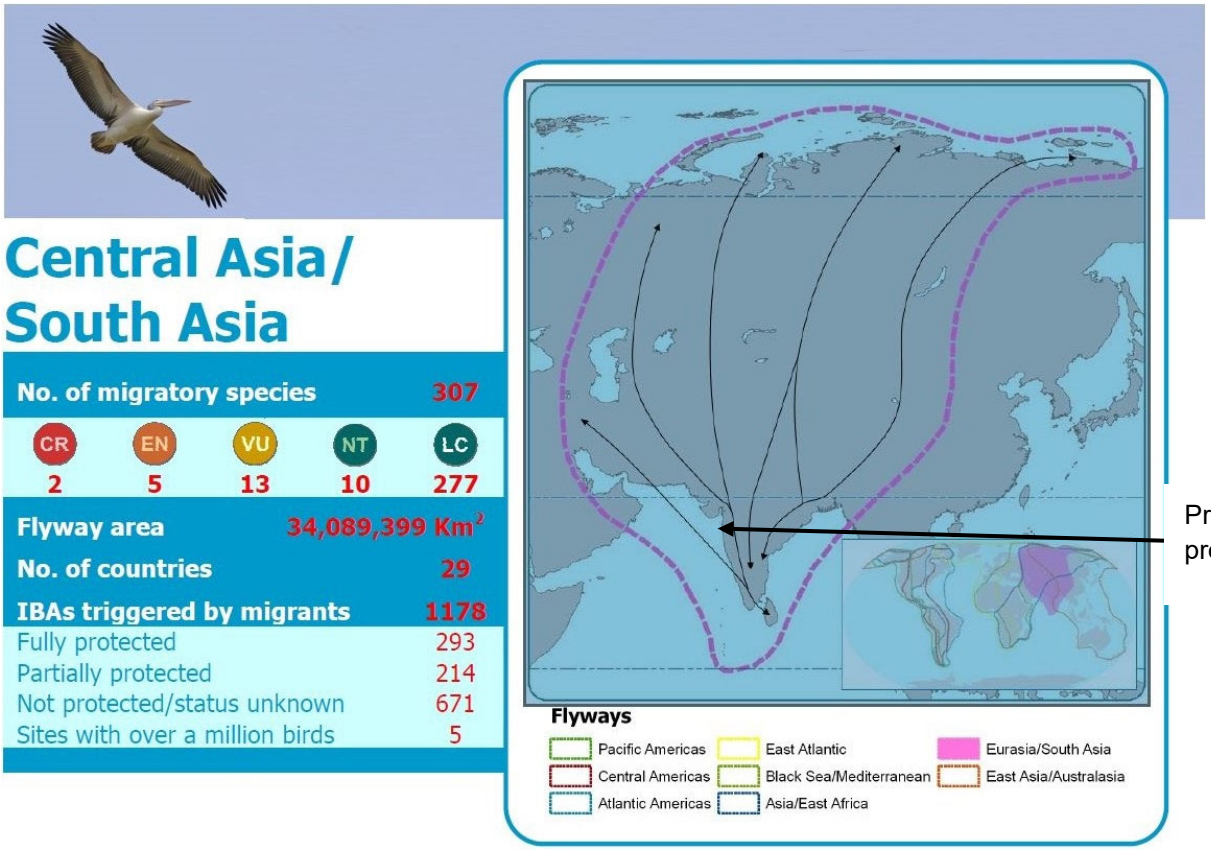
Important Bird Area

No IBA is present with in the 10 km radius of the solar plant site[26]. The nearest IBA is Godavarai river which is over 100 kms from the project area.

5.4.8 Migratory Routes

The migratory birds start visiting the wintering grounds in India from the month of September and stay until the month of March. The migration of the birds happens along nine certain migratory flyways globally. Three flyways overlap the Indian mainland and support high concentrations of migratory birds including several threatened species. The area of the Project site falls within Central Asian Flyway. However, the primary survey and review of the secondary resources such as ebird.org did not confirm high activity of migratory and congregatory avifaunal species in the Study area which may be attributed to unavailability of larger/major water bodies in this landscape. Also, there is no IBA within 100km radius of the Project site that supports congregations of migratory birds.

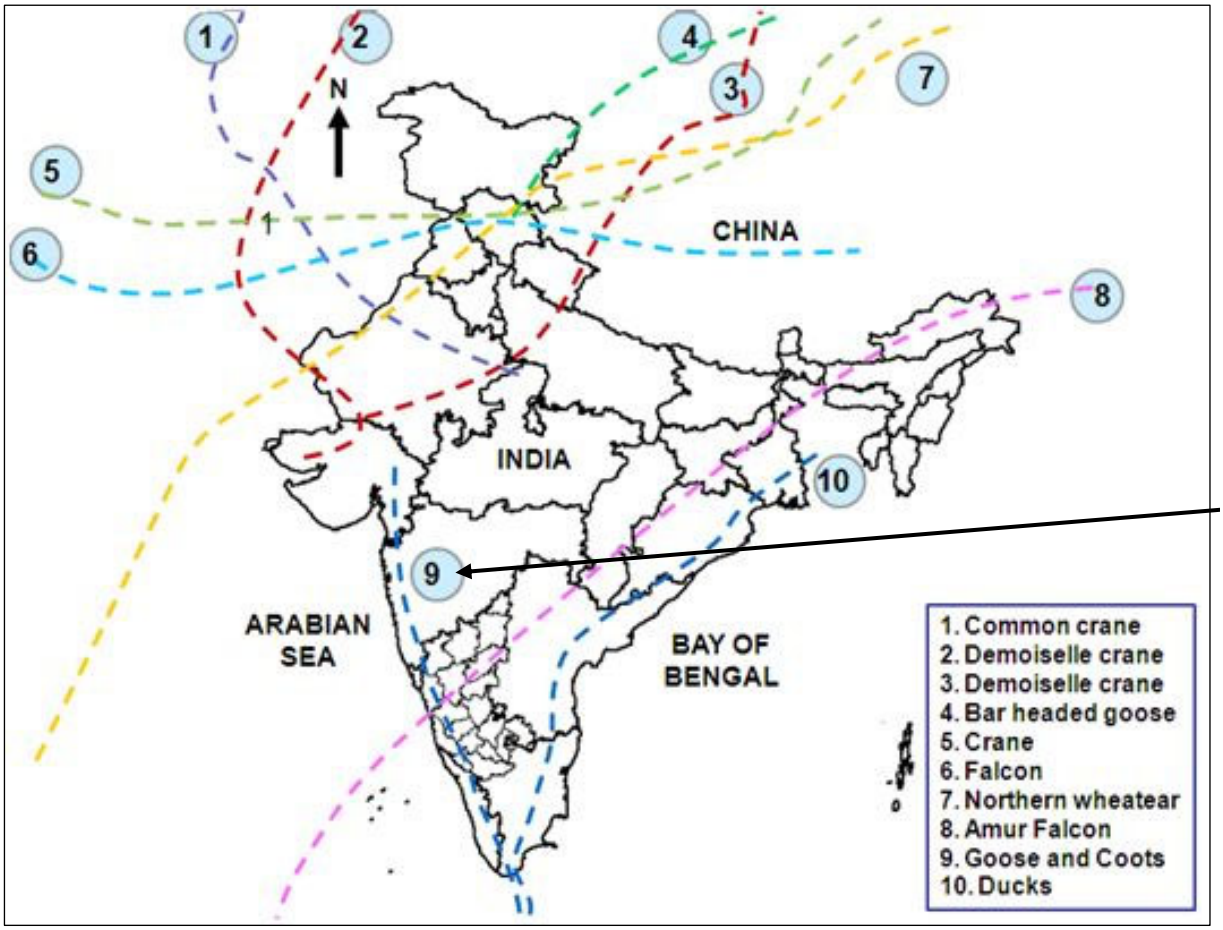
Figure 5-8 Central Asian Flyway



Source: Lama, D. 2017. Migratory Routes and Movement Ecology. In: Prins, H. & Namgail, T. (Eds.), Bird Migration Across the Himalayas: Wetland Functioning amidst Mountains and Glaciers. Cambridge University Press, Cambridge pp 13-142.

[26] Important Bird and Biodiversity Areas in India Priority sites for conservation Second Edition: Revised and Updated 2nd Edition, Volume I, 2016

Figure 5-9 Migratory Routes passing through India



Source: Ramachandra T.V., Durga Mabhab Mahapatra, M. Boominathan, K. Sankara Rao and Harish R. Bhat, 2011. Environmental Impact Assessment of the National Large Solar Telescope Project and its ecological impact in Merak area., CES Technical Report : 123, Energy & Wetlands Research Group, Centre for Ecological Sciences, Indian Institute of Science, Bangalore 560 012. (Available at: http://wgbis.ces.iisc.ernet.in/biodiversity/pubs/ces_tr/TR123/section6.htm)

Figure 5-10 Central Asian Flyway

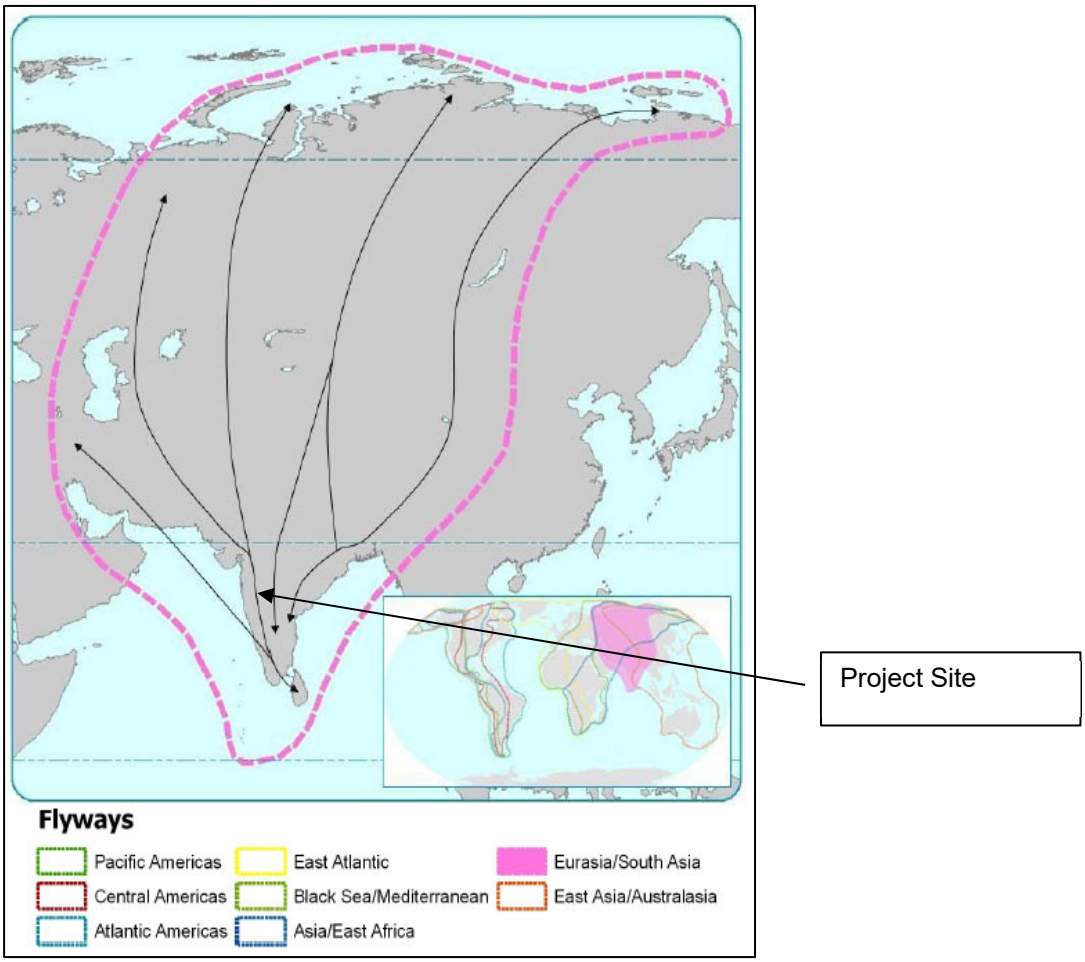
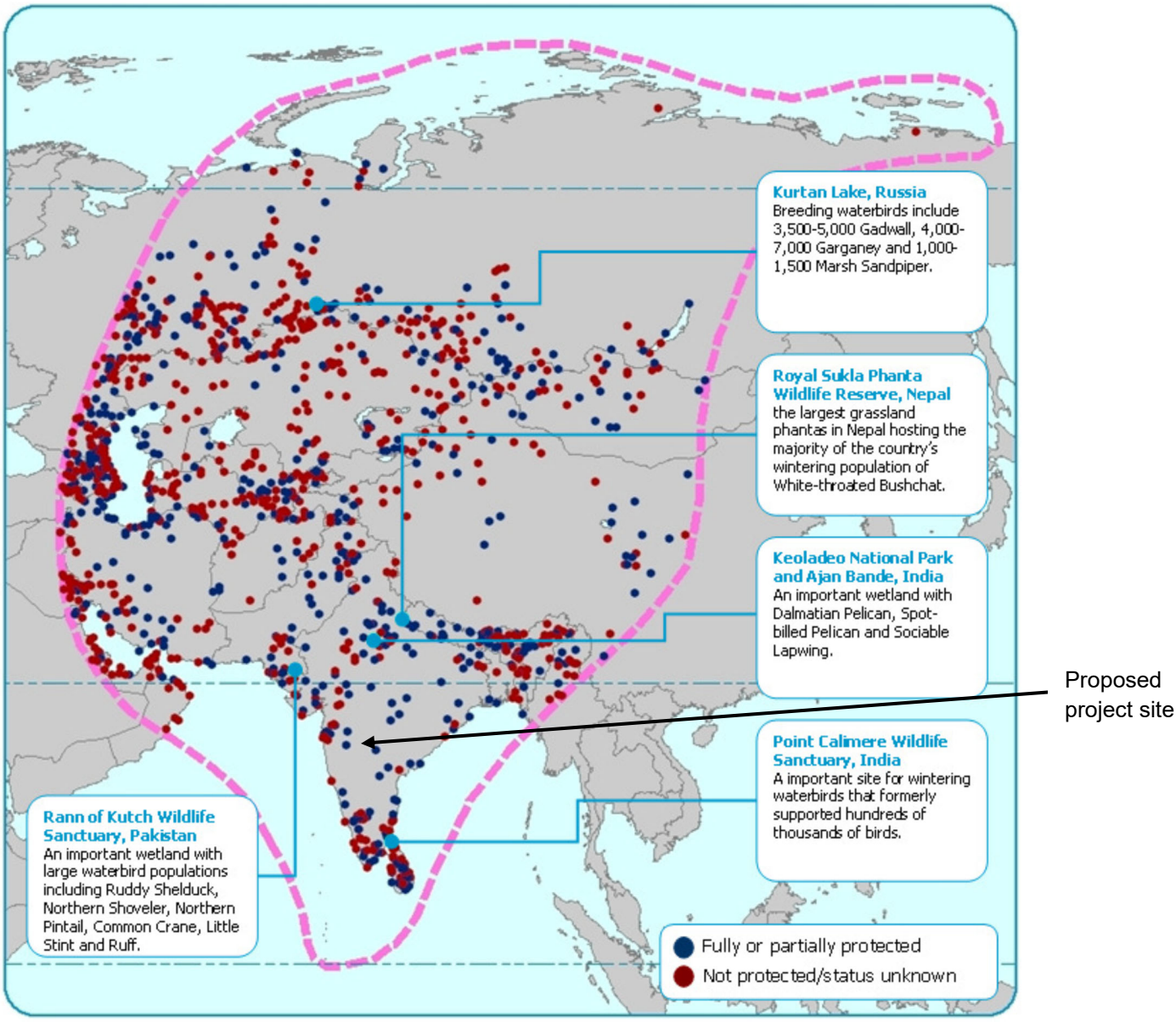


Figure 5.11 Central Asian Flyway



6. STAKEHOLDER ENGAGEMENT

6.1 Introduction

"*A stakeholder is defined as a party that has an interest in an enterprise or project. The primary stakeholders in a typical corporation are its investors, employees, customers and suppliers. However, modern theory goes beyond this conventional notion to embrace additional stakeholders such as the community, government and trade associations*"[27]

Stakeholder identification and their inclusion in the decision making process is critical in prioritizing, analysing and addressing issues; and developing management systems and mechanisms to address their respective concerns as well as apprehensions. This also helps in instilling trust within stakeholders regarding the project.

For the purpose of the project, stakeholder mapping has been carried out with the following objectives;

- Identify relevant stakeholder groups;
- Study the profile and characteristics and the nature of stakes each stakeholder group has;
- Assess their respective influence levels on the Project; and
- Appreciate the precise issues and concerns as well as the expectations from the Project that each group possesses

6.2 Stakeholder Consultation and Disclosure Requirement for the Project

The disclosure of project information and consultations with stakeholders has been increasingly emphasized by project finance institutions and government regulatory bodies. A brief overview of the requirements of public disclosure and stakeholder consultation applicable to this project is provided below.

Table 6.1 Overview of Disclosure and stakeholder consultation requirement

Institution/ Regulatory Body	Reference Regulation/ Standard	Requirements
IFC	PS-1 (Assessment and Management of Environmental and Social Risks and Impacts)	■ . Community engagement is to be undertaken with the affected communities and must be free of external manipulation, interference, or coercion, and intimidation. ■ Furthermore, in situations where an affected community may be subject to risks or adverse impacts from a project, the proponent must undertake a process of consultation so as to provide the affected communities with an opportunity to express their views on the project risks, impacts, and mitigation measures, as well as allow the proponents to consider and respond to them. ■ *Informed participation:* For projects with significant adverse impacts on affected communities, the consultation process must ensure that free, prior and informed consultation with affected communities occurs and that processes exist to facilitate participation by those affected. ■ Apart from such a consultation process, the project proponents are also to establish a Grievance Redressal Mechanism, which

Institution/ Regulatory Body	Reference Regulation/ Standard	Requirements
		will allows the affected communities' concerns and grievances about the project proponent's environmental and social performance to be received and allow for steps to be taken to resolve the same ■ *Broader stakeholder engagement:* The proponent must identify and engage with stakeholders that are not directly affected by the project but those that have established relationships with local communities and/or interest in the project – local government, civil society organizations, etc. – and establish a dialogue.

6.2.1 Stakeholder Categorisation

A stakeholder is "any identifiable group or individual who can affect the achievement of an organization's objectives or who is affected by the achievement of an organization's objectives"[28]. Stakeholders thus vary in terms of degree of interest, influence and control they have over the project. While those stakeholders who have a direct impact on or are directly impacted by the project are known as **Primary Stakeholders,** those who have an indirect impact or are indirectly impacted are known as **Secondary Stakeholders**. Keeping in mind the nature of the project and its setting, the stakeholders have been identified and listed in the table given below.

Table 6.2 Stakeholder Group categorisation

Stakeholder Groups	Primary Stakeholders	Secondary Stakeholders
Community	■ Land sellers ■ Developers and Contractors ■ Local Laborers	■ Local Community ■ Vulnerable groups
Institutional Stakeholders	■ Gram Panchayat	■ Civil Society/ Local NGOs
Government Bodies	■ Regulatory Authorities ■ District Administration	
Others	■ Migrant workforce	

6.2.2 Approach and Methodology for Stakeholder Analysis

The significance of a stakeholder group is categorized considering the magnitude of impact (type, extent, duration, scale and frequency) or degree of influence (power and proximity) of stakeholder group and urgency/likelihood of the impact/influence associated with the particular stakeholder group in the project context. The magnitude of stakeholder impact/influence is assessed taking the power/responsibility and proximity of the stakeholder group and the group is consequently categorized as negligible, small, medium or large. The urgency or likelihood of the impact on/influence by the stakeholder is assessed on a scale of low, medium and high. The overall significance of the stakeholder group is assessed as per the matrix provided in **Table 6.3**.

Table 6.3 Stakeholder Significance and Engagement Requirement

		Likelihood of Influence on/ by Stakeholder		
		Low	Medium	High
Magnitude of	Negligible	Negligible	Negligible	Negligible

[28]. Freeman, R. and Reed, D. (1983).Stockholders and Stakeholders: A new perspective on Corporate Governance. *California Management Review.* pp. 88 – 106.

		Likelihood of Influence on/ by Stakeholder		
		Low	Medium	High
Influence/ Impact	Small	Negligible	Minor	Moderate
	Medium	Minor	Moderate	Urgent
	Large	Moderate	Urgent	Urgent

Source: ERM Internal Impact Assessment Standards

6.2.3 Stakeholder Analysis

The table below has been used to classify the identified stakeholders (directly or indirectly impacting the project) in accordance to their levels of influence on the Project. The influence and priority have both been primarily rated as:

- **High Influence**: This implies a high degree of influence of the stakeholder on the project in terms of participation and decision making or high priority to engage with the stakeholder;
- **Medium Influence**: Which implies a moderate level of influence and participation of the stakeholder in the project as well as a priority level to engage the stakeholder which is neither highly critical nor are insignificant in terms of influence; and
- **Low Influence**: This implies a low degree of influence of the stakeholder on the project in terms of participation and decision making or low priority to engage that stakeholder.

The intermediary categories of low to medium or medium to high primarily imply that their influence and importance could vary in that particular range subject to context specific conditions or also based on the responses of the project towards the community

The coverage of stakeholders as stated above includes any person, group, institution or organization that is likely to be impacted (directly or indirectly) or may have interest/influence over project. Keeping this wide scope of inclusion in stakeholder category and the long life of project, it is difficult to identify all potential stakeholders and gauge their level of influence over project at the outset of the project. Therefore the Project proponent is advised to consider this stakeholder mapping as a live document which should be revised in a timely manner so as to make it comprehensive for any given period of time.

Table 6.4 Stakeholder Analysis

Stakeholder Category	Relevant Stakeholders	Profile/ Status	Impact/Influence of the project on this Stakeholder Group	Impact/Influence of the Stakeholder Group on the project	Expectations, Opinions Key Concerns of Stakeholders	Overall Rating of Stakeholder Influence
Primary Stakeholder	Land sellers	■ Project will procure about 180 acres agricultural land for the proposed Solar Project on lease. The land procurement will not result into any physical displacement.	■ land sellers are also likely to get preference in contractual and employment opportunities that will arise during construction and operational phase of the project.	■ This stakeholder group is expected to have a positive influence on the Project, as they will be getting regular payment against the land leased for the project. Lease value is perceived to be significantly higher than actual produce value for the same area of land. The stakeholder groups' influence on the project pertains to the smooth functioning of the project and the timely completion of the project activities.	■ Secondly, they might also expect development works for their village by project developer. ■ The general major concern of this stakeholder group till now is related to availability of employment opportunities that the project will generate. .	Primary Stakeholder

Stakeholder Category	Relevant Stakeholders	Profile/ Status	Impact/Influence of the project on this Stakeholder Group	Impact/Influence of the Stakeholder Group on the project	Expectations, Opinions Key Concerns of Stakeholders	Overall Rating of Stakeholder Influence
Developers and EPC Contractors	Developer and EPC Contractors of Radiance will be responsible for construction and operation and maintenance of the project will be managed by Operation and Maintenance contractors.	Smooth operation of the construction activity and to complete the work within the scheduled time and cost.	■ Non-compliance to the legal requirements; ■ Not meeting the community expectations.	The contractors and sub-contractors play an important role during the project construction phase for timely commissioning of the project with quality construction and within the stipulated budgetary provisions.	Medium	Developers and EPC Contractors
	Gram Panchayats (GPs)	■ Constituting the lowest strata of Decentralized Local Governance in the Country, a typical Panchayat consists of one or more revenue villages. This body of local governance was created through the 73rdAmendment to the Constitution of India; and ■ Sarpanch and other members of the Gram Panchayat	■ The Gram panchayat might expect positive impact from the project in the following manner: - Generation of employment opportunities at the local level - Adequacy of the community development	Most of the rural development schemes and funds for central schemes are channelled through this body of governance. Also, it is the Panchayats who are bestowed with the decision making authority for economic development and social justice. They also play a key role	The expectations/ concerns of the GPs include: ■ Employment Opportunities for the Local Youth; ■ Corporate Social Responsibility (CSR) activities for development of local area; and Nature of impact that the Project would have on the livelihoods of communities.	Medium

Stakeholder Category	Relevant Stakeholders	Profile/ Status	Impact/Influence of the project on this Stakeholder Group	Impact/Influence of the Stakeholder Group on the project	Expectations, Opinions Key Concerns of Stakeholders	Overall Rating of Stakeholder Influence
		need to be actively involved in various activities relating to the economic development and social justice of their Panchayat. The smooth and hassle-free functioning of the project is also the onus of the Panchayats.	initiatives to be undertaken by the project Timely and adequate disclosure of information throughout the life of the project	in the opinion formulation towards the project.		
	Regulatory Authorities	This stakeholder group comprise of the central, state and district level regulatory authorities. These authorities influence the project in terms of establishing policy, granting permits and approvals for the project, monitoring and enforcing compliance with the applicable rules and regulations. ■ The primary authorities are:	■ The influence of the project on this stakeholder group pertains to the role the project will play in the development of the project. The project should comply with applicable regulatory framework comprising of the guidelines and policies of the State	The failure of the project to comply with the various rules and regulations applicable is instrumental for the timely implementation of the project	The sole expectation of the Regulatory Authorities from the project Proponents will be abidance to all applicable guidelines, policies and laws.	Low

Stakeholder Category	Relevant Stakeholders	Profile/ Status	Impact/Influence of the project on this Stakeholder Group	Impact/Influence of the Stakeholder Group on the project	Expectations, Opinions Key Concerns of Stakeholders	Overall Rating of Stakeholder Influence
		- The office of District Industries Commissioner (DIC) regulates Industrialization at the District Level; and Karnataka Transmission Corporation Limited for power evacuation/grid connectivity etc.	Government such as Renewable Energy Policy.			
	Employees	This stakeholder group comprises of the regular employees of Radiance who will be involved in the various stages of the project	The expectations of this stakeholder group in regards to the project pertain to the following: ■ Job security ■ Safe working conditions ■ Provision of rewards and recognitions for good performances and safe behaviour ■ Proper work-life balance	■ The influence of these stakeholders pertains to the roles played by them in the overall smooth functioning of the project operations as well as the brand value. They will also serve an extremely important role in the maintenance and	The primary concern of the stakeholder group will pertains to the role of the project in ensuring continued economic opportunities and work generation	High

Stakeholder Category	Relevant Stakeholders	Profile/ Status	Impact/Influence of the project on this Stakeholder Group	Impact/Influence of the Stakeholder Group on the project	Expectations, Opinions Key Concerns of Stakeholders	Overall Rating of Stakeholder Influence
			■ Ethical and professional conduct ■ Employee engagement within & after working hours ■ Regular updating of rules and regulations Facilitation and maintenance of everyday convenience in regards to facilities such as transport, seating, food, accommodation etc.	improvement of services and facilities		
	Contractual Labourers	■ This stakeholder group comprises of those workers who are to be engaged in the project on a contractual basis through the different phases of project life. These labourers will be primarily semi-skilled	These stakeholder group's influence on the project pertains to their role in the smooth functioning of the project and the opinion formation towards the project.	The primary concern of the stakeholder group pertaining to the project will be as following: the role of the project in continued economic opportunity, work	The main expectations from the project will be: ■ timely settlement of dues and payments in keeping with the legal requirements ■ continued work opportunities safety at work	Medium

Stakeholder Category	Relevant Stakeholders	Profile/ Status	Impact/Influence of the project on this Stakeholder Group	Impact/Influence of the Stakeholder Group on the project	Expectations, Opinions Key Concerns of Stakeholders	Overall Rating of Stakeholder Influence
		and unskilled workers. As understood from other projects of Radiance, labourers are reported by Radiance.		generation and a source of income		
	District/Tehsil Administration	■ The project area is administered at three levels by different Government Bodies: at the district level, at the block/tehsil level and at the Panchayat level in each village/or cluster of villages; In this context, local administration refers to the district level and block level administration comprising of the offices of the Tehsildaar, District Magistrate Collectors, and Revenue officer etc.	The primary concern of the stakeholder group can be: ■ project's compliance towards the regulatory requirement role played by the project in the development of the area	These authorities not only serve as important points of contact for villagers or other party wanting to liaise with higher authorities but are also critical in obtaining permissions and support for the various project activities	■ The main expectations of the stakeholders from the project might be: ■ Compliance with the regulatory requirements and legal provisions specific to the project ■ Timely disclosure of information pertaining to the project activities Involvement in the formulation and implementation of the community development activities throughout the life of the project	Low

Stakeholder Category	Relevant Stakeholders	Profile/ Status	Impact/Influence of the project on this Stakeholder Group	Impact/Influence of the Stakeholder Group on the project	Expectations, Opinions Key Concerns of Stakeholders	Overall Rating of Stakeholder Influence
Secondary stakeholders	Local community	■ The stakeholder group comprising of local communities around a radius of 1 kms inhabit the Villages; There are no villages within 1 km of project site -	The project can play a critical role in the development of the community through economic opportunities and CSR projects.	■ The support of the local community to the Project and its activities play an essential role to ensure smooth functioning of the Project	■ Expectations of getting employment benefits from the Project; and ■ Contributing positively through targeted community development activities would be also among the key expectations. The community should experience minimal disruption as a result of various construction, operation, and decommissioning phases	Low
	Vulnerable Groups such as women headed households, Below Poverty Line (BPL) and Landless households	This stakeholder group generally includes women headed household, BPL household and landless. These subdivisions are on the basis of the	In view of the poor social and economic conditions of the Vulnerable Communities, the project Proponent may have to provide	The influence of this stakeholder group in regards to the project pertains to the smooth functioning of the project and the opinion formation of	■ The primary expectations of this stakeholder group from the project pertain to the following: - Appropriate community development	Low

Stakeholder Category	Relevant Stakeholders	Profile/ Status	Impact/Influence of the project on this Stakeholder Group	Impact/Influence of the Stakeholder Group on the project	Expectations, Opinions Key Concerns of Stakeholders	Overall Rating of Stakeholder Influence
		understanding of the possibility of differentiated impacts on the community on the basis of the economic and social status in the society.	engagement avenues for the group	the same. While due to the position of this group in the community, the level of influence towards the project is limited, the project can disproportionately influence this group.	activities in keeping with the needs of the community - Involvement in the formulation of the community development activities and their implementation Timely disclosure of information through the life of the project	
	Civil Society/Local NGOs	There are many NGOs in the Koppal district such as Arunodaya Gramina Abhirudhi Sanga and Prayatna Foundation Karatagi working on the livelihoods of rural communities along with their related socio-cultural facets.	With respect to contributing towards the cause of local development, the project proponent can either participate in the ongoing developmental activities of the Government or might take up interventions on its own or through partnerships with	■ The opinion of the NGOs and Civil Society Groups towards a project is determined largely by whether the impacts of setting up of the development venture is being viewed/ perceived in positive light by	■ The NGOs and Civil Society Groups often play a critical role in bringing to the limelight the issues of vulnerable communities in the society; and They can also play a major role in community mobilization, building trust and even participate in	Low

Stakeholder Category	Relevant Stakeholders	Profile/ Status	Impact/Influence of the project on this Stakeholder Group	Impact/Influence of the Stakeholder Group on the project	Expectations, Opinions Key Concerns of Stakeholders	Overall Rating of Stakeholder Influence
			NGOs and Community-based organisations (CBOs) after obtaining prior approval from competent authorities.	the local population with special reference to the vulnerable communities or not. The key concerns of this stakeholder group centres around justice and equal opportunities in matters of economic and social development being provided to the Vulnerable Communities.	implementing CSR initiatives.	

7. IMPACT ASSESSMENT AND MITIGATION MEASURES

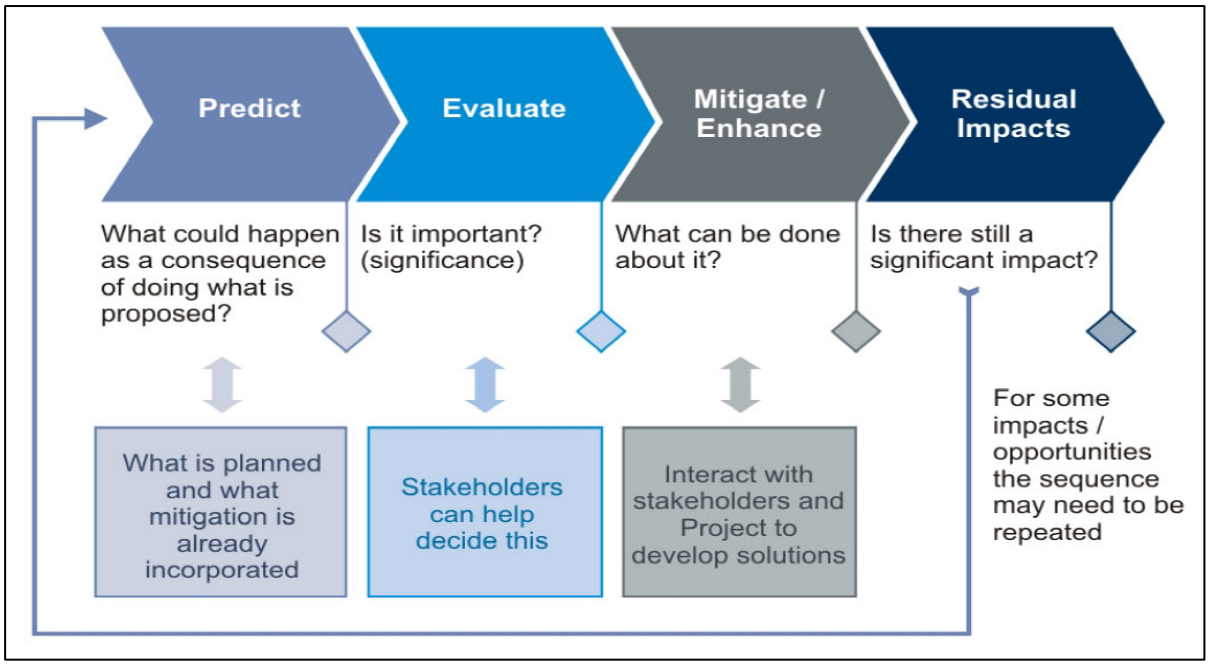
This section assesses the manner in which the Project will interact with elements of the physical, ecological or social environment to produce impacts to resources/ receptors. It has been organized as per the construction, operation and decommissioning phases of the project life cycle to understand the risks and impacts associated with each phase.

7.1 Impact Assessment Methodology

Impact identification and assessment starts with scoping and continues through the remainder of the Impact Assessment (IA) Process. The principal IA steps are summarized in ***Figure 7.1*** and comprises of the following:

- **Impact prediction**: to determine what could potentially happen to resources/receptors as a consequence of the projects and its associated activities.
- **Impact evaluation**: to evaluate the significance of the predicted impacts by considering their magnitude and likelihood of occurrence, and the sensitivity, value and/or importance of the affected resource/receptor.
- **Mitigation and enhancement**: to identify appropriate and justified measures to mitigate negative impacts and enhance positive impacts.
- **Residual impact evaluation**: to evaluate the significance of impacts assuming effective implementation of mitigation and enhancement measures.

Figure 7.1 Impact Assessment Process



7.1.1 Prediction of Impacts

Prediction of impacts was carried out with an objective to determine what is likely to happen to the environment as a consequence of the Project and its associated activities. From the potentially significant interactions identified in scoping, the impacts to the various resources/receptors were elaborated and evaluated.

7.1.2 Evaluation of Impacts

Each impact was described in terms of its various relevant characteristics (e.g., type, scale, duration, frequency, extent). The terminology used to describe impact characteristics is as shown in the table below.

Table 7.1 Impact Characteristic Terminology

Characteristic	Definition	Designation
Type	A descriptor indicating the relationship of the impact to the project (in terms of cause and effect)	Direct Indirect Induced
Extent	The "reach" of the impact (e.g., confined to a small area around the Project Footprint, projected for several kilometres, etc.)	Local National Global
Duration	The time period over which a resource/ receptor is affected.	Temporary Short-term Long-term Permanent
Scale	The size of the impact (e.g., the size of the area damaged or impacted, the fraction of a resource that is lost or affected, etc.)	[no fixed designations; intended to be a numerical value or a qualitative description of "intensity"]
Frequency	A measure of the constancy or periodicity of the impact.	[no fixed designations; intended to be a numerical value or a qualitative description]

The definitions for the type designations are given in the table below. Definitions for the other designations are resource/receptor-specific.

Table 7.2 Impact Type Definitions

Type	Definition
Direct	Impacts that result from a direct interaction between the Project and a resource/ receptor
Indirect	Impacts that follow on from the direct interactions between the Project and its environment as a result of subsequent interactions within the environment
Induced	Impacts that result from other activities (which are not part of the Project) that happen as a consequence of the Project.

The above characteristics and definitions apply to planned and unplanned events. An additional characteristic that pertains only to unplanned events is likelihood. The likelihood of an unplanned event occurring was designated using a qualitative scale, as described in the table below.

Table 7.3 Definitions of Likelihood Designations

Likelihood	Definition
Unlikely	The event is unlikely but may occur at some time during normal operating conditions (probability less than 20%)

Likelihood	Definition
Possible	The event is likely to occur at some time during normal operating conditions (probability greater than 20% and less than 50%)
Likely	The event will occur during normal operating conditions (probability greater than 50%

Once an impact's characteristics were defined, each impact was assigned a 'magnitude'. Magnitude is typically a function of a combination (depending on the resource/receptor in question) of the following impact characteristics:

- Extent
- Duration
- Scale
- Frequency

In case of unplanned events only, magnitude incorporates the 'likelihood' factor discussed above.

Magnitude essentially describes the intensity of the change that was predicted to occur in the resource/receptor as a result of the impact. As discussed above, the magnitude designations themselves are universally consistent, but the descriptions for these designations vary on a resource/receptor-by-resource/receptor basis. The universal magnitude designations are:

- Positive
- Negligible
- Small
- Medium
- Large

In the case of a positive impact, no magnitude designation (aside from 'positive') was assigned. It was considered sufficient for the purpose of the IA to indicate that the Project was expected to result in a positive impact, without characterising the exact degree of positive change likely to occur.

In the case of impacts resulting from unplanned events, the same resource/ receptor-specific approach to concluding a magnitude designation was followed, but the 'likelihood' factor was considered, together with the other impact characteristics, when assigning a magnitude designation.

In addition to characterising the magnitude of impact, the other principal impact evaluation step was definition of the sensitivity/ vulnerability/ importance of the impacted resource/receptor. There are a range of factors that was taken into account when defining the sensitivity/ vulnerability/ importance of the resource/receptor, which may be physical, biological, cultural or human. Other factors were also considered when characterising sensitivity/ vulnerability/importance, such as legal protection, government policy, stakeholder views and economic value. The sensitivity/ vulnerability/importance designations used herein for all resources/receptors are:

- Low
- Medium
- High

Once magnitude of impact and sensitivity/ vulnerability/ importance of resource/ receptor have been characterised, the significance was assigned for each impact. Impact significance is designated using the matrix shown in the figure below.

Figure 7.2 Impact Significance

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

The matrix applies universally to all resources/receptors, and all impacts to these resources/receptors, as the resource/receptor-specific considerations are factored into the assignment of magnitude and sensitivity/ vulnerability/ importance designations that enter into the matrix. The box below provides a context of what the various impact significance ratings imply.

Box 7.1 Context of Impact Significance

An impact of **negligible** significance is one where a resource/ receptor (including people) will essentially not be affected in any way by a particular activity or the predicted effect is deemed to be 'imperceptible' or is indistinguishable from natural background variations.

An impact of **minor** significance is one where a resource/ receptor will experience a noticeable effect, but the impact magnitude is sufficiently small and/or the resource/receptor is of low sensitivity/ vulnerability/ importance. In either case, the magnitude should be well within applicable standards/ guidelines.

An impact of **moderate** significance has an impact magnitude that is within applicable standards/guidelines, but falls somewhere in the range from a threshold below which the impact is minor, up to a level that might be just short of breaching a legal limit. Clearly, to design an activity so that its effects only just avoid breaking a law and/or cause a major impact is not best practice. The emphasis for moderate impacts is therefore on demonstrating that the impact has been reduced to a level that is as low as reasonably practicable (ALARP). This does not necessarily mean that impacts of moderate significance have to be reduced to minor, but that moderate impacts are being managed effectively and efficiently.

An impact of **major** significance is one where an accepted limit or standard may be exceeded, or large magnitude impacts occur to highly valued/sensitive resource/receptors. An aim of IA is to get to a position where the Project does not have any major residual impacts, certainly not ones that would endure into the long-term or extend over a large area. However, for some aspects there may be major residual impacts after all practicable mitigation options have been exhausted (i.e. ALARP has been applied). An example might be the visual impact of a facility. It is then the function of regulators and stakeholders to weigh such negative factors against the positive ones, such as employment, in coming to a decision on the Project.

It is important to note that impact prediction and evaluation takes into account any embedded controls (i.e., physical or procedural controls that are already planned as part of the Project design, regardless of the results of the IA Process).

An activity – impact interaction matrix for construction and operation phases of the Project is presented in below which has been further used to assess the impact significance at activity levels on environmental, ecological and social resources.

7.1.3 Identification of Mitigation and Enhancement Measures

Once the significance of an impact has been characterised, the next step was to evaluate what mitigation and enhancement measures are warranted. For the purposes of this IA, ERM adopted the following Mitigation Hierarchy:

- **Avoid at Source, Reduce at Source:** avoiding or reducing at source through the design of the Project.
- **Abate on Site:** add something to the design to abate the impact.
- **Abate at Receptor:** if an impact cannot be abated on-site then control measures can be implemented off-site.
- **Repair or Remedy:** some impacts involve unavoidable damage to a resource (e.g. agricultural land and forestry due to creating access, work camps or materials storage areas) and these impacts can be addressed through repair, restoration or reinstatement measures.
- **Compensate in Kind, Compensate Through Other Means:** where other mitigation approaches are not possible or fully effective, then compensation for loss, damage and disturbance might be appropriate (e.g., planting to replace damaged vegetation, financial compensation for damaged crops or providing community facilities for loss of fisheries, access, recreation and amenity space).

The priority in mitigation was to first apply mitigation measures to the source of the impact (i.e., to avoid or reduce the magnitude of the impact from the associated Project activity), and then to address the resultant effect to the resource/receptor via abatement or compensatory measures or offsets (i.e., to reduce the significance of the effect once all reasonably practicable mitigations have been applied to reduce the impact magnitude).

7.1.4 Management and Monitoring

The final stage in the IA Process is the definition of the basic management and monitoring measures that are needed to identify whether: a) impacts or their associated Project components remain in conformance with applicable standards/ guidelines; and b) mitigation measures are effectively addressing impacts and compensatory measures and offsets are reducing effects to the extent predicted. This is covered in **Section 8** under Environmental and Social Management Plan (ESMP).

7.2 Impact Assessment Criteria

For the purpose of this assessment the following sections define the criteria against which the impacts associated with the 50 MW proposed Project have been assessed. The impact assessment criteria are general criteria and not specifically associated with the project. Interactions that are likely to lead to significant impacts, as identified during the scoping exercise and baseline conditions are presented in the table below.

Table 7.4 Interactions identified that are likely to result in significant impacts

Resource/Receptor	Potentially Significant Impacts
Land Use	■ Permanent changes in land use due to installation of PV Modules, Central Monitoring Station, Switching Yard, access roads. ■ Temporary changes in land use due to temporary site office and material storage yard.
Topography and drainage	■ Alteration of topography and micro drainage channel due to construction of project site approach road.
Soil Environment	■ Decrease of soil quality due to loss of vegetation cover;

Resource/Receptor	Potentially Significant Impacts
	■ Soil erosion during monsoon season and windy periods; ■ Sedimentation into nearby water bodies due to soil erosion and run-off; ■ Storage and handling of hazardous materials (e.g., fuel and lubricant) and waste generated from operation of construction equipment and machinery and their maintenance may lead to soil contamination due to leaks/ spillage; and ■ Impact on soil and land environment due to improper management of domestic solid waste generated.
Ambient Air Quality	■ Fugitive dust emissions due to movement of machinery and vehicles; ■ Fugitive emission due to operation of pile drivers; and ■ Air emissions due to operations of DG sets and machinery.
Water Environment	■ Usage of ground water for construction activities and cleaning of PV modules; ■ Surface and ground water contamination due to improper disposal of sewage at site; and ■ Surface and ground water contamination due to spillage of oil, lubricant and hazardous waste.
Ambient Noise Quality	■ Noise generation due to movement of vehicles and machineries; ■ Noise generation due to operation of pile drivers; and ■ Noise generation due to operation of DG set.
Occupational Health and Safety	■ Occupational health hazards due to dust and noise pollution; ■ Safety risk due to wrong handling of construction machinery, working at heights; and ■ Exposure of workers to electromagnetic field (EMF) while working in proximity to charged electric power lines during operation and maintenance.

7.2.1 Assessment Criteria for Change in Land Use

For the purpose of assessment of impacts on land use of the area, following project activities, leading to an alteration in land use of the area during construction phase, were considered:

- Strengthening of access roads and construction of internal access roads;
- Installation of PV modules;
- Construction of Central Monitoring Station, Switching Yard; and
- Establishment and operation of temporary structures such as temporary site office (porta cabin) and store yard.

For the assessment of land use, the sensitivity and magnitude criteria outline in ***Table 7.5*** and ***Table 7.6*** have been used respectively.

Table 7.5 Sensitivity Assessment Criteria for Land Use

Land Use Sensitivity	Criteria
Low	■ Land use not of relevant use by Community ■ Negligible visual change.

Medium	■ Land use of local use by communities e.g. grazing, agriculture, but no major dependence ■ Visual Change but common feature
High	■ Land use of regional importance. Change would impact Land use classification of the area. ■ Land use of major dependence of local people for agriculture, livestock grazing, settlement etc. ■ Visual Change aesthetically affecting locals.

Table 7.6 Criteria for Impact Magnitude for Assessment of Impact to Land Use

Magnitude	Criteria
Negligible	An imperceptible, barely or rarely perceptible change in land use characteristics. The change may be short term.
Small	Subtle changes in land use character over a wide area of a more noticeable change either over a restricted area or infrequently perceived. The change may be short term to long term and is reversible.
Medium	A noticeable change in land use character, frequently perceived or continuous and over a wide area; or a clearly evident change over a restricted area that may be infrequently perceived. The change may be medium to long term and may not be reversible.
Large	A clearly evident, frequently perceived and continuous change in land use characteristics affecting an extensive area. The change may be long term and would not be reversible.

7.2.2 Assessment Criteria for Impact on Topography and Drainage

For the purpose of assessment of impacts on topography and drainage of the area, sensitivity and magnitude criteria have been outlined in ***Table 7.7*** and ***Table 7.8*** respectively.

Table 7.7 Sensitivity Assessment Criteria for Topography

Topography and Drainage Sensitivity	Criteria
Low	Flat topography
Medium	Undulating topography
High	Hilly area

Table 7.8 Criteria for Impact Magnitude for Assessment of Impacts on Topography and Drainage

Magnitude	Criteria
Negligible	An imperceptible, barely or rarely perceptible change in topographical characteristics. The change may be short term.

Small	A subtle change in topography character over a wide area of a more noticeable change either over a restricted area or infrequently perceived. The change may be short term to long term and is reversible.
Medium	A noticeable change in topographic character, frequently perceived or continuous and over a wide area; or a clearly evident change over a restricted area that may be infrequently perceived. The change may be medium to long term and may not be reversible.
Large	A clearly evident, frequently perceived and continuous change in topographic characteristics affecting an extensive area. The change may be long term and would not be reversible.

7.2.3 Assessment Criteria for Impact on Soil Environment

7.2.3.1 Project Phases and Associated Activities

For impact assessment, the following phases of the project cycles were considered for potential impacts on the soil environment. The phase wise project activities that may impact the environment are described below.

Construction Phase

- Construction/strengthening of access roads;
- Vegetarian clearance and top soil removal;
- Storage of oil and lubricants onsite;
- Storage of construction materials; and
- Disposal of different type of waste generated from the temporary project site.

Operation and Maintenance Phase

- Storage of oil and lubricants onsite;
- Disposal of municipal solid waste and waste water from site office; and
- Storage of waste materials onsite.

Decommissioning Phase

- Removal of PV modules; and
- Removal of associated infrastructure.

For the assessment of soil quality, the sensitivity and magnitude criteria is as outlines in ***Table 7.9*** and ***Table 7.10*** respectively.

Table 7.9 Sensitivity Assessment Criteria for Soil Quality (compaction, erosion and contamination)

Sensitivity Criteria	Contributing Criteria	
	Environment	***Social***
Soil Quality related criteria as compaction, erosion and	The extent to which the soil and its quality plays an ecosystem role in terms of supporting biodiversity. This includes its role as in supporting a lifecycle stage	The extent to which the soil and its quality provides a use (agricultural use) to the local communities and businesses, or is important in

Sensitivity Criteria	Contributing Criteria	
	Environment	***Social***
contamination and Land use change		terms of national resource protection objectives, targets and legislation
Low	The soil quality does not support diverse habitat or populations and/or supports habitat or population of low quality	The soil quality has little or no role in provisioning of services as agricultural uses for the local community.
Medium	The soil quality supports diverse habitat or population of flora and fauna and supports habitats commonly available in the study area	The soil has local importance in terms of provisioning services as agricultural services but there is ample capacity and / or adequate opportunity for alternative sources of comparable quality i.e. ready availability across the study area.
High	The soil quality supports economically important or biologically unique species or provides essential habitat for such species.	The soil is wholly relied upon locally, with no suitable technically or economically feasible alternatives, or is important at a regional level for provisioning services.

Table 7.10 Criteria for Impact Magnitude for Assessment of Impact to Soil

Magnitude Criteria	Negligible	Small	Medium	Large
Soil compaction and erosion	■ Qualitative-No perceptible or readily measurable change from baseline conditions ■ Scale-Localized area as Particular activity areas ■ Time-Short duration (few days) or one time as temporary	■ Perceptible change from baseline conditions but likely to easily revert back to earlier stage with mitigation ■ Scale- - Project site, activity areas and immediate vicinity not impacting any sensitive receptor ■ Short term-Only during particular activities or phase of the project lifecycle as	■ Clearly evident (e.g. perceptible and readily measurable) change from baseline conditions and/or likely take time to revert back to earlier stage with mitigation ■ Scale- Project site, activity areas and immediate vicinity impacting sensitive receptor/s ■ Long term-Spread across several phases of the project	■ Major (e.g. order of magnitude) change in comparison to baseline conditions and/or likely difficult or may not to revert back to earlier stage with mitigation ■ Scale-Regional or international; ■ Permanent change

		civil works or construction phase (few months)	lifecycle (few years)	
Soil contamination	Well within standards	Well within standards	Exceeds Target Value but well within Interventional Value	Exceeds Interventional Value and needs intervention.

7.2.4 Assessment Criteria for Impact on Water Environment

The impacts of project on the water environment are assessed due to consumption of water during project activities and contamination of water from accidental spillage of fuel, lubricant and hazardous waste.

For the assessment of water quality, the sensitivity criteria and magnitude criteria are outlined in ***Table 7.11*** and ***Table 7.12*** respectively have been used.

Table 7.11 Sensitivity Assessment Criteria for Water Resources (Surface water and Ground water)

Sensitivity Criteria	Contributing Criteria	
	Environment	***Social***
Water Resources - Surface water and ground water (quality/quantity related criteria)	The extent to which the water resource plays an ecosystem or amenity role in terms of supporting biodiversity either directly or indirectly, particularly with respect to dependent ecosystems.	The extent to which the water resource provides or could provide a use (drinking water, agricultural uses, washing and other domestic or industrial, use as waterways) to the local communities and businesses, or is important in terms of national resource protection objectives, targets and legislation.
Low	The water resource does not support diverse aquatic habitat or populations, or supports aquatic habitat or population that is of low quality.	The water resource has little or no role in terms of provisioning services as agricultural water source, other domestic uses as washing, bathing, industrial use and waterways for the local community. The groundwater resource is not currently abstracted and used in the vicinity of the Project, but is of sufficient quality and yield to be used for that purpose in the future (and there is a reasonable potential for future use).
Medium	The water resource supports diverse populations of flora and / or fauna but available in the surface water bodies in the region.	The surface water resources have local importance in terms of provisioning services but there is ample capacity and / or adequate opportunity for alternative sources of comparable quality.

Sensitivity Criteria	Contributing Criteria	
	Environment	***Social***
		The groundwater resource is an important water supply, and is currently used, but there is capacity and / or adequate opportunity for alternative sources of comparable quality.
High	The water resource supports economically important or biologically unique aquatic species or provides essential habitat for such species.	The surface water resources are wholly relied upon locally, with no suitable technically or economically feasible alternatives, it is important at a regional or transboundary watershed level for provisioning services. The groundwater resource is wholly relied upon locally, with no suitable technically or economically feasible alternatives. The development stage of groundwater is critical or over exploited.

Table 7.12 Criteria for Impact Magnitude for Assessment of Impact to Surface and Groundwater Resources

Magnitude Criteria	Negligible	Small	Medium	Large
General Criteria	No perceptible or readily measurable change from baseline conditions.	Perceptible change from baseline conditions but likely to be within applicable norms and standards for mode of use.	Clearly evident (e.g. perceptible and readily measurable) change from baseline conditions and / or likely to approach and even occasionally exceed applicable norms and standards for mode of use.	Major changes in comparison to baseline conditions and / or likely to regularly or continually exceed applicable norms and standards for mode of use.
Water	There is likely to be negligible or no consumption of surface water by the Project at any time	The Project will consume surface water, but the amounts abstracted are likely to be relatively small in comparison to the resource available at the time of use (i.e. taking into account seasonal fluctuation)	The Project will consume surface water, and the amounts abstracted are likely to be significant in comparison to the resource available at the time of use (i.e. taking into account seasonal fluctuation)	The Project will consume surface water, and the amounts abstracted are likely to be very significant in comparison to the resource available at the time of use (i.e. taking into account seasonal fluctuation)
	There is likely to be negligible or no	The Project will consume	The Project will consume groundwater or	The Project will consume groundwater

Magnitude Criteria	Negligible	Small	Medium	Large
	abstraction, use of or discharge to the groundwater by the Project at any time.	groundwater or deliver discharge to groundwater, but the amounts abstracted / discharged are likely to be relatively small in comparison to the resource available at the time of use (i.e. taking into account seasonal fluctuation).	discharge to groundwater, and the amounts abstracted / discharged are likely to be significant in comparison to the resource available at the time of use (i.e. taking into account seasonal fluctuation).	or discharge to groundwater, and the amounts abstracted / discharged are likely to be very significant in comparison to the resource available at the time of use (i.e. taking into account seasonal fluctuation).

7.2.5 Assessment Criteria for Impact on Air Quality

The assessment with respect to air quality of the study area has been done for the following project activities:

- Fugitive emissions from site clearing, excavation work, material handling etc.;
- Fugitive emission from traffic movement;
- Exhaust emission from operation of machineries like pile drivers, vehicles; and
- Point source emission from diesel generator.

The sensitivity criteria and impact magnitude criteria has been provided in ***Table 7.13*** and ***Table 7.14*** respectively.

Table 7.13 Sensitivity criteria for air quality

Sensitivity Criteria	Contributing Criteria	
	Human Receptors	***Ecological Receptors***
Low	Locations where human exposure is transient.[129]	No
Medium	Few Receptors (settlements) within 500 m of the project site	Nationally designated sites.
High	Densely populated receptors(settlements) within 500 m of project site	Internationally designated sites.

Table 7.14 Criteria for Impact Magnitude for Assessment of Impact to Air Quality

Magnitude Criteria	Negligible	Small	Medium	Large

[29] As per the NAAQS and World Bank/IFC guidelines, there are no standards that apply to short –term exposure, e.g., one or two hours, but there is still a risk of health impacts, albeit less certain.

Air Quality	Soil type with large grain size (e.g. sand); and/or No emissions/dust generation due to Project across all phases	Soil type with large grain size (e.g. sand); and/or Limited emissions/dust generations for short duration	Moderately dusty soil type (e.g. silt); and/or Dust generation and emissions from Projects for long duration	Potentially dusty soil type (e.g. clay, which will be prone to suspension when dry due to small particle size); and Significant process emissions from Project for the entire Project cycle.

7.2.6 Assessment Criteria for Impact on Ambient Noise

The assessment with respect to ambient noise quality of the study area has been done for the following project activities:

- Construction activities including site preparation, piling work, access road widening, construction of ancillary facilities;
- Transportation of construction materials, machinery and personnel;
- Operation of DG sets; and
- Demolition activities during decommissioning phase.

The ambient noise levels have been assessed with respect to Noise Pollution (Regulation and Control) Rules, 2000 and WHO Guidelines as shown in ***Table 7.15*** and ***Table 7.16*** respectively.

Table 7.15 Ambient noise quality standards

Area Code	Category of Area	Limits in dB(A) L_{eq}*	
		Day Time	Night Time
(A)	Industrial Area	75	70
(B)	Commercial Area	65	55
(C)	Residential Area	55	45
(D)	Silence Zone	50	40

Note:
1. Day time shall mean from 6.00 a.m. and 10.00 p.m.
2. Night time shall mean from 10.00 p.m. and 6.00 a.m.
3. Silence zone is an area comprising not less than 100 metres around hospitals, educational institutions, courts, religious places or any other area which is declared as such by the competent authority.
4. Mixed categories of areas may be declared as one of the four above mentioned categories by the competent authority.

* dB(A) Leq denotes the time weighted average of the level of sound in decibels on scale A which is relatable to human hearing. A “decibel” is a unit in which noise is measured. “A”, in dB (A) Leq, denotes the frequency weighting in the measurement of noise and corresponds to frequency response characteristics of the human ear. Leq: It is energy mean of the noise level over a specified period

Table 7.16 Noise emission criteria

Location	Noise Level Limit (dB(A)	
	Daytime (0700 – 2200 hrs)	Night-time (2200 – 0700 hrs)
Industrial; commercial	70	70

Residential; institutional; educational	55	45

Source: Guidelines values are for noise levels measured out of doors. Source: Guidelines for Community Noise, World Health Organisation (WHO), 1999.

The above standards have been utilized to create a sensitivity criteria for ambient noise and criteria for impact magnitude for assessment of impact to ambient noise.

Table 7.17 Sensitivity criteria for ambient noise

Sensitivity Criteria	Contributing Criteria	
	Human Receptors	***Ecological Receptors***
Low	Industrial Use	Locally designated sites; and/or areas of specific ecological interest, not subject to statutory protection (for example, as defined by the project ecology team).
Medium	Residential and Recreational place	Nationally designated sites.
High	Educational/ Religious/ Medical Facilities	Internationally designated sites.

Table 7.18 Criteria for impact magnitude for assessment of impact to ambient noise

Magnitude Criteria	Negligible	Small	Medium	Large
Noise Quality	Predicted noise levels are at or less than 3 dB (A) above the relevant limits / thresholds. Short term exposure (Few hours in a day and not continuous)	Predicted noise levels are 3 to less than 5 dB (A) above the relevant limits / thresholds.	Predicted noise levels are between 5 and 10 dB (A) above the relevant limits / thresholds. Medium Term Exposure (1 to 6 months)	Predicted noise levels are more than 10 dB (A) above the relevant limits / thresholds. Long term exposure (> 6 months)

7.2.7 Assessment Criteria for Socio-economic Impacts

For the assessment of social impacts, the sensitivity and magnitude criteria outlined in ***Table*** 7.20 and ***Table 7.21*** respectively have been used.

The social impacts associated with the operations and decommissioning stages have been assessed qualitatively and in some cases quantitatively (subject to availability of data), using professional judgement and based on past experience from similar projects.

Table 7.19 Identified interactions that are likely to result in significant impacts

Resource/Receptor	Potentially Significant Impacts
Economic Opportunities	The impacts on economic opportunities include the local community within the study area.
Labour Influx/ Migrant Workforce	Due to lack of the required skills among the local youth, the migrant labourers might be engaged during the construction phase
Community Health and Safety	During the construction Phase, the movement of material and personnel may result in impacts on the health and safety of the community
Indigenous Communities	The proposed site does not fall under schedule v area,It was reported by Land Aggregator that no tribal land has been identified/ procured for the project and none of the land owners belong to schedule tribal community .
Economy and Employment	The project will lead to creation of local employment and procurement opportunities during the construction phase. As majority of total workforce engaged during construction period will be sourced from nearby areas.

Table 7.20 Impact Magnitude for Local Communities

Category	Extent / Duration / Scale / Frequency
Large	Change dominates over baseline conditions. Affects the majority of the area or population in the area of influence and/or persists over many years. The impact may be experienced over a regional or national area.
Medium	Clearly evident difference from baseline conditions. Tendency is that impact affects a substantial area or number of people and/or is of medium duration. Frequency may be occasional and impact may potentially be regional in scale.
Small	Perceptible difference from baseline conditions. Tendency is that impact is local, rare and affects a small proportion of receptors and is of a short duration.
Negligible	Change remains within the range commonly experienced within the household or community.

Table 7.21 Receptor Sensitivity for Local Communities

Category	Extent / Duration / Scale / Frequency
High	Profound or multiple levels of vulnerability that undermine the ability to adapt to changes brought by the Project.
Medium	Some but few areas of vulnerability; but still retaining an ability to at least in part adapt to change brought by the Project.
Low	Minimal vulnerability; consequently with a high ability to adapt to changes brought by the Project and opportunities associated with it.

On the basis of this understanding of magnitude and sensitivity, the significance of impacts will be assessed, as depicted in the table below.

Table 7.22 Impact Significance Matrix

Receptor Sensitivity	Impact Magnitude			
	Negligible	Small	Medium	Large
Low	Negligible	Negligible	Minor	Moderate

Receptor Sensitivity	Impact Magnitude			
	Negligible	Small	Medium	Large
Medium	Negligible	Minor	Moderate	Major
High	Negligible	Moderate	Major	Critical

7.2.8 Assessment Criteria for Ecological Impacts

ERM Impact Assessment Standards define sensitivity of ecological receptors by determining the significance of effects on species and habitats separately. The significance tables for species and habitats are given in tables below.

Table 7.23 Habitat-Impact Assessment Criteria

Habitat Sensitivity/ Value		Magnitude of Effect on Baseline Habitats			
		Negligible	Small	Medium	Large
		Effect is within the normal range of variation	Affects only a small area of habitat, such that there is no loss of viability/ function of the habitat	Affects part of the habitat but does not threaten the long-term viability/ function of the habitat	Affects the entire habitat, or a significant portion of it, and the long-term viability/ function of the habitat is threatened.
Negligible	Habitats with negligible interest for biodiversity.	**Negligible**	**Negligible**	**Negligible**	**Negligible**
Low	Habitats with no, or only a local designation / recognition, habitats of significance for species listed as of Least Concern (LC) on IUCN Red List of Threatened Species, habitats which are common and widespread within the region, or with low conservation interest based on expert opinion.	**Negligible**	**Negligible**	**Minor**	**Moderate**
Medium	Habitats within nationally designated or recognised areas, habitats of significant importance to globally Vulnerable (VU) Near Threatened (NT), or Data Deficient (DD) species, habitats of significant importance for nationally restricted range species, habitats supporting nationally significant concentrations of migratory species and / or congregatory species, and low value habitats used by species of medium value.	**Negligible**	**Minor**	**Moderate**	**Major**
High	Habitats within internationally designated or recognised areas; habitats of significant importance to globally Critically Endangered (CR) or Endangered (EN) species, habitats of significant importance to endemic and/or globally restricted-range species, habitats supporting globally significant concentrations of migratory species and / or congregatory species, highly threatened and/or unique ecosystems, areas associated with key evolutionary species, and low or medium value habitats used by high value species.	**Negligible**	**Moderate**	**Major**	**Critical**

Table 7.24 Species-Impact Assessment Criteria

Baseline Species Sensitivity/ Value		Magnitude of Effect on Baseline Habitats			
		Negligible	Small	Medium	Large
		Effect is within the normal range of variation for the population of the species	Effect does not cause a substantial change in the population of the species or other species dependent on it	Effect causes a substantial change in abundance and/or reduction in distribution of a population over one, or more generations, but does not threatened the long term viability/ function of that population dependent on it.	Affects entire population, or a significant part of it causing a substantial decline in abundance and/or change in and recovery of the population (or another dependent on it) is not possible either at all, or within several generations due to natural recruitment (reproduction, immigration from unaffected areas).
Negligible	Species with no specific value or importance attached to them.	**Negligible**	**Negligible**	**Negligible**	**Negligible**
Low	Species and sub-species of LC on the IUCN Red List, or not meeting criteria for medium or high value.	**Negligible**	**Negligible**	**Minor**	**Moderate**
Medium	Species on IUCN Red List as VU, NT, or DD, species protected under national legislation, nationally restricted range species, nationally important numbers of migratory, or congregatory species, species not meeting criteria for high value, and species vital to the survival of a medium value species.	**Negligible**	**Minor**	**Moderate**	**Major**
High	Species on IUCN Red List as CR, or EN. Species having a globally restricted range (i.e. plants endemic to a site, or found globally at fewer than 10 sites, fauna having a distribution range (or globally breeding range for bird species) less than 50,000 km^2), internationally important numbers of migratory, or congregatory species, key evolutionary species, and species vital to the survival of a high value species.	**Negligible**	**Moderate**	**Major**	**Critical**

7.3 Construction Phase Impacts

7.3.1 Change in Land use and Land Cover

7.3.1.1 Context

The predominant land use/cover of the study area within 5 km radius includes agricultural land. The Project will be set up over agricultural land, however the identified land is not suitable for agricultural purposes due to low fertility of the land. Therefore impacts envisaged on land use are small. As for land cover, the Project site was observed to be devoid of any vegetation at the time of ERM site visit.

Furthermore, the Project construction phase will not involve construction of new roads, but may involve developing of access roads within the project site. As part of site clearance, vegetation in the form of grasses and shrubbery will be cleared to set up the Project.

7.3.1.2 Embedded/inbuilt controls

Radiance did not share the Project's proposed embedded/in-built control, however, as part of general industry practices the following control will be implemented:

- Construction activities will be restricted to within the allotted land and immediate surroundings only;
- After construction work, any land taken for a temporary basis for storage of material will be restored to their original form;
- Existing roads will be used for access to the Project site.

7.3.1.3 Impact Significance

The establishment of the solar project will lead to conversion of land for industrial use for a long term (25 years). Changes in land use are also envisaged for material store yard and temporary site office (porta cabin). However, those changes in land use will take place only during construction period (~6 months). Therefore, the impact magnitude is assessed to be **medium** and the overall significance of impact is assessed to be **moderate**.

7.3.1.4 Additional Mitigation Measures

- Construction activities should be restricted to designated area;
- On completion of construction activities, land used for temporary facilities such as stockyard should be restored to the extent possible;
- The land use in and around permanent Project facilities should not be disturbed.

7.3.1.5 Residual Impact Significance

The residual impact significance will remain **moderate** as changes in land use will be long term for majority of the project component (installation of PV modules, access roads, central monitoring station, switching yard).

Impact	**Change in land use and land cover during construction and operation**			
Impact Nature	Negative	Positive	Neutral	
Impact Type	Direct	Indirect	Induced	
Impact Duration	Temporary	Short-term	Long-term	Permanent
Impact Extent	Local	Regional	International	
Impact Scale	Limited to the Project site and immediate surroundings			

Impact Magnitude	Positive	Negligible	Small	**Medium**	Large
Resource/ Receptor Sensitivity	Low	**Medium**	High		
Impact Significance	Negligible	Minor	**Moderate**	Major	
	Significance of impact is assessed to be moderate.				
Residual Impact Magnitude	Positive	Negligible	Small	**Medium**	Large
Residual Impact Significance	Negligible	Minor	**Moderate**	Major	
	Significance of impact is assessed to be moderate as well.				

7.3.2 Impact on Topography and Drainage

7.3.2.1 Context

The project area exhibits fairly flat topography with very slight undulation. There are no major waterbodies within the proposed project site, however the Project site consists of micro-drainage channels and manmade ponds. Since the proposed Project and the access road are located on flat terrain, but plot on does consist of micro-drainage channels, the receptor sensitivity has been assessed to be **low to medium**

7.3.2.2 Embedded/inbuilt controls

Radiance did not share the Project's proposed embedded/in-built control, however, as part of general industry practices, the EPC contractor will be instructed to avoid any unnecessary changes in the topography.

7.3.2.3 Impact Significance

Ground levelling activities will involve a slight change in the topography. These changes will be long term considering the lifecycle of the Project is 25 years. The proposed Project site does have micro drainage channels (newly identified land) and Radiance may need to adopt mitigation measures to avoid blocking natural drainage flow from the Project site in the future. Therefore, the impact magnitude is assessed to be small to medium and the overall significance of impact is assessed to be minor to moderate.

7.3.2.4 Additional Mitigation Measures

A storm water drainage system will need to be installed at the Project site to ensure passage for water to the micro-drainage channels outside the Project site.

7.3.2.5 Residual Impact Significance

Upon application of additional mitigation measure, the residual impact significance will become minor.

Impact	**Change in topography and drainage**				
Impact Nature	**Negative**	Positive	Neutral		
Impact Type	**Direct**	Indirect	Induced		
Impact Duration	Temporary	Short-term	**Long-term**	Permanent	
Impact Extent	**Local**	Regional	International		
Impact Scale	Limited to Project site, immediate surroundings, and access road.				
Impact Magnitude	Positive	Negligible	**Small**	**Medium**	Large

Resource/ Receptor Sensitivity	Low		Medium		High
Impact Significance	Negligible	Minor	Moderate		Major
	Significance of impact is assessed to be minor to moderate.				
Residual Impact Magnitude	Positive	Negligible	Small	Medium	Large
Residual Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is assessed to be minor.				

7.3.3 Impact on Soil Environment

7.3.3.1 Soil Compaction and Erosion

Context

Soil compaction and erosion has been considered for the construction and decommissioning phases only. The receptor sensitivity has been assessed as medium considering the Project is being set up in agricultural land and agricultural activities are being undertaken on the exiting land parcel, also that receptors are present within 1 km radius of the site. Site clearance, excavation for foundation and possible access road upgradation will largely affect the top layers of the soil. Site clearance will be restricted only to the Project site. Agricultural land close to the project site will not be disturbed. Therefore, the impact magnitude is assessed to be small.

The quality of access road was assessed to be moderate due to it being unpaved, and can lead to soil erosion impacts during the construction phase. Therefore minor strengthening will be required to ensure there is no soil erosion. The usage of existing access roads by vehicles and minimal access road construction/upgradation will reduce the impact from soil compaction in the area.

In the **operation phase**, soil compaction and erosion may occur due to vehicle movement, which only happens during the occasional maintenance activities. Soil compaction for the operation phase has therefore been considered infrequent and negligible.

Embedded/inbuilt controls

Radiance did not share the Project's proposed embedded/in-built control, however, as part of general industry practices vehicles will utilize existing roads to access the site.

Impact Significance

The overall impact significance on soil erosion and compaction has been assessed as minor.

Additional Mitigation Measures

Site clearance, piling, excavation and access road upgradation will not be carried out during the monsoon/windy season to minimize erosion and run-off.

Residual Impact Significance

The significance of residual impacts has been reduced to **negligible** taking into account the recommended mitigation measures.

Impact	**Soil Erosion and Compact (Construction and Decommissioning)**		
Impact Nature	Negative	Positive	Neutral
Impact Type	Direct	Indirect	Induced

Impact Duration	Temporary	**Short-term**	Long-term	Permanent	
Impact Extent	**Local**	Regional	International		
Impact Scale	Limited to Project site, immediate surroundings and access road				
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
Resource/ Receptor Sensitivity	Low	**Medium**	High		
Impact Significance	Negligible	**Minor**	Moderate	Major	
	Significance of impact is assessed to be minor				
Residual Impact Magnitude	Positive	**Negligible**	Small	Medium	Large
Residual Impact Significance	**Negligible**	Minor	Moderate	Major	
	Significance of impact is assessed to be negligible				

7.3.3.2 Soil Contamination due to Improper Waste Disposal

Context

General construction waste generated onsite will comprise of concrete, steel cuttings/filings, packaging paper or plastic etc. Municipal solid wastes consisting of food waste, plastic, glass and waste paper will also be generated by the construction workforce at canteen facility. A small proportion of the waste generated during construction phase will be hazardous and will include waste fuel, grease and waste oil containing rags. Used transformer oil and damaged PV cells, which are categorised as hazardous waste, will be generated from the plant. If improperly managed, solid waste could create impacts on soil quality. Therefore, the receptor sensitivity has been assessed as medium.

The impact magnitude has been assessed as medium as the Project is being set up on an agricultural land. The client will need to manage the solar power project through effective management systems for waste and hazardous substances being generated or utilized during the project life cycle.

Embedded/inbuilt controls

Radiance did not share the Project's proposed embedded/in-built control, however, as part of general industry practices hazardous material and waste will be properly labelled, stored onsite at a location provided with impervious surface and in a secondary containment system.

Impact Significance

The overall impact significance for waste generation and soil contamination has been assessed as **moderate**, since the site is present on agricultural land, and the waste management infrastructure will need to developed.

Additional Mitigation Measures

- EPC Contractor should ensure that no unauthorized dumping of used oil and other hazardous waste is undertaken at the site;
- Designated areas should be provided for Solid Municipal Waste and daily collection and period disposal should be ensured;
- Construction and Demolition Waste should be stored separately and be periodically collected by an authorized agency;

- All waste should be stored in a shed that is protected from the elements (wind, rain, storms, etc.) and away from natural drainage channels;
- A log book should be maintained for quantity and type of hazardous waste generated; and
- In case of accidental/unintended spillage, the contaminated soil should be immediately collected and stored as hazardous waste.

Residual Impact Significance

The significance of impacts due to waste generation during the construction phase after implementation of mitigation measures has been considered as **minor**.

Impact	**Impact on soil environment due to waste generation (hazardous and non-hazardous)**				
Impact Nature	Negative	Positive	Neutral		
Impact Type	Direct	Indirect	Induced		
Impact Duration	Temporary	Short-term	Long-term	Permanent	
Impact Extent	Local	Regional	International		
Impact Scale	Limited to Project site and immediate surroundings with occasional frequency				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource/ Receptor Sensitivity	Low	Medium	High		
Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is assessed to be moderate.				
Residual Impact Magnitude	Positive	Negligible	Small	Medium	Large
Residual Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is assessed to be minor.				

7.3.4 Impact on Water Environment

7.3.4.1 Water Availability

Context

According to the CGWB report on Aquifer Maps and Ground Water Management Plan, Jalna District, Mahrashtra, 2018, the groundwater in Ghanaswangi block is classified under '**SAFE**' category with 54.69% of stage of ground water development. Ghanaswangi taluka is a not a water stressed region and the groundwater resources have been classified as safe.

There are multiple dug wells present within the project site along with minor drainage channels and and artificial ponds. Considering the overall high dependence on water resources and multiple groundwater resources to meet the demand, the receptor sensitivity has been classified as medium.

Embedded/inbuilt controls

Radiance did not share the Project's proposed embedded/in-built control, however, as part of general industry practices it will be ensured that the local water availability is not adversely impacted during the construction phase. In case of additional water requirement than peak requirement, water will be obtained through an authorised vendor who has relevant permits (such as one from gram panchayat) for obtaining water from nearby water resource.

Impact Significance

Considering the groundwater availability scenario in Ghanaswangi Taluka, Jalna district and the short duration of construction phase (6-8 months), the impact magnitude is assessed to be small. Taking into consideration the receptor sensitivity and impact magnitude, the overall significance of impact is assessed to be minor.

Additional Mitigation Measures

- It shall be ensured that the Project obtains necessary authorisation from Gram Panchayat and/or notify Water Resources Department, Government of Maharashtra before utilising groundwater for industrial purposes;
- Conditions in the NOC obtained from CGWA to be complied with;
- Maintain separate and thorough logbooks of water consumption for industrial and domestic usage; and
- Prepare and implement water conservation scheme e.g., rainwater harvesting at the project site, to recharge groundwater; and
- No construction activities should be undertaken during monsoon season. A storm water drainage system for season showers shall be installed at the site.

Residual Impact Significance

Residual impact significance upon application of additional mitigation measures, considering the water availability scenario in the region is considered as **Minor**.

Impact	**Impact on water availability during construction**				
Impact Nature	Negative	Positive	Neutral		
Impact Type	Direct	Indirect	Induced		
Impact Duration	Temporary	Short-term	Long-term	Permanent	
Impact Extent	Local	Regional	International		
Impact Scale	Limited to Project site and immediate surroundings				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource/ Receptor Sensitivity	Low	Medium	High		
Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is assessed to be minor				
Residual Impact Magnitude	Positive	Negligible	Small	Medium	Large
Residual Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is assessed to be minor as well				

7.3.4.2 Water Quality

Context

There is a potential for contamination of surface and groundwater resources from improper management of wastewater and any accidental spills/leaks/leaching of contaminants into groundwater layers from storage areas of the Project. As there are no major water bodies in the study area, however presence of multiple dug wells, artificial ponds and presence of micro drainage channels, the

likelihood of impact to surface water body resources is small to medium. The impact to groundwater resources, however, has to be considered for the Project. Groundwater quality in the area may be affected due to mismanagement of hazardous and non-hazardous materials/wastes during the construction phase of the Project. Therefore, the receptor sensitivity is assessed to be medium.

The soil was observed to be predominantly black cotton soil which is silty/clayey (medium percolation rate) with presence of silica, quartz, basalt and gravels (high percolation rate), therefore, the magnitude of accidental spillage of hazardous/non-hazardous materials may vary. Also, the construction phase of the Project will be short term. Therefore, the impact significance is assessed to be moderate.

Embedded/inbuilt controls

Radiance did not share the Project's proposed embedded/in-built control, however, as part of general industry practices provision for impervious storage area, especially for fuel & lubricant, hazardous waste, etc. will be made onsite.

Impact Significance

The overall impact significance is therefore assessed to be moderate.

Additional Mitigation Measures

- Hazardous material should be kept on impervious layer with secondary containment;
- In case of accidental/unintended spillage, the contaminated soil should be immediately collected and stored as hazardous waste;
- Regularly monitoring the ground water quality by engaging a NABL accredited laboratory to be undertaken.

Residual Impact Significance

Residual impact significance retained as minor upon application of additional mitigation measures.

Impact	**Impact on water quality during construction phase**				
Impact Nature	Negative	Positive	Neutral		
Impact Type	Direct	Indirect	Induced		
Impact Duration	Temporary	Short-term	Long-term	Permanent	
Impact Extent	Local	Regional	International		
Impact Scale	Limited to Project site and immediate surroundings				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource/ Receptor Sensitivity	Low	Medium	High		
Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is assessed to be moderate				
Residual Impact Magnitude	Positive	Negligible	Small	Medium	Large
Residual Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is assessed to be minor				

7.3.5 Impact on Air Quality

7.3.5.1 Context

Air quality impacts in the construction phase will be largely due to the following sources:

- Fugitive dust emissions from site clearance, piling work, handling of construction materials, emission due to movement of vehicles on unpaved roads, plying of vehicles, etc.
- Vehicular emissions due to increased traffic movement on site and on the approach roads;
- Exhaust emissions from construction machinery and other equipment such as pile drivers; and
- Emissions from diesel generators required to be run for construction power purposes.

The receptor sensitivity has been assessed as medium for human receptors, considering that there are settlements located within 1 km radius as well as in the near vicinity of the project site.

The biggest source of emissions in the construction phase is the fugitive dust emissions from construction activities. The construction activities are also going to occur for a small period of time (~6-8 months). The impact magnitude has been categorized as medium because dust emissions will occur frequently, especially at the Project site during site clearance and preparation.

No impacts are envisaged during operational phase of the Project with respect to impact on air quality.

7.3.5.2 Embedded/inbuilt controls

- Diesel generator use should be restricted to emergencies and power back-up only to minimize air emissions; and
- Vehicle engines need to be properly maintained and should have a valid Pollution under Control (PUC) to ensure minimization in vehicular emissions.

7.3.5.3 Impact Significance

The impact significance for air quality in the construction phase is assessed as moderate considering the proximity of the Project to nearby receptors. There will be some impacts due to plying of vehicles on the access roads and during site preparation and clearance. The impacts however, are not anticipated to be significant considering short duration of the construction phase of the project.

7.3.5.4 Additional Mitigation Measures

- Speed of vehicles on site should be limited to 10-15 km/hr;
- DG sets should be placed within enclosures and have an adequate stack height;
- Switch off machinery and equipment when not in use;
- Prevent idling of vehicles and equipment; and
- Vehicle engines need to be properly maintained and should have a valid Pollution under Control (PUC) to ensure minimization in vehicular emissions.

7.3.5.5 Residual Impact Significance

The significance of residual impact will be minor after implementing mitigation measures.

Impact	**Impact on ambient air quality during construction phase**			
Impact Nature	Negative	Positive	Neutral	
Impact Type	Direct	Indirect	Induced	
Impact Duration	Temporary	Short-term	Long-term	Permanent

Impact Extent	Local	Regional	International		
Impact Scale	Limited to Project site and immediate surroundings				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource/ Receptor Sensitivity	Low	Medium	High		
Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is assessed to be moderate.				
Residual Impact Magnitude	Positive	Negligible	Small	Medium	Large
Residual Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is assessed to be minor.				

7.3.6 Impact on Ambient Noise

7.3.6.1 Context

The sources of noise in the construction phase include construction activities, operation of DG sets and movement of vehicles. There will also be increased noise levels because of increased anthropogenic movement in the area.

Due to presence of residential settlements within 500m of the project site and within 1 km radius of the Project site and it is envisaged that human settlements in the vicinity will be affected by increased noise levels during construction phase because of proximity to the Project site. However, movement on the approach roads and the access road will lead to increased noise impacts on settlements along said roads (especially approach roads) due to increased vehicular movement. The noise levels are predicted to be between 5 -10 dB (A) above the prescribed limits of CPCB during the construction phase. Furthermore, no construction activities will be carried out during night time. Therefore, receptor sensitivity is therefore considered as low to medium**.**

Impact magnitude is considered to be small to medium, considering the construction period of the Project will last for approximately 6-8 months. However, the impacts may decrease due to Project's proximity to the nearby villages**.**

No impacts are envisaged during operational phase of the Project with respect to impact on ambient noise.

7.3.6.2 Embedded/inbuilt controls

As a general industry practice, Radiance will ensure normal working hours of the contractor are defined (preferable 8 am to 6 pm). If work needs to be undertaken outside these hours, it will be limited to activities which do not generate noise.

7.3.6.3 Impact Significance

The impact significance has therefore been assessed as minor to moderate, considering the increase in noise levels during the construction phase and proximity of the Project to nearby settlements.

7.3.6.4 Additional Mitigation Measures

- Construct an enclosure around the construction site that will act as a noise barrier to minimize the effects of noise pollution;
- Only well-maintained equipment should be operated on-site;

- Machinery and construction equipment that may be in intermittent use should be shut down or throttled down during non-work periods; and
- Minimal use of vehicle horns and heavy engine breaking in the area needs to be encouraged.

7.3.6.5 Residual Impact Significance

Significance of residual impact is assessed to be negligible to minor taking into consideration above mentioned mitigation measures.

Impact	**Impact on ambient noise quality during construction phase**				
Impact Nature	Negative	Positive	Neutral		
Impact Type	Direct	Indirect	Induced		
Impact Duration	Temporary	Short-term	Long-term	Permanent	
Impact Extent	Local	Regional	International		
Impact Scale	Limited to Project site and immediate surroundings				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource/ Receptor Sensitivity	Low	Medium	High		
Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is assessed to be minor to moderate.				
Residual Impact Magnitude	Positive	Negligible	Small	Medium	Large
Residual Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is assessed to be negligible to minor.				

7.3.7 Impact on Occupational Health and Safety

7.3.7.1 Context

Working at height will be undertaken during erection of transmission line and stringing of wires. Construction of support structure for PV module would require operation of pile drivers. The installation of solar module will involve operation of cranes and other mechanical lifting equipment. Laying of interconnecting cable with require digging. The commissioning of the inverter rooms and internal transmission line will also involve live power lines. Working at height has the risks of falling from the height and working on live wires carrying power has dangers of electric shock and electrocution. The Project site will also implement proper measures for fire safety, structural safety and any for emergency situations.

The occupational health and safety concerns mentioned above would be consistent across the entire project life cycle (construction, operation and decommissioning stages) and therefore the impacts would be similar in nature.

7.3.7.2 Embedded/inbuilt controls

Radiance did not share the Project's proposed embedded/in-built control, however, as part of general industry practices Radiance will ensure that:

- All construction activities should be carried out during daytime hours and vigilance should be maintained for any potential accidents;
- Personal Protective Equipment (PPEs) including safety shoes, helmet, goggles, ear muffs and face masks;

- Cranes and other lifting equipment are operated by trained and authorised persons;
- Training of the workers on climbing techniques, and rescue of fall-arrested workers;
- Excavated areas should be temporarily fenced to avoid access to outsiders and wildlife;
- An up-to-date first aid box should be provided at all construction sites and a trained person should be appointed to manage it; and
- Electrical and maintenance work should not be carried out during poor weather and during lightning strikes.

7.3.7.3 Impact Significance

The impact on occupational health and safety during the construction phase is evaluated to be of **minor to moderate** significance, as the installation of solar module and laying of internal transmission line will be done through experienced and trained workers.

7.3.7.4 Additional Mitigation Measures

- All workers (regular and contracted) should be provided with training on Health and Safety management system of the EPC contractor during construction stage;
- Obtain and check safety method statements from contractors;
- Monitor health and safety performance, and have an operating audit system;
- Permitting system should be implemented to ensure that cranes and lifting equipment is operated by trained and authorized persons only;
- Appropriate safety harnesses and lowering/raising tools should be used for working at heights;
- All equipment should be turned off and checked when not in use; and
- A safety or emergency management plan should be in place to account for natural disasters, accidents and any emergency situations.

7.3.7.5 Residual Impact Significance

Significance of residual impact is assessed to be **negligible to medium** considering above mentioned mitigation measures.

Impact	**Occupational health and safety during Project life-cycle**				
Impact Nature	Negative	Positive	Neutral		
Impact Type	Direct	Indirect	Induced		
Impact Duration	Temporary	Short-term	Long-term	Permanent	
Impact Extent	Local	Regional	International		
Impact Scale	The construction work involves construction of solar power station along with laying of internal transmission lines, operations work involves regular checks, replacements and maintenance.				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource/ Receptor Sensitivity	Low	Medium	High		
Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is assessed to be minor.				
Residual Impact Magnitude	Positive	Negligible	Small	Medium	Large

Residual Impact Significance	Negligible	Minor	Moderate	Major
	Significance of impact is assessed to be negligible to moderate.			

7.3.8 Impact on Community Health and Safety

7.3.8.1 Source of Impact

The receptors for impacts on community health and safety include project site workers and people residing in settlements in the close proximity of the project site (within 1km and along the access road and transmission line (within 100 m from the centreline), which will be exposed to health impacts from the project activities.

The construction phase activities such as installation of solar PV panels, construction of transmission lines and movement of material and personnel may result in impacts on the health and safety of the community and workers. These activities will involve the use of heavy machinery and live transmission power lines. Furthermore, the movement of material and personnel via the access roads may result in damage to human life or livestock due to accidents. The major community health and safety risks include structural failure of project infrastructure, life and fire safety, public accessibility and management of emergency situations. As per IFC EHS guidelines, the occupational and community health and safety hazards during the construction, operation, and decommissioning of solar power projects are generally similar to those of most large infrastructure projects.

7.3.8.2 Embedded/In-built Controls

It is understood that the following embedded/ in built control measures will be put in place during the construction phase;

- The excavated areas will be properly fenced for safety and sign boards in local languages will be put up;
- No hazardous waste or any waste be stored within the site for long periods of time and be in contact with the soil in order to prevent against ground water contamination;
- The truck drivers carrying construction machinery and materials will be instructed to drive within speed limits with careful consideration for village traffic;
- Movement of heavy equipment and construction materials will be regulated during peak hours (09:00 AM to 06:00 PM).

7.3.8.3 Receptor Sensitivity

The impact to community health and safety during the construction phase is evaluated to be of **minor to moderate** significance due to the low density of population

7.3.8.4 Additional Mitigation measures

The following risk mitigation measures are suggested to minimize the risks/ hazards of construction activities onsite;

- Developing Community Health & Safety Plan;
- Monitoring Contractor's EHS performance for its worker;
- Proper fencing around Project boundaries;
- Drivers should be instructed to follow speed limit and careful while driving to avoid accidents;
- Water sprinkling on roads leading to Project site to avoid dust related impacts on the community;
- Regulating movement of heavy equipment and construction materials during peak hours during the day to avoid community health and safety threats;

- As part of the stakeholder engagement and information disclosure process, providing an understanding to the community concerning the activities proposed to be undertaken and the precautions being adopted for safety;
- Communicating the local community about the accidental risks and safety features of the solar PV panels;
- Construct sanitation facilities for labourers inside the Project area boundaries along with septic tanks to avoid contagion in the adjacent land;
- Involving the district disaster management cell and the nearest fire service station while preparing for emergency situations; and
- Obtain an adequate third party insurance cover to meet the financial loss to any third party due to such emergencies.

7.3.8.5 Residual Impact Significance

After the implementation of the above mitigation measures, the residual impact significance is anticipated to be **negligible to minor.**

Impact	Community Health and Safety				
Impact Nature	Negative	Positive	Neutral		
Impact Type	Direct	Indirect	Induced		
Impact Duration	Temporary	Short-term	Long-term	Permanent	
Impact Extent	Local	Regional	International		
Impact Scale	Project area and vicinity				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource Sensitivity	Low	Medium	High		
Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is considered **Minor to moderate**				
Residual Impact Magnitude	Positive	Negligible	Small	Medium	Major
Residual Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is considered **Negligible to minor**				

7.3.9 Labour Influx and Labour Welfare

The project will employ skilled, semi-skilled and unskilled workers, across the project lifecycle, which will include contractual and regular employees and local and migrant workers. The regular skilled workers are likely to be comprised of migrant workers, from different districts and states in the country, depending upon the need for technical expertise.

Embedded built in control

Radiance should ensure that subcontractor agreements compel each contractor to follow all applicable labour laws.

Significance of Impact

The overall impact significance of the labour rights and welfare during the operation phase is assessed **as minor.** The resource sensitivity is medium and impact magnitude is small considering small size of workforce.

Additional Mitigation Measures

The following additional mitigation measures are suggested in order to ensure compliance with labour laws/provisions as per the industry best practices:

- The labour accommodation facility(if any) for contractual workers and as well as for regular employees should meet the requirements of the applicable reference framework in terms of space per worker, water and sanitation facilities, first aid, lighting and ventilation etc. and regular monitoring should be undertaken to ensure compliance through the project lifecycle;
- Radiance should ensure a monthly monitoring and regular auditing mechanism for monitoring the sub-contractors and suppliers with respect to compliance to the applicable reference framework, in terms of resources, migrant workers, child labour and forced labour, health and safety, payment of wages etc.; and
- Establish a grievance redressal mechanism in place, to allow for the employees and workers to report any concern or grievance related to work activities.

Residual Impact Significance

The significance of impact will be reduced to **minor** on implementation of mitigation measures

Impact	**Labour Influx/ migrant workforce**				
Impact Nature	Negative	Positive	Neutral		
Impact Type	Direct	Indirect	Induced		
Impact Duration	Temporary	Short-term	Long-term	Permanent	
Impact Extent	Local	Regional	International		
Impact Scale	The project will follow the additional mitigation measures as suggested above in order to ensure compliance with labour laws/provisions as per the industry best practices				
Frequency	Project life cycle				
Likelihood	Possible				
Impact Magnitude	Positive	Negligible	small	Medium	Large
Resource/Receptor Sensitivity	Low	Medium	High		
Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is considered to be **Minor**				
Residual Impact Magnitude	Positive	Negligible	Small	Medium	Large
Residual Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of Residual Impacts is considered **Minor**				

7.3.10 Impact on Ecology

7.3.10.1 Habitat Modification and Loss

7.3.10.2 Context and Analysis

The entire project is majorly located on mix of agricultural and scrub land areas. Thus, the vegetation clearance within the entire project boundary is required for the installation of the solar project, which may cause habitat loss/modification.

7.3.10.3 Embedded/ In-built Controls

The impacts during the construction activity will be short term. Clearance of vegetation shall be limited to the project area. After construction work, any land taken for a temporary basis for storage of material will be restored to their original form. Existing roads will be used for access to project site.

7.3.10.4 Receptor Sensitivity

The ecological baseline section reveals the project site is devoid of large trees and shrub species. However, as the nearby areas have agricultural fields the avian movement for foraging is envisaged.

7.3.10.5 Magnitude of Impact

Clearance of vegetation will be restricted to these scrub land habitats only, which will be minimal and such changes will be permanent. Moreover, there is substantial habitat for these species in the region and any impact within the solar project area is unlikely to cause loss of habitat viability and function in the region, so overall Impact Magnitude is expected to be **Negligible** for Habitat.

For species also, loss of vegetation is not going to cause a significant change so magnitude of impact is also expected to be **Negligible** for Species.

7.3.10.6 Significance of Impacts

Significance of Impact on Habitat is expected to be **Negligible** as Habitat sensitivity is **Low** and magnitude of impact is **Negligible**.

Significance of impact on species is also **Negligible** as species sensitivity is **Low** and magnitude of impact on species is **Negligible**.

7.3.10.7 Mitigation Measures

The following mitigation measures will further reduce the impact significance on the habitat and species:

- Vegetation disturbance, clearance and construction activities should be restricted to the Project activity area;
- Areas around water sources should be avoided to the extent possible during the planning of access/internal roads, storage areas, labour camps and ancillary facilities;
- Top soil that is disturbed should be stored separately for later restoration of the habitat;
- Unnecessary disturbance of neighbouring vegetation due to off-road vehicular movement, fuel wood procurement and destruction of floral resources should be prohibited;
- Simultaneous revegetation using native species on outskirts of Project activity area should be practiced for areas that are determined to have loose or unstable soil to avoid erosion; and
- Strict prohibition on use of fuel wood and shrubs from nearby areas as kitchen fuel.

7.3.10.8 Residual Impacts

The removal of vegetation can have a direct and indirect impact on the local ecology. Here in this Project the vegetation removal is going to be on scrub land. The significance of the residual impacts will be **Not significant** for habitats and species after employing the mitigation measures.

Impact	Clearance of vegetation			
Impact Nature	Negative	Positive	Neutral	
Impact Type	Direct	Indirect	Induced	
Impact Duration	Temporary	Short-term	Long-term	Permanent

Impact Extent	Local	Regional	International		
Impact Scale	Limited to construction area and immediate surroundings				
Frequency	Construction phase				
Likelihood	Likely				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource Sensitivity (Habitat)	Low	Medium	High		
Resource Sensitivity (Species)	Low	Medium	High		
Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is considered **Minor** for habitat and also **Minor** for species**.**				
Residual Impact Magnitude	Positive	Negligible	Small	Medium	Large
Residual Impact Significance	Not significant	Minor	Moderate	Major	
	Significance of impact is considered **Not significant** for habitats and species.				

7.3.11 Impact on Ecology due to other Construction Activities

7.3.11.1 Context and Analysis

Construction of switchyard, transmission towers; installation of solar panels; and laying of transmission line increases the anthropogenic movement (men and material transport), noise and chance of sedimentation /contamination of water resources due to excavation and filling activities in the study area. These activities are assessed with respect to disturbance of habitats and species.

Excavation for the construction activities will have a direct impact on burrowing fauna, such as the Indian Grey Mongoose (*Herpestes edwardsii*), and an indirect impact on flora/fauna through the changing of soil properties.

Anthropogenic movement will result in an increased stress on fauna in the area that will have to remain alert for an extended period of time and may prevent proper breeding, nesting, mating, socializing and foraging. Noise from anthropogenic movement (men and material transport) along with the construction activities may further disturb fauna in the nearby areas. Specific impacts such as disturbance and displacement of species due to noise, light, anthropogenic movement and traffic are envisaged. Mortality of the species are also envisaged during other construction activities. Mortality as a result of worker influx and increased hunting, trapping and poaching of wildlife, loss of resources and barrier to movement of the mammalian species is also envisaged.

7.3.11.2 Embedded / In-built Controls

The labour force and the supervisory staff will be provided in-house and external trainings for the situations dealing with wildlife encounters and dos and don’ts while dealing with these situations. Selection of labour camps, and equipment laydown areas will be located away from the areas from where the sedimentation/contamination of water resources can happen.

7.3.11.3 Receptor Sensitivity

The ecological baseline section describes that the construction activities for solar project could lead to the clearance of shrub and herb species. This vegetation clearance along with the increased noise level (because of the movement and activity of heavy vehicles, etc.) and anthropogenic activities will lead to habitat disturbance for reptiles, avifauna which could be using the area for roosting and foraging and mammals like Nilgai who use the areas for foraging.

There were limited species at the project site as the site is adjacent to the solar park. However, as per the discussions with the locals and observations, no important species has been reported or observed on site. Thus the sensitivity of the site has however been deemed **Small** for Habitat and **Small** for Species as similar habitat is available in all the surrounding area

7.3.11.4 Magnitude of Impact

Anthropogenic movement will create an increased stress on faunal species. Mammals, birds and reptiles in the project study area are particularly susceptible to this movement. Mammal species are also susceptible to higher noise levels from anthropogenic movement and construction due to their better auditory perception. Noises can affect mating and breeding behaviour in all species that utilize sound to communicate with one another and find suitable mates.

Most of the construction activity will be limited to the solar plant, so overall Impact Magnitude is expected to be **Small** for Habitat.

Impacts from construction activity will not cause a significant change in the population of the above mentioned species so magnitude of impact is expected to be **Small** for Species.

7.3.11.5 Significance of Impacts

Significance of impact on habitat is expected to be **Minor** as habitat sensitivity is **Low** and magnitude of impact is **Small**.

Significance of impact on species is also **Minor** as species sensitivity is **Low** and magnitude of impact on species is **Small**.

7.3.11.6 Mitigation Measures

The following mitigation measures could potentially reduce the impact significance on the habitat and species:

- Construction and transportation activities should be avoided at night (6:00 pm to 6:00 am) and should particularly avoid high faunal activity areas like locations near forest or water bodies during dawn (6:00 am to 7:30 am) and dusk (5:00 pm to 6:30 pm);
- Areas with pre-existing burrows or ground roosting sites of birds should be avoided when possible;
- Temporary barriers should be installed on excavated areas;
- Hazardous materials should not be stored near water bodies, and drainage channels;
- Simultaneous revegetation on outskirts of Project activity area should be practiced for areas that have loose or unstable soil to avoid erosion and sedimentation;
- Efforts should be made to minimize construction noise and the use of noise barriers should be considered for high noise levels;
- Waste materials should be cleared in a timely manner and the use of artificial lights should be minimized so as to not attract wildlife;
- Good housekeeping should be followed for construction activities, waste packaging material should be properly disposed;
- Labour movement should be restricted; and
- General awareness regarding fauna should be enhanced through trainings, posters, etc. among the staff and labourers.

7.3.11.7 Residual Impacts

The implementation of suggested mitigation measures can reduce the impacts of construction activities but there will still be some impacts due to noise and anthropogenic movement. The residual impacts for species will be **Minor**. Although impacts of construction activity will be reduced there will still continue to be some disturbance to fauna and flora.

Impact	Construction activities			
Impact Nature	Negative	Positive	Neutral	
Impact Type	Direct	Indirect	Induced	
Impact Duration	Temporary	Short-term	Long-term	Permanent
Impact Extent	Local	Regional	International	
Impact Scale	Largely restricted to construction area and immediate surroundings			
Frequency	Construction phase			
Likelihood	Likely			
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource Sensitivity (Habitat)	Low	Medium	High	
Resource Sensitivity (Species)	Low	Medium	High	
Impact Significance	Not significant	Minor	Moderate	Major
	Significance of impact is considered **Minor** for habitats and **Minor** for species.			
Residual Impact Magnitude	Positive	Negligible	Small	Medium	Large
Residual Impact Significance	Not significant	Minor	Moderate	Major
	Significance of impact is considered **Minor** for habitats and species.			

7.3.12 Impact on Soil Environment

7.3.12.1 Soil Compaction and Erosion

Context

In the operation phase, soil compaction and erosion may occur due to vehicle movement, which only happens during the occasional maintenance activities. Soil compaction for the operation phase has therefore been considered to be infrequent and **low**.

Since the chances of soil compaction and erosion during the O&M phase are less, the impact magnitude is assessed to be **small**.

Embedded/in-built control

Vehicles will utilise the existing access road to undertake maintenance activities at the solar plant.

Significance of Impact

The overall impact significance on soil erosion and compaction has been assessed as **negligible**.

Additional Mitigation Measures

No further mitigation measures are suggested as embedded/in-built control will be sufficient to reduce the impact on soil environment.

Residual Impact Significance

The significance of residual impacts has been retained as **negligible**.

Impact	**Soil erosion and compaction during operations**			
Impact Nature	Negative	Positive	Neutral	
Impact Type	Direct	Indirect	Induced	
Impact Duration	Temporary	Short-term	Long-term	Permanent
Impact Extent	Local	Regional	International	
Impact Scale	Limited to Project site and immediate surroundings			
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource/ Receptor Sensitivity	Low	Medium	High	
Impact Significance	Negligible	Minor	Moderate	Major
	Significance of impact is assessed to be negligible			

7.3.12.2 Waste Generation and Soil Contamination

Context

During operation phase, the waste generated from project includes domestic solid waste at SCADA building and substation and hazardous waste like waste oil and lubricants and oil containing jutes and rags will be generated during maintenance activities. The quantity of hazardous waste generated will be much lesser quantity than during the construction phase. Therefore, receptor sensitivity has been assessed as **low.**

The quantity of municipal and hazardous waste generated will be much lesser in quantity in operation phase than during the construction phase. Thus, the Impact magnitude has been assessed to **small**.

Embedded/in-built control

The waste generated will be disposed of through approved vendors in accordance with Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016. The hazardous wastes will be stored onsite at separate designated covered area provided with impervious flooring and sent for disposal to nearest TSDF in Maharashtra. During operation phase, the quantity of municipal waste and hazardous waste generated is less and probability of the hazardous waste generation is only during plant maintenance and therefore occasional. The waste generated would be routed through proper collection and containment.

Additional, following steps must be undertaken to avoid soil contamination:

- Ensure oil/ lubricants are stored on impervious floor in the storage area having secondary containment;
- Use of spill control kits to contain and clean small spills and leaks during O&M activities; and
- The guidelines and procedures shall be prepared and followed for immediate clean-up actions following any spillages.

Significance of Impact

The overall impact significance on land due to waste disposal during O&M phase has been assessed as **minor**.

Additional Mitigation Measures

- Municipal domestic waste generated at site to be segregated onsite;
- Ensure routinely disposal of hazardous waste through approved vendors and records are properly documented;
- Ensure hazardous waste is properly labelled, stored onsite at a location provided with impervious surface, shed and secondary containment system as per in accordance to Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016; and
- Also, disposal of hazardous wastes shall be done strictly as per the conditions of Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016.

Residual Impact Significance

The significance of residual impacts will be **negligible** post implementation of recommended mitigation measures.

Impact	**Waste generation and soil contamination during operations**				
Impact Nature	Negative	Positive	Neutral		
Impact Type	Direct	Indirect	Induced		
Impact Duration	Temporary	Short-term	Long-term	Permanent	
Impact Extent	Local	Regional	International		
Impact Scale	Limited to Project site and immediate surroundings				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource/ Receptor Sensitivity	Low	Medium	High		
Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is assessed to be minor				
Residual Impact Magnitude	Positive	Negligible	Small	Medium	Large
Residual Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is assessed to be negligible				

7.3.13 Impact on Water Environment

7.3.13.1 Impact on Water Availability

Context

The primary water requirement during the operation phase will be for solar module cleaning, drinking water, domestic water for toilet/washing and small amount of water that will be used in maintenance works. The amount of water used for domestic purposes during the operation phase by the Project will fall within the typical water usage patterns by domestic households in the local villages for domestic water use. The periodic maintenance and module cleaning, however, will have a higher water requirement than the typical domestic water use but the activity is periodic and therefore the water requirement will not be on a consistent/day to day basis.

It is estimated that approximately 3,000 litres per MW of water will be required for cleaning of solar PV modules and drinking/domestic purposes. Furthermore, it is understood that the Project will utilise groundwater. Considering the groundwater and water stress scenario in Ghanaswangi taluka, receptor sensitivity is assessed to be low to medium.

The impact magnitude is assessed to be medium as well considering that the Project may require a wash cycle consisting of 2-3 times cleaning of solar modules per month. If not diligently done, use of groundwater over a 25 year period for cleaning of solar modules may adversely impact the groundwater availability in the region. As mentioned earlier, groundwater in the region is used for agricultural purposes, which is one of the primary sources of occupation.

Embedded/in-built control

- Authorisation will be obtained from Central Groundwater Authority for abstraction of groundwater for industrial and domestic use during the operational phase; and
- Water conservation system, such as rainwater harvesting system, will be installed during the operation phase of the Project.

Significance of Impact

The overall impact on water availability during operation phase is assessed to be moderate**.**

Additional Mitigation Measures

- Optimising water usage in the SCADA building by application of water conservation measures such as sensor based taps, low flush urinals etc. at site;
- Regularly monitor the ground water quality;
- Maintain logbook for water consumption; and
- Consider adopting less water consuming module cleaning methods, such as semi-water (mix of water vapour and air) and dry robotic cleaning; and
- Storm water drainage system should be installed to ensure that micro-drainage channels that form during the monsoon season do not dry up. The Project must ensure there are no hindrances in formation of seasonal water bodies during the construction phase.

Residual Impact Significance

The significance of residual impacts will be minor to moderate post implementation of recommended mitigation measures.

Impact	**Impact of water availability during operational phase**				
Impact Nature	Negative	Positive	Neutral		
Impact Type	Direct	Indirect	Induced		
Impact Duration	Temporary	Short-term	Long-term	Permanent	
Impact Extent	Local	Regional	International		
Impact Scale	Limited to Project site and immediate surroundings				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource/ Receptor Sensitivity	Low	Medium	High		
Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is assessed to be minor to moderate				
Residual Impact Magnitude	Positive	Negligible	Small	Medium	Large
Residual Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is assessed to be minor				

7.3.13.2 Impact on Water Quality

The fuels, lubricant and hazardous waste generated during construction and operation phase of the project will be considerably lower than in the construction phase and will be stored at a designated area which is paved with provision of secondary containment. Thus the contamination of groundwater can happen only due to accidental spillage of fuel, lubricants and chemicals from storage areas or during the transfer of fuels and chemicals. However, in case of accidental spillage, groundwater may get contamination due to varying percolation rate of the soil present at the Project site. Therefore, the receptor sensitivity is assessment to be **low** to **medium**.

Furthermore, there will be no wastewater generation from the power generation process. Only sewage would be generated from SCADA building and this will also be of negligible quantity. Therefore, the impact magnitude during the operation phase is assessed to be small to medium**.**

As part of the site preparation stage, septic tank will be constructed for the site office and toilet facilities within the operational site. Sewage disposal trucks will be used to periodically remove the sludge/sewage from the septic tank.

Embedded/in-built control

- The drainage and sewerage system will be available on site for the collection and treatment of waste water at SCADA building and substation areas;
- No wastewater discharge on open land will be practiced;
- Provision for impervious storage area, especially for fuel & lubricant, hazardous waste, etc.

Significance of Impact

The overall impact significance is assessed to be **minor**.

Additional Mitigation Measures

In case of accidental/unintended spillage, the contaminated soil should be immediately collected and stored as hazardous waste.

Residual Impact Significance

Residual impact significance has to be retained as **negligible** to **minor.**

Impact	**Impact on water quality during operational phase**				
Impact Nature	Negative	Positive	Neutral		
Impact Type	Direct	Indirect	Induced		
Impact Duration	Temporary	Short-term	Long-term	Permanent	
Impact Extent	Local	Regional	International		
Impact Scale	Limited to Project site and immediate surroundings				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource/ Receptor Sensitivity	Low	Medium	High		
Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is assessed to be minor				
Residual Impact Magnitude	Positive	Negligible	Small	Medium	Large
	Negligible	Minor	Moderate	Major	

Residual Impact Significance	Significance of impact is assessed to be negligible to minor

7.3.14 Impact on Ecology

7.3.14.1 Collision and electrocution risk

7.3.14.2 Context

There is a significant risk to the resident avifauna due to the transmission line infrastructure of the project. The risk of electrocution rises from transmission towers by bridging two phase conductors by the species when passing close to conductors.

7.3.14.3 Embedded / In-built Controls

No specific embedded controls provided.

7.3.14.4 Receptor Sensitivity

The site visit was carried out in summer season. Eurasian Spoonbill and Black Necked Stork were the migratory species observed along with Black Kite which is also a Schedule I species closer to the water bodies in the South of the project area. The resource sensitivity is therefore **Medium** for species and habitats

7.3.14.5 Magnitude of Impact

Mortality from collision and electrocution risk due to transmission infrastructure are likely to cause changes in the population viability of the species. The magnitude of impact is expected to be **Small** for Species and Habitat.

7.3.14.6 Significance of Impacts

Significance of impact on species is low as the distance between the project site and the Grid substation is less than a kilometre. Also the species sensitivity is **Medium** and magnitude of impact on species is **Medium**.

The following mitigation measures will further reduce the impact significance on avifaunal species:

- Regular checking of the transmission towers to avoid nesting by any of the birds;
- Marking overhead cables using diffractors / diverters (**Figure 7-3**)
- The transmission poles cross arms should have suspended insulators and perch rejecters in order to reduce the electrocution of bird species **(Figure 7-4).**

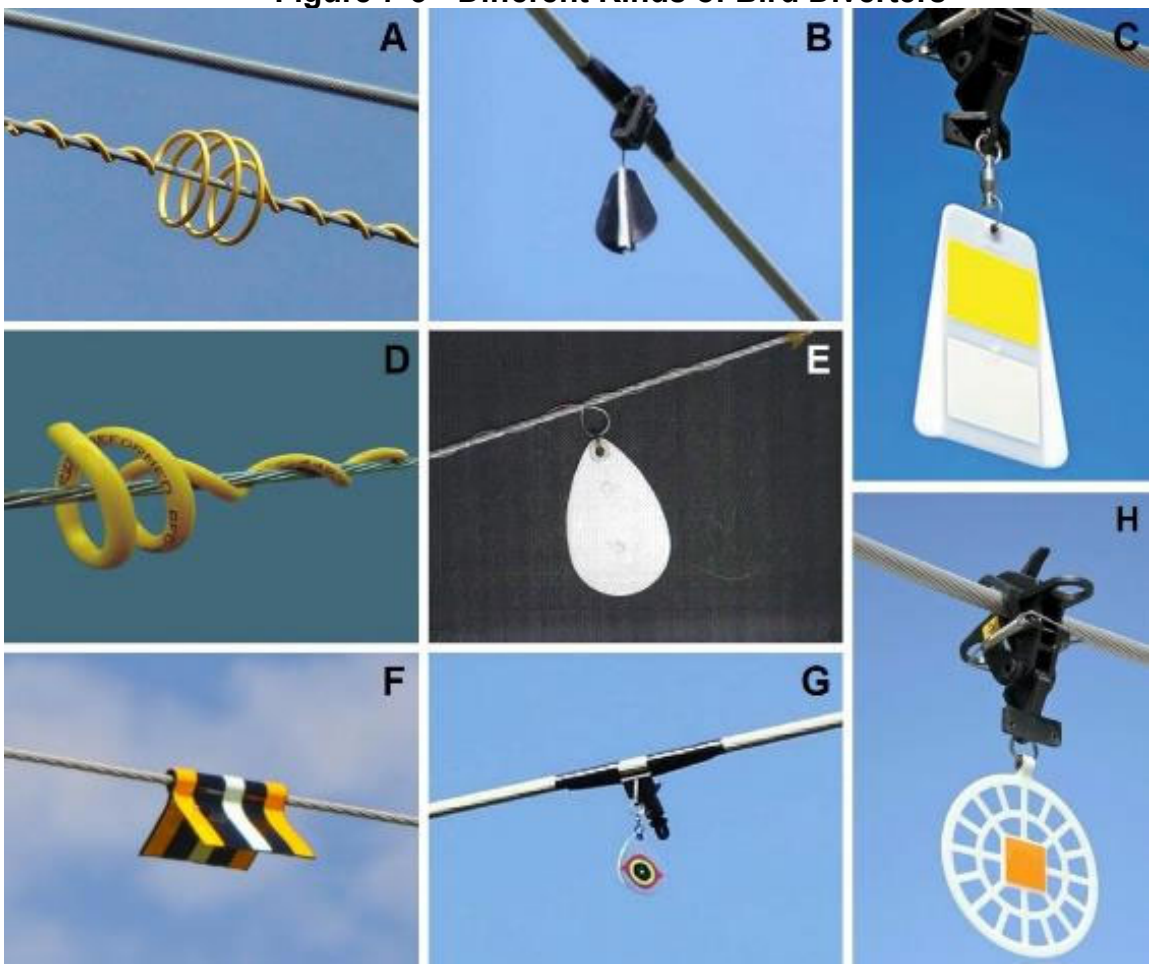
7.3.14.7 Residual Impact

The proper and successful implementation of all the suggested mitigation measures and embedded controls can reduce the significance of impacts to **Minor - Moderate**. This significance has been retained as the mitigation measures are likely to reduce mortality to some extent, but complete cessation of mortality cannot be expected.

Impact	Collision and Electrocution hazards			
Impact Nature	Negative	Positive	Neutral	
Impact Type	Direct	Indirect	Induced	
Impact Duration	Temporary	Short-term	Long-term	Permanent

Impact Extent	Local	Regional	International		
Impact Scale	Limited to electrical components of transmission lines and transmission poles.				
Frequency	Operation phase				
Likelihood	Likely				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource Sensitivity (Species)	Low	Medium	High		
Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is **Moderate** for species.				
Residual Impact Magnitude	Positive	Negligible	Small	Medium	Large
Residual Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is considered **Minor- Moderate**.				

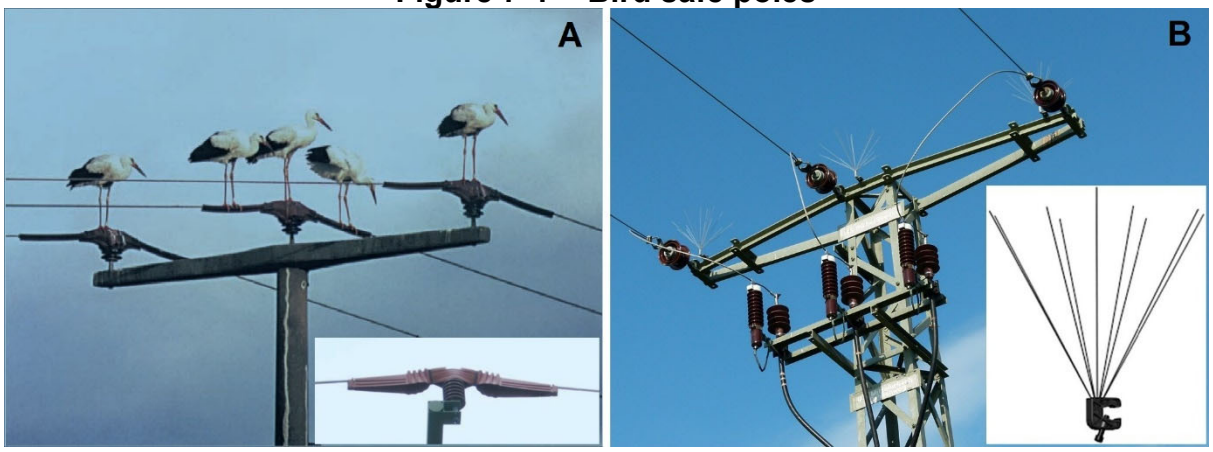
Figure 7-3 Different Kinds of Bird Diverters



A, Swan Flight Diverter; **B,** Rotating Bird Flapper; **C,** Fire-fly Diverter; **D,** Bird Flight Diverter; **E,** Bird Flapper; **F,** Power Line Markers; **G,** Bird Diverter and **H,** Bird Mark Flapper

Sources: https://www.fwspubs.org/doi/suppl/10.3996/052016-JFWM-037/suppl_file/052016-jfwm-037.s4.pdf; https://wildlife.onlinelibrary.wiley.com/doi/abs/10.1002/wsb.329; http://www.chinesebirds.net/EN/abstract/abstract170.shtml; https://powerlinesentry.com/product/bird-flight-diverters-and-line-markers/

Figure 7-4 Bird safe poles



A, Use of Conductor Insulator and **B**, Use of Perch Rejecter

Sources: https://images.slideplayer.fr/61/11796725/slides/slide_26.jpg; https://farm9.static.flickr.com/8425/7734849122_d4740c9685_b.jpg

7.3.14.8 Wildlife access to Project compound

Context

The solar modules will be fenced by a wall on all sides to prevent wildlife access to the Project site. However, a few signs were recorded during the survey proving that the fenced area is being used by small mammalian species. This fauna could possibly be entering through the small drainage pathways across the facility.

Species that can climb or fly over the walls can also enter the compound. Solar modules or other such obstacles can injure wildlife. Some studies also suggest that avifauna is attracted to the solar module as they mistake it for water bodies and the phenomenon is called as “Lake effect”. The important species that can access the solar compound include Black Kite (*Milvus migrans*), and Black-winged Kite (*Elanus caeruleus*)). Among mammals, it was reported that Nilgai are often seen in the study area. Thus the receptor sensitivity has been assessed as **Medium**

Impact magnitude

All the species observed have been classified as Least Concern as per IUCN Red List except Laggar Falcon and five species are protected under Schedule I as per Indian Wildlife (Protection) Act 1972. However, since the distribution of these is widespread, it is unlikely to cause a significant and irreversible change in populations of ground dwelling species. Thus, the impact magnitude has been deemed **Small**

Impact Significance

The impact significance has been assessed as **Minor**

Mitigation Measures

The following mitigation measures will further reduce the impact significance on species:

- If water is collected on the site during monsoon, it should be drained out of site to prevent avifauna from being attracted to the area.
- Fencing of the boundary should be wildlife proof and repaired accordingly where required;
- Bird detractors such as scarecrows or moving clothes could be installed around the solar modules to prevent avifauna from venturing close; and

- Maintenance (de weeding/removal) of the vegetation within the solar plant site is required, as the dried plant material can lead to fire hazard and may affect the fauna as well

Residual Impact Significance

The direct and indirect impacts are limited to the Project site. With the proper implementation of the mitigation measures, significance of the residual impact may reduce to **Negligible.**

Impact	Wildlife access to project compound				
Impact Nature	Negative	Positive	Neutral		
Impact Type	Direct	Indirect	Induced		
Impact Duration	Temporary	Short-term	Long-term	Permanent	
Impact Extent	Local	Regional	International		
Impact Scale	Limited to project facility				
Frequency	Operation Phase				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource Sensitivity	Low	Medium	High		
Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is considered **Minor**				
Residual Impact Significance					
Residual Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource Sensitivity	Low			Medium	High
Residual Impact Significance	Negligible	Minor	Moderate	Major	
	The residual impact significance is considered **Negligible**				

7.4 Decommissioning Phase Impacts

7.4.1 Impact on Water Environment

7.4.1.1 Context

Water during the decommissioning phase will be consumed by labourers and will be required for civil work. The water demand will be met through bore wells and tanked water. Also, there is a potential for contamination of groundwater and surface water resources resulting from improper management of sewage and accidental spills/leaks at the storage areas. Therefore, the receptor sensitivity is assessed to be medium**.**

7.4.1.2 Embedded/in-built control

- The provisions of septic tank and soak pits will be provided onsite for treatment and disposal of sewage, thereby minimizing the impacts of wastewater discharge. Planning of toilets, soak pits and septic tanks, waste collection areas should be away from natural drainage channels;
- Use of licensed contractors for management and disposal of waste and sludge;
- Spill/ leakage clearance plan to be adopted for immediate cleaning of spills and leakages;

7.4.1.3 Significance of Impact

The overall impact significance is assessed to be moderate.

7.4.1.4 Additional Mitigation Measures

- Ensure proper cover and stacking of loose construction material to prevent surface runoff and contamination of receiving water body;
- Labourers will be given training towards proactive use of designated areas/bins for waste disposal and encouraged for use of toilets. Open defecation and random disposal of sewage shall be strictly restricted;
- Construction labour deputed onsite to be sensitised about water conservation and encouraged for optimal use of water;
- Regular inspection for identification of water leakages and preventing wastage of water from water supply tankers; and
- Recycling/reusing to the extent possible.

7.4.1.5 Residual Impact Significance

The residual impact significance is envisaged to be minor upon application of embedded controls and additional mitigation measures.

Impact	**Impact on water environment during decommissioning phase**				
Impact Nature	Negative	Positive	Neutral		
Impact Type	Direct	Indirect	Induced		
Impact Duration	Temporary	Short-term	Long-term	Permanent	
Impact Extent	Local	Regional	International		
Impact Scale	Limited to project area				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource/ Receptor Sensitivity	Low	Medium	High		
Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is assessed to be moderate				
Residual Impact Magnitude	Positive	Negligible	Small	Medium	Large
Residual Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is assessed to be minor				

7.4.2 Impact on Air Quality

7.4.2.1 Context

Air quality will largely get impacted from the following sources during the decommissioning phase:

- Fugitive dust emissions from site clearing, excavation work, cutting and levelling work at site and access/ internal roads, stacking of soils, handling of construction material, transportation of material, emission due to movement of vehicles and heavy construction machinery etc.;
- Vehicular emissions due to traffic movement on site and on access roads;
- Exhaust emissions from heavy equipment like bull dozers and compactors;
- Emissions from emergency power diesel generator used during decommissioning activity.

Based on the above, the receptor sensitivity is assessed to be medium.

The biggest source of emissions in the decommissioning phase is the fugitive dust emissions from demolition activities. The demolition activities are likely to occur for a very small period of time and therefore the impact magnitude has been assessed as small.

7.4.2.2 Embedded/in-built control

- Emissions from the emergency DG set and other stationary machines will be controlled by ensuring that the engines are always properly tuned and maintained;
- Minimize stockpiling by coordinating excavations, spreading, re-grading and compaction activities;
- Speed of vehicles on site will be limited to 10-15 km/hr which will help in minimizing fugitive dust emissions due to vehicular movement; and
- Idling of vehicles and equipment will be prevented.

7.4.2.3 Significance of Impact

The impact significance for air quality in the decommissioning phase is assessed as minor.

7.4.2.4 Additional Mitigation Measures

- Burning of any waste material shall be prevented;
- Labourers shall be provided with gas connection to prevent burning of fuel wood for cooking purposes;
- Work shall be ceased or phased down if excess fugitive dust is observed. Source of dust shall be investigated and proper suppression measures ensured; and
- Proper maintenance of engines and use of vehicles with Pollution under Control (PUC) Certificate shall be ensured.

7.4.2.5 Residual Impact Significance

The significance of residual impact will be negligible to minor after implementing mitigation measures because of the fugitive dust emissions anticipated during demolition activities.

Impact	**Impact on air quality during decommissioning phase**				
Impact Nature	Negative	Positive	Neutral		
Impact Type	Direct	Indirect	Induced		
Impact Duration	Temporary	Short-term	Long-term	Permanent	
Impact Extent	Local	Regional	International		
Impact Scale	Project area and vicinity				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource/ Receptor Sensitivity	Low	Medium	High		
Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is assessed to be minor				
Residual Impact Magnitude	Positive	Negligible	Small	Medium	Large
Residual Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is assessed to be negligible to minor				

7.4.3 Impact on Ambient Noise

7.4.3.1 Context

During decommissioning phase of the project, noise will generate from movement of vehicles carrying dismantled structure and equipment.

There may be other solar projects and there is a grid substation located within 5 km radius of the project site along with the three village. The area would then be an Industrial area and therefore the receptor sensitivity is assessed to be low to medium.

Impact magnitude is considered to be small considering the decommissioning period to last for small duration.

7.4.3.2 Embedded/in-built control

Normal working hours of the contractor to be defined (preferable 8 am to 6pm). If work needs to be undertaken outside these hours, it should be limited to activities which do not generate noise.

7.4.3.3 Significance of Impact

The overall impact significance is envisaged to be negligible to minor.

7.4.3.4 Additional Mitigation Measures

- Only well-maintained equipment should be operated on-site;
- If it is noticed that any particular equipment is generating too much noise then lubricating moving parts, tightening loose parts and replacing worn out components should be carried out to bring down the noise and placing such machinery far away from the households as possible;
- Machinery and equipment that may be in intermittent use should be shut down or throttled down during non-work periods; and
- Minimal use of vehicle horns and heavy engine breaking in the area needs to be encouraged.

7.4.3.5 Residual Impact Significance

Significance of residual impact is assessed to be negligible upon incorporation of the above mentioned mitigation measures.

Impact	Impact on ambient noise levels during decommissioning phase				
Impact Nature	Negative	Positive	Neutral		
Impact Type	Direct	Indirect	Induced		
Impact Duration	Temporary	Short-term	Long-term	Permanent	
Impact Extent	Local	Regional	International		
Impact Scale	Project area and vicinity				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource/ Receptor Sensitivity	Low	Medium	High		
Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is assessed to be negligible to minor				
Residual Impact Magnitude	Positive	Negligible	Small	Medium	Large
	Negligible	Minor	Moderate	Major	

Residual Impact Significance	Significance of impact is assessed to be negligible

7.4.4 Impact on Economy and Employment

Context and Receptor

The operation phase would require much smaller workforce as compared to construction phase and the skillset of the required workforce shall be different. The operation phase would require Engineers, Technicians to manage the Plant operations and amongst the requirement of semiskilled workers in limited numbers for housekeeping and security related jobs. Additionally, there may be some vacancies with the appointed Contractors, which may have some local employment, if feasible.

Furthermore, based on the previous understanding the requirement for unskilled and semi-skilled labour it is expected to reduce to 20 and 15 respectively during the operations phase. The locally procured services will include maintenance work of the facility, 24-hour security, bush and undergrowth cleaning and housekeeping activities.

Enhancement Measures

While, the significance of the impact on economy and employment opportunities during the operations phase is understood to be positive, the following measures should be put in place to ensure that the local community receives maximum benefit from the presence of the project:

- Preference should be provided to local labour or suppliers to pass on maximum economic benefit locally;
- Preference should be provided to the vulnerable population in the Study Area;
- Ensure that security guards are trained to maintain positive behaviour with the community representatives to avoid any conflict with them
- The Project should provide the local community an understanding of the operational activities and the grievance redressal mechanism should be a part of the stakeholder engagement process.

Residual Impact Significance

The significance of the residual impacts will remain **positive**

Impact	**Impact on Economy and Employment during Operational Phase**				
Impact Nature	Negative		Positive		Neutral
Impact Type	Direct		Indirect		Induced
Impact Duration	Temporary	Short-term	Long-term	Permanent	
Impact Extent	Local		Regional		International
Impact Scale	Local population in the Study Area. The impact may also be experienced at the regional level.				
Frequency	Regular during Operational Phase				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource Sensitivity	Low		Medium		High
Impact Significance	Significance of impact is considered **Positive**				

8. ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

This section presents the Environmental and Social Management Plan (ESMP) for the 50 MW Solar Power Project in Jalna, Maharashtra. The purpose of this ESMP is to specify the standards and controls required to manage and monitor environmental and social impacts during different phase of project life cycle, i.e. construction, operation and decommissioning phases. To achieve this, the ESMP identifies potential adverse impacts from the planned activities and outlines mitigation measures required to reduce the likely negative effects on the physical, natural and social environment. This is in accordance to IFC Performance Standards 1 which emphasizes the importance of managing social and environmental performance through the lifecycle of the Project.

8.1 Project Organisational Structure

Project specific and corporate level organisation structures were not shared with ERM. Organisational structure for the project was not describe/shared by Radiance during and post ERM site visits. Since ERM does not have an understanding of the organisational structure of the Project, it is recommended the organisational structure of the Project is developed to include the aspects described in subsequent sections.

8.2 Roles and Responsibilities

Radiance will majorly play a role of supervisor to oversee the Project performance pertaining to environment, health, safety and social issues. It is recommended to strength the EHS organizational structure by creating a dedicated EHS department at the corporate level. An outline for responsibilities of the proposed EHS department is given below.

Environmental, Health and Safety Department (EHS Department)

The Environment, Health and Safety department of Radiance shall be responsible for monitoring the implementation of the various actions which are to be executed by the agencies specified in the ESMP.

In general, the EHS 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 programmes;
- Providing job specific induction training;
- Compliance of regulatory requirements;
- Carrying out environmental audits;
- Identify unsafe acts and conditions and suggest remedies;
- Develop safety culture and comply with company's EHS policy and standard requirements;
- Encourage and enforce the use of PPE's;
- Educate all employees for the use of PPE's and 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.

8.3 Inspection, Monitoring and Audit

Inspection and monitoring of the environmental impacts of the Project activities will increase the effectiveness of ESMP. Through the process of inspection and auditing, Radiance will ensure that the conditions stipulated in various permits are complied. The inspections and audits will be done by contractors, trained team of Radiance EHS department subject to be reviewed and conducted by external agencies/experts. The entire process of inspections and audits should be documented. The inspection and audit findings are to be implemented by the site in-charge in their respective areas.

8.4 Reporting and Documentation

Radiance will develop and implement a programme of regular reporting through the various stages of the Project lifecycle. The personnel who are delegated EHS roles shall be required to fully comply with the monitoring programme in terms of timely submissions of reports as per acceptable level of detail. Reporting will be done in the form of environmental check list, incident record register, training records, and environmental and social performance reports (weekly, monthly, quarterly, half yearly, yearly etc.).

8.4.1 External Reporting and Communication

EHS Head will be responsible for ensuring that communication with regulatory agencies and stakeholders are maintained as per the requirement. All complaints and enquiries will be appropriately dealt with and records should be maintained in a Complaint/Enquiry Register by the delegated staff of EHS.

Radiance will also need to establish a Community Disclosure and Grievance Redressal (CDGR) system that will be part of Stakeholder Engagement Plan and will be applicable to the O&M and decommissioning phases. Radiance should formulate a Community Relations team to implement the CDGR system and lead the community engagement process which would have the following tasks:

- Interface between Radiance, contractors, sub-contractors and the local community;
- Disclosure of project specific information for all components to villages within the footprint area;
- Establish a mechanism to obtain, report and monitor all grievances from the local community;
- Regular engagement with gram panchayats and other external stakeholder groups identified; and
- Plan, implement and evaluate community development programs: To the extent possible, the CSR activities should be relevant to the needs of the locality and in no case should be detrimental to the E&S sensitivities of the project area.

8.4.2 Internal Monitoring and Communication

Internally, the personnel delegated EHS roles, i.e. the Radiance site lead, will share inspection and audit findings with their suggested measures regularly to the senior management for their consideration. The same are also to be communicated within the staff working on the project. To maintain an open communication between the staff and management on EHS and social issues the followings are being used:

- Team Briefings,
- On-site work group meetings;

- Work Specific Instructions

8.4.3 Documentation

Documentation is an important step in the implementation of the ESMP, Radiance will establish a documentation and record keeping system in keeping with their ESMS, to ensure recording and updating of documents as discussed in the ESMP. Responsibilities have to be assigned to relevant personnel for ensuring that the ESMP documentation system is maintained and that document control is ensured through access by and distribution to, identified personnel in form of the following:

- 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; and
- Complaints register and issues attended/closed.

8.4.4 ESMP Review and Amendments

The ESMP acts as an environment and social management tool which needs to be periodically reviewed to address changes in the organization, process or regulatory requirements.

Following a review, Site in charge in coordination with delegated EHS personnel will be responsible for making the amendments in the ESMP and seeking approval from the Regional and Corporate heads. The amended ESMP will be communicated to all the staff on the project.

8.5 Training Programme and Capacity Building

Training is needed for effective implementation of ESMP. The training programme will ensure that all concerned members of the team understand the following aspects:

- Purpose of management plan for the project activities;
- Requirements of the management plan and specific action plans;
- Understanding the sensitive environmental and social features within and surrounding the project areas; and
- Aware of the potential risks from the Project activities.

EHS head of Radiance will ensure that Environmental health and safety induction training and job specific trainings are identified and given to the concerned personnel for operation of the solar plant.

Also general environmental awareness will be increased among the project's team to encourage the implementation of environmentally sound practices and compliance requirements of the project activities. This will help in minimising adverse environmental impacts, compliance with the applicable regulations and standards, and achieving performance beyond compliance. The same level of awareness and commitment should be imparted to the contractors and sub-contractors prior to the commencement of the project.

8.6 Environmental and Social Management Plan

This section outlines the potential adverse impacts, mitigation measures, monitoring and management responsibilities during operation and decommissioning phases of the Project.

The purpose of ESMP is to:

- Provide an institutional mechanism with well-defined roles and responsibilities for ensuring that measures identified in ESIA designated to mitigation potentially adverse impacts are implemented;
- List all suggested mitigation measures and control technologies, safeguards identified through the ESIA process;
- Provide Project monitoring program for effective implementation of the mitigation measures and ascertain efficacy of the environmental management and risk control systems in place; and
- Assist in ensuring compliance with all relevant legislations at local, state and national level for the Project.

Table 8.1 Environmental and Social Management Plan - 50 MW Solar Power Project in Jalna, Maharashtra

Project Activities	Impact/Issue	Applicable Project Phase	Mitigation Measures	Responsibility for ensuring implementation of the suggested mitigation	Means of Verification that mitigation has been met	Timelines /frequency of Monitoring	Responsibility for implementation of monitoring	Supervision responsibility	Reporting Requirements
Land use									
■ Construction and strengthening of access road; ■ Installation of PV modules ■ Construction of Central Monitoring Station, Switching Yard; and ■ Establishment and operation of temporary structures such as temporary site office and store yard.	Permanent and temporary changes in land use	Construction	On completion of construction activities, land used for temporary facilities such as store yard should be restored to the extent possible	EPC Contractor	Site inspection	Upon completion of task	Site lead/Site HSE in-charge of EPC Contractor	HSE In-charge of Radiance	Report from HSE in-charge of EPC Contractor to site HSE In-charge of Radiance
			The land use in and around permanent project facilities should not be disturbed.	EPC Contractor	Site inspection	Monthly Monitoring	Site lead/Site HSE in-charge of EPC Contractor	HSE In-charge of Radiance	Report from HSE in-charge of EPC Contractor to site HSE In-charge of Radiance
			Construction activities should be restricted to designated area.	EPC Contractor	Site inspection	Monthly Monitoring	Site lead/Site HSE in-charge of EPC Contractor	HSE In-charge of Radiance	Report from HSE in-charge of EPC Contractor to site HSE In-charge of Radiance
Topography and Drainage									
■ Construction and strengthening of access roads; and ■ Site clearance.	Changes in Topography and Drainage	Construction	Disruption/alteration of micro-watershed drainage pattern should be minimized to the extent possible.	EPC Contractor	Site inspection	Monthly Monitoring	Site lead/Site HSE in-charge of EPC Contractor	HSE In-charge of Radiance	Report from HSE in-charge of EPC Contractor to site HSE In-charge of Radiance
			A storm water drainage system will need to be installed at the Project site to ensure passage for water to the micro-drainage channels outside the Project site.	EPC Contractor	Site inspection	Monthly Monitoring	Site lead/Site HSE in-charge of EPC Contractor	HSE In-charge of Radiance	Report from HSE in-charge of EPC Contractor to site HSE In-charge of Radiance
Soil									
■ Construction/ strengthening of access roads; ■ Vehicular movement; and ■ Piling and excavation work.	Soil compaction and soil erosion	Construction and Decommissioning	Vehicles will utilize existing roads to access the site.	EPC Contractor/O&M Team	Site inspection	Monthly Monitoring	Site lead/Site HSE in-charge of EPC Contractor	HSE In-charge of Radiance	Report from HSE in-charge of EPC Contractor to site HSE In-charge of Radiance
			Piling and excavation work will not be carried out during the monsoon season to minimize erosion and run-off.	EPC Contractor/O&M Team	Site inspection	Monthly Monitoring	Site lead/Site HSE in-charge of EPC Contractor	HSE In-charge of Radiance	Report from HSE in-charge of EPC Contractor to site HSE In-charge of Radiance
■ Storage and transport of construction materials; ■ Storage of oil and lubricants onsite; ■ Storage of hazardous waste onsite;	Soil contamination	Construction, Operation, Decommissioning	No unauthorized dumping of used oil and other hazardous waste should be undertaken at site.	EPC Contractor/O&M Team	Site inspection	Monthly Monitoring	Site lead/Site HSE in-charge of EPC Contractor/Site HSE in-charge of O&M contractor	HSE In-charge of Radiance	Report from HSE in-charge of EPC Contractor/O&M contractor to site HSE In-charge of Radiance
			Construction and Demolition Waste should be stored separately and be periodically collected by an	EPC Contractor/O&M Team	Site inspection	Monthly Monitoring	Site lead/Site HSE in-charge of EPC Contractor/Site HSE in-	HSE In-charge of Radiance	Report from HSE in-charge of EPC Contractor/O&M

Project Activities	Impact/Issue	Applicable Project Phase	Mitigation Measures	Responsibility for ensuring implementation of the suggested mitigation	Means of Verification that mitigation has been met	Timelines /frequency of Monitoring	Responsibility for implementation of monitoring	Supervision responsibility	Reporting Requirements
■ Storage of waste (MSW and construction/demolition) onsite from project site; and Sewage generated from the site office.			authorized treatment and storage facility				charge of O&M contractor		contractor to site HSE In-charge of Radiance
			Hazardous waste should be properly labelled, stored onsite at a location provided with impervious surface and in a secondary containment system. Ensure routinely disposal of hazardous waste through approved vendors and records are properly documented.	EPC Contractor/O&M Team	Site inspection	Monthly Monitoring	Site lead/Site HSE in-charge of EPC Contractor/Site HSE in-charge of O&M contractor	HSE In-charge of Radiance	Report from HSE in-charge of EPC Contractor/O&M contractor to site HSE In-charge of Radiance
			In case of accidental/unintended spillage on small area, the contaminated soil should be immediately collected and stored as hazardous waste.	EPC Contractor/O&M Team	Site inspection	Monthly Monitoring	Site lead/Site HSE in-charge of EPC Contractor/Site HSE in-charge of O&M contractor	HSE In-charge of Radiance	Report from HSE in-charge of EPC Contractor/O&M contractor to site HSE In-charge of Radiance
			Designated areas should be provided for Solid Municipal Waste and daily collection and period disposal should be ensured	EPC Contractor/O&M Team	Site inspection	Monthly Monitoring	Site lead/Site HSE in-charge of EPC Contractor/Site HSE in-charge of O&M contractor	HSE In-charge of Radiance	Report from HSE in-charge of EPC Contractor/O&M contractor to site HSE In-charge of Radiance
			All waste should be stored in a shed that is protected from the elements (wind, rain, storms, etc.) and away from natural drainage channels	EPC Contractor/O&M Team	Site inspection	Monthly Monitoring	Site lead/Site HSE in-charge of EPC Contractor/Site HSE in-charge of O&M contractor	HSE In-charge of Radiance	Report from HSE in-charge of EPC Contractor/O&M contractor to site HSE In-charge of Radiance
Air Quality									
■ Fugitive emissions from site clearing, excavation work, material handling etc.; ■ Fugitive emission from traffic movement; ■ Exhaust emission from operation of machineries like pile drivers, vehicles; ■ Point source emission from diesel generator.	Fugitive and point source emission	Construction, Operation, Decommissioning	Speed of vehicles should be limited to 10-15 km/hr	EPC Contractor/O&M Team	Site inspection	Monthly Monitoring	Site lead/Site HSE in-charge of EPC Contractor/Site HSE in-charge of O&M contractor	HSE In-charge of Radiance	Report from HSE in-charge of EPC Contractor/O&M contractor to site HSE In-charge of Radiance
			DG sets should be placed within enclosures and have an adequate stack height;	EPC Contractor/O&M Team	Site inspection	Monthly Monitoring	Site lead/Site HSE in-charge of EPC Contractor/Site HSE in-charge of O&M contractor	HSE In-charge of Radiance	Report from HSE in-charge of EPC Contractor/O&M contractor to site HSE In-charge of Radiance
			Prevent idling of vehicles and equipment	EPC Contractor/O&M Team	Site inspection	Monthly Monitoring	Site lead/Site HSE in-charge of EPC Contractor/Site HSE in-charge of O&M contractor	HSE In-charge of Radiance	Report from HSE in-charge of EPC Contractor/O&M contractor to site HSE In-charge of Radiance
			Vehicle engines need to be properly maintained and should have a valid Pollution Under	EPC Contractor/O&M Team	Review of PUC documents of vehicles	Monthly Monitoring	Site lead/Site HSE in-charge of EPC Contractor/Site HSE in-	HSE In-charge of Radiance	Report from HSE in-charge of EPC Contractor/O&M

Project Activities	Impact/Issue	Applicable Project Phase	Mitigation Measures	Responsibility for ensuring implementation of the suggested mitigation	Means of Verification that mitigation has been met	Timelines /frequency of Monitoring	Responsibility for implementation of monitoring	Supervision responsibility	Reporting Requirements
			Control (PUC) to ensure minimization in vehicular emissions				charge of O&M contractor		contractor to site HSE In-charge of Radiance
Water Environment									
Water required for construction phase and operation phase of the project	Depletion of water resource	Construction, Operation Phase	Permission will be obtained from Maharashtra State Level/Central Groundwater Authority for abstraction of ground water.	EPC Contractor/O&M Team	Permission letter	Monthly Monitoring	Site lead/Site HSE in-charge of EPC Contractor/Site HSE in-charge of O&M contractor	HSE In-charge of Radiance	Report from HSE in-charge of EPC Contractor/O&M contractor to site HSE In-charge of Radiance
			Maintain logbook for water consumption; and	EPC Contractor/O&M Team	Water consumption log book	Monthly Monitoring	Site lead/Site HSE in-charge of EPC Contractor/Site HSE in-charge of O&M contractor	HSE In-charge of Radiance	Report from HSE in-charge of EPC Contractor/O&M contractor to site HSE In-charge of Radiance
			Prepare and implement water conservation scheme e.g., rainwater harvesting	EPC Contractor/O&M Team	Site inspection	Monthly Monitoring	Site lead/Site HSE in-charge of EPC Contractor/Site HSE in-charge of O&M contractor	HSE In-charge of Radiance	Report from HSE in-charge of EPC Contractor/O&M contractor to site HSE In-charge of Radiance
			No construction activities should be undertaken during monsoon season. A storm water drainage system for season showers shall be installed at the site.	EPC Team	Site inspection	Monthly Monitoring	Site lead/Site HSE In-charge of O&M Team	HSE In-charge of Radiance	Report from HSE O&M contractor to site HSE In-charge of Radiance
			Use of dry cleaning technologies or similar new technologies (PV module cleaning) during the operation phase to conserve water.	O&M Team	Site inspection	Monthly Monitoring	Site lead/Site HSE In-charge of O&M Team	HSE In-charge of Radiance	Report from HSE O&M contractor to site HSE In-charge of Radiance
■ Storage of hazardous substances onsite; and ■ Storage of hazardous waste onsite.	Water Contamination	Construction, Operation, Decommissioning	Prevent & mitigate spill of fuel within the construction site. Hazardous material should be kept on impervious layer with secondary containment.	EPC Contractor/O&M Team	Site inspection	Monthly Monitoring	Site lead/Site HSE in-charge of EPC Contractor/Site HSE in-charge of O&M contractor	HSE In-charge of Radiance	Report from HSE in-charge of EPC Contractor/O&M contractor to site HSE In-charge of Radiance
			Regularly monitoring the ground water quality by engaging a NABL accredited laboratory to be undertaken.	EPC Contractor/O&M Team	Site inspection	Monthly Monitoring	Site lead/Site HSE in-charge of EPC Contractor/Site HSE in-charge of O&M contractor	HSE In-charge of Radiance	Report from HSE in-charge of EPC Contractor/O&M contractor to site HSE In-charge of Radiance
Noise quality									
■ Construction and demolition activities; ■ Operation of DG sets; and ■ Vehicular movement	Increase in noise level	Construction and Decommissioning	Normal working hours of the contractor to be defined (preferable 8 am to 6pm). If work needs to be undertaken outside these hours, it should be limited to activities which do not generate noise;	EPC Contractor	Site inspection	Monthly Monitoring	Site lead/Site HSE in-charge of EPC Contractor	HSE In-charge of Radiance	Report from HSE in-charge of EPC Contractor to site HSE In-charge of Radiance

Project Activities	Impact/Issue	Applicable Project Phase	Mitigation Measures	Responsibility for ensuring implementation of the suggested mitigation	Means of Verification that mitigation has been met	Timelines /frequency of Monitoring	Responsibility for implementation of monitoring	Supervision responsibility	Reporting Requirements
			Construct an enclosure around the construction site that will act as a noise barrier to minimize the effects of noise pollution. Minimal use of vehicle horns and heavy engine breaking in the area to be encouraged.	EPC Contractor	Site inspection	Inspection upon completion of task	Site lead/Site HSE in-charge of EPC Contractor	HSE In-charge of Radiance	Report from HSE in-charge of EPC Contractor to site HSE In-charge of Radiance
			Only well-maintained equipment should be operated on-site. Machinery and construction equipment that may be in intermittent use should be shut down or throttled down during non-work periods.	EPC Contractor	Site inspection	Monthly Monitoring	Site lead/Site HSE in-charge of EPC Contractor	HSE In-charge of Radiance	Report from HSE in-charge of EPC Contractor to site HSE In-charge of Radiance
Operational Health and Safety									
■ Working at heights; ■ Working with live electrical components; and ■ Operation of cranes and other mechanical lifting equipment	Injury, near-misses and fatalities for labour contracted on site.	Construction, Operation, Decommissioning	All workers (regular and contracted) should be provided with training on Health and Safety policies in place with appropriate refresher courses throughout the life cycle of the Project	EPC Contractor/O&M Team	Training report	Monthly Monitoring	Site lead/Site HSE in-charge of EPC Contractor/Site HSE in-charge of O&M contractor	HSE In-charge of Radiance	Report from HSE in-charge of EPC Contractor/O&M contractor to site HSE In-charge of Radiance
			Obtain and check safety method statements from contractors	EPC Contractor/O&M Team	Site inspection	Monthly Monitoring	Site lead/Site HSE in-charge of EPC Contractor/Site HSE in-charge of O&M contractor	HSE In-charge of Radiance	Report from HSE in-charge of EPC Contractor/O&M contractor to site HSE In-charge of Radiance
			Permitting system should be implemented to ensure that cranes and lifting equipment is operated by trained and authorized persons only	EPC Contractor/O&M Team	Permitting document	Monthly Monitoring	Site lead/Site HSE in-charge of EPC Contractor/Site HSE in-charge of O&M contractor	HSE In-charge of Radiance	Report from HSE in-charge of EPC Contractor/O&M contractor to site HSE In-charge of Radiance
			Appropriate safety harnesses and lowering/raising tools should be used for working at heights	EPC Contractor/O&M Team	Site inspection	Monthly Monitoring	Site lead/Site HSE in-charge of EPC Contractor/Site HSE in-charge of O&M contractor	HSE In-charge of Radiance	Report from HSE in-charge of EPC Contractor/O&M contractor to site HSE In-charge of Radiance
			A safety or emergency management plan should be in place to account for natural disasters, accidents and any emergency situations	EPC Contractor/O&M Team	Site specific Emergency Management Plan	Monthly Monitoring	Site lead/Site HSE in-charge of EPC Contractor/Site HSE in-charge of O&M contractor	HSE In-charge of Radiance	Report from HSE in-charge of EPC Contractor/O&M contractor to site HSE In-charge of Radiance
			The nearest hospital, ambulance, fire station and police station should be identified in the	EPC Contractor/O&M Team	Site inspection	Monthly Monitoring	Site lead/Site HSE in-charge of EPC Contractor/Site HSE in-	HSE In-charge of Radiance	Report from HSE in-charge of EPC Contractor/O&M

Project Activities	Impact/Issue	Applicable Project Phase	Mitigation Measures	Responsibility for ensuring implementation of the suggested mitigation	Means of Verification that mitigation has been met	Timelines /frequency of Monitoring	Responsibility for implementation of monitoring	Supervision responsibility	Reporting Requirements
			implemented emergency management plan.				charge of O&M contractor		contractor to site HSE In-charge of Radiance
Impacts on Ecology									
Vegetation Clearance	Habitat Modification and Loss	Construction	Vegetation disturbance and clearance should be restricted to the Project activity area only; Large old trees should be completely avoided and the project infrastructure if needs to be modified in such avoidance should be exercised; Old mature trees with significant height and girth should be avoided when constructing the solar compound and access roads; Unnecessary disturbance of neighbouring vegetation due to off-road vehicular movement, fuel wood procurement, needless expansion of labour camp and destruction of floral resources should be prohibited; Site levelling and clearing activity should not result in soil erosion that will affect the surrounding forest and scrub land.	EHS Officer	Visual Verification	Duration of the Activity	Site lead/Site HSE in-charge of EPC Contractor/Site HSE in-charge of O&M contractor	HSE In-charge of Radiance	Report from onsite HSE officer to HSE department
Excavation and construction	Disturbance to wildlife and habitat loss	Construction	Workshop or formal training exercise. The training should also communicate presence of species protected under Wildlife Protection Act, 1972 Schedule I and the penalties associated with contravention on the identified law; Set routes, consolidation of trips and no off-roading policies should be introduced by the EPC contractor to reduce the impact from noise and human-wildlife conflict; Adequate toilets, gas/firewood and space should be provided in any anticipated labour accommodation and the labourers should be informed not to enter or utilize any resources from surrounding forest land over the course of the construction period;	EHS Officer	Visual Verification	Duration of the Activity	Site lead/Site HSE in-charge of EPC Contractor/Site HSE in-charge of O&M contractor	HSE In-charge of Radiance	Report from onsite HSE officer to HSE department

Project Activities	Impact/Issue	Applicable Project Phase	Mitigation Measures	Responsibility for ensuring implementation of the suggested mitigation	Means of Verification that mitigation has been met	Timelines /frequency of Monitoring	Responsibility for implementation of monitoring	Supervision responsibility	Reporting Requirements
			Local semi-skilled and unskilled labourers should be used to the extent possible to reduce demographic influx into the Project site and therefore reduce the risk of disturbance to local fauna;						
			Waste that is generated from the Project during construction and operation should be stored in covered containers within the site premises. Uncovered waste may attract fauna to the Project site;						
			Excavated areas should be adequately fenced and security should be deployed to prevent wildlife intrusion into these areas;						
			Construction activities and transportation should be avoided during peak ecological activity i.e. dawn (5:30 am to 7:30 am) and dusk (5:00 pm to 7:00 pm). Night-time activities should be kept to a minimum;						
			Areas with pre-existing nests, ground-roosting sites and burrows should be avoided for construction related work to reduce the impact on local fauna;						
			Hazardous materials and waste should not be stored near any drainage channels or cliff-sides to prevent contamination of the surrounding environment and impact on local flora/fauna;						
			Avoid ground roosting sites and previously burrowed holes when possible;						
			Whenever possible, existing village or tractor roads should be upgraded to create an approach road which will minimize the disturbances on local flora and fauna.						

Project Activities	Impact/Issue	Applicable Project Phase	Mitigation Measures	Responsibility for ensuring implementation of the suggested mitigation	Means of Verification that mitigation has been met	Timelines /frequency of Monitoring	Responsibility for implementation of monitoring	Supervision responsibility	Reporting Requirements
Power evacuation	Electrocution and collision with transmission line components	Operation	Installing bird diverters which are reflective and can flap with the wind as a bird collision deterrent;	O&M Team	Visual inspection and record keeping	Monthly	HSE Manager	HSE In-charge of Radiance	Reports from EPC to the HSE In-charge
			A carcass register as part of the O&M phase should be maintained to record any bird carcasses or suspected bird carcasses. The register should include a date, type of specie (to the extent identifiable), geographic location and nearest Transmission Line infrastructure for each carcass entry. If possible, the register should be backed-up with photo-documentation of any identified carcasses or remains. If the number of carcasses are significant, then an ecologist should be commissioned to suggest more stringent mitigation measures at the sensitive Project components;						
			The O&M team should be instructed to regularly inspect transmission towers as part of their periodic maintenance and rounds of the operational Project. The purpose is to identify any roosting or nesting of bird species;						
			Use of plastic insulator caps or tubing of conductor at the electricity poles crossover should be considered.						
			Use of plastic insulator caps or tubing of conductor at the electricity poles crossover should be considered.						
Social Aspects									
Influx of migrant workforce into the study area during construction phase	Potential loss of livelihood	Construction Phase	▪ The sourcing of local labour, wherever possible should be made obligatory by Radiance (through contractual provisions) for sub-contractors,	Radiance	▪ Record Keeping	The proposed activities should be considered upon commencing any construction or	Plant Head of the Project along with Admin officer and Community Development Team	Monthly Progress Report	Embedded within cost of ongoing Skill development and community development programs

Project Activities	Impact/Issue	Applicable Project Phase	Mitigation Measures	Responsibility for ensuring implementation of the suggested mitigation	Means of Verification that mitigation has been met	Timelines /frequency of Monitoring	Responsibility for implementation of monitoring	Supervision responsibility	Reporting Requirements
			at least for construction phase ; ■ Preference should be given to the land sellers and vulnerable population in the study area, to the extent practicable; ■ It should be clearly communicated to the workers working during the construction period that this will be short term employment and the duration should be informed; ■ Information on local employment should be communicated to the gram panchayat (GP) and information on availability of employment opportunities should be displayed at GP office premises (preferably in the local language) in consultation with the Sarpanch ■ Engagement of local vendors, to the extent possible, for the goods and services required for the project during construction phase; ■ Radiance will establish a mechanism to audit subcontractors and suppliers with respect to compliance of utilizing local labour and resources; ■ Provision of Grievance Redressal Mechanism to all the key stakeholders in order to raise and register their grievance with respect to information sharing related to jobs and opportunities for vendor-ship ■ **Decommissioning Phase** ■ Radiance should ensure proper communication in terms			operation work at the Project site to engage the family members to the extent possible.			

Project Activities	Impact/Issue	Applicable Project Phase	Mitigation Measures	Responsibility for ensuring implementation of the suggested mitigation	Means of Verification that mitigation has been met	Timelines /frequency of Monitoring	Responsibility for implementation of monitoring	Supervision responsibility	Reporting Requirements
			of decommissioning timelines, and shall evaluate options of internal transfer of employees to other projects before planning for closure, in order to minimize retrenchment linked job losses; ■ The contractor shall inform the workers and local community about the duration of work, in advance, to clearly set out and manage expectations; ■ Reduction of worker will be done phase wise and corresponding to completion of each activity						
Engagement of unskilled and semi-skilled local and migrant labour	Impact on Employment and Entrepreneurship Opportunities	Construction, Operation and decommissioning phase	■ Adequately monitor the contractor's compliance to the applicable rules and regulations; ■ To the extent possible, locate the labour camp(s) within the project footprint area identified; ■ Development of the labour camp in keeping with the IFC Worker's Accommodation Guideline; ■ Provide adequate sanitation and waste management facilities including, such as safe drinking water, proper waste collection and disposal system, etc.; ■ Undertake health awareness among the local community, ■ Provide the local community an understanding of the project activities and the possible health and safety risks associated with the same as part of the engagement process; ■ Implement on-site vector control measures;	Radiance along with Contractors engaged during construction phase	■ Record of employment provided to members of Households affected due to project land take; ■ Records of Grievances being raised by locals or contractual workers engaged for the project.	Monthly	Project Plant Head along with EPC contractors and subcontractors	Monthly Progress Report	Embedded within cost of engagement of EPC contractor

Project Activities	Impact/Issue	Applicable Project Phase	Mitigation Measures	Responsibility for ensuring implementation of the suggested mitigation	Means of Verification that mitigation has been met	Timelines /frequency of Monitoring	Responsibility for implementation of monitoring	Supervision responsibility	Reporting Requirements
			■ Access to the local community to the grievance redressal mechanism for the project;						
■ Migrant worker-community conflicts; ■ Pressure on local resources; ■ Risk of diseases	Impact due to Labour Influx	Construction Phase		Radiance along with Contractors engaged during construction phase	■ Health and Safety Audits of Contractors; Physical verification	Monthly	Plant Head	Monthly Inspection Report	Management Time

9. IMPACT SUMMARY AND CONCLUSION

This environmental and social impact assessment has been conducted to evaluate the impacts associated with the solar power project of 50 MW capacity. The impact assessment has been conducted in compliance with the administrative framework identified herein, including relevant national legislative requirements and international guidelines/conventions.

9.1 Impacts Requiring Detailed Assessment

Following a scoping and impact assess exercise, this ESIA was focused on interactions between the Project activities and various resources/receptors that could result in significant impacts. The table below presents the outcomes of the comprehensive assessment of identified impacts as a result of the various phases of the Project.

Table 9.1 Impact Assessment Summary

Impact Description	Impact Nature	Significance of Impact	
		Without Mitigation	With Mitigation
Construction Phase			
Change in Land Use	Negative	Moderate	Moderate
Impact on Drainage and Topography	Negative	Minor to Moderate	Minor
Soil Compaction and Erosion	Negative	Minor	Negligible
Waste Generation and Soil Contamination	Negative	Moderate	Minor
Impact on Water Availability	Negative	Minor	Minor
Impact on Water Quality	Negative	Moderate	Minor
Impact on Air Quality	Negative	Moderate	Minor
Impact on Ambient Noise	Negative	Minor to Moderate	Negligible to Minor
Impact on Occupational Health and Safety	Negative	Minor to Major	Negligible to Moderate
Impact of Labour Influx/Migrant Workforce	Negative	Moderate	Minor
Impact on Community Health and Safety	Negative	Minor to Moderate	Negligible to Minor
Impact due to vegetation clearance and construction activities	Negative	Minor	Negligible to Minor
Impact on ecology habitat loss and modification	Negative	Minor	Negligible to Minor
Operation and Maintenance Phase			
Soil Compaction and Erosion	Negative	Negligible	Negligible
Waste Generation and Soil Contamination	Negative	Minor	Negligible
Impact on Water Availability	Negative	Minor to Moderate	Minor
Impact on Water Quality	Negative	Minor	Negligible to Minor
Impact on economy and employment	Negative		
Collision and Electrical Hazards and Transmission Infrastructure Context	Negative	Moderate	Minor- Moderate

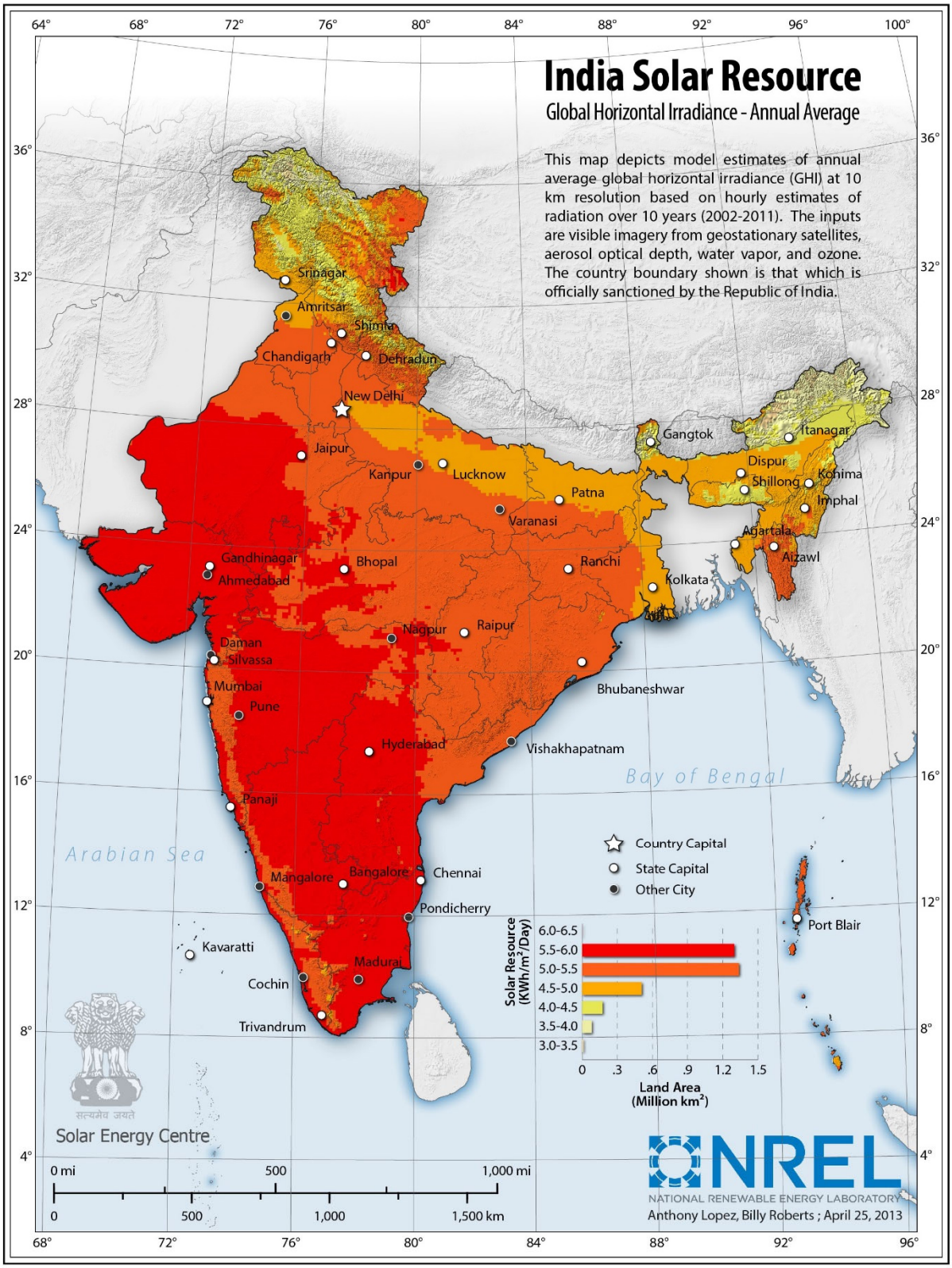
Impact Description	Impact Nature	Significance of Impact	
		Without Mitigation	With Mitigation
Wildlife access to project compound	Negative	Minor	Minor
Decommissioning Phase			
Impact on Water Environment	Negative	Moderate	Minor
Impact on Air Quality	Negative	Minor	Negligible to Minor
Impact on Ambient Noise	Negative	Negligible to Minor	Negligible
Impact on Economy and Employment	Positive		

9.2 Conclusion

The Project is a green energy project proposing to generate 50MW power through solar energy. The Project and its key components such as site office building, external transmission lines, etc. are likely to have had environmental impacts on baseline parameters, such as on land use (conversion from agricultural to industrial land), ambient air quality and noise quality, especially during the construction phase. The social impacts from the Project are assessed to be beneficial in terms of local employment and overall local area development.

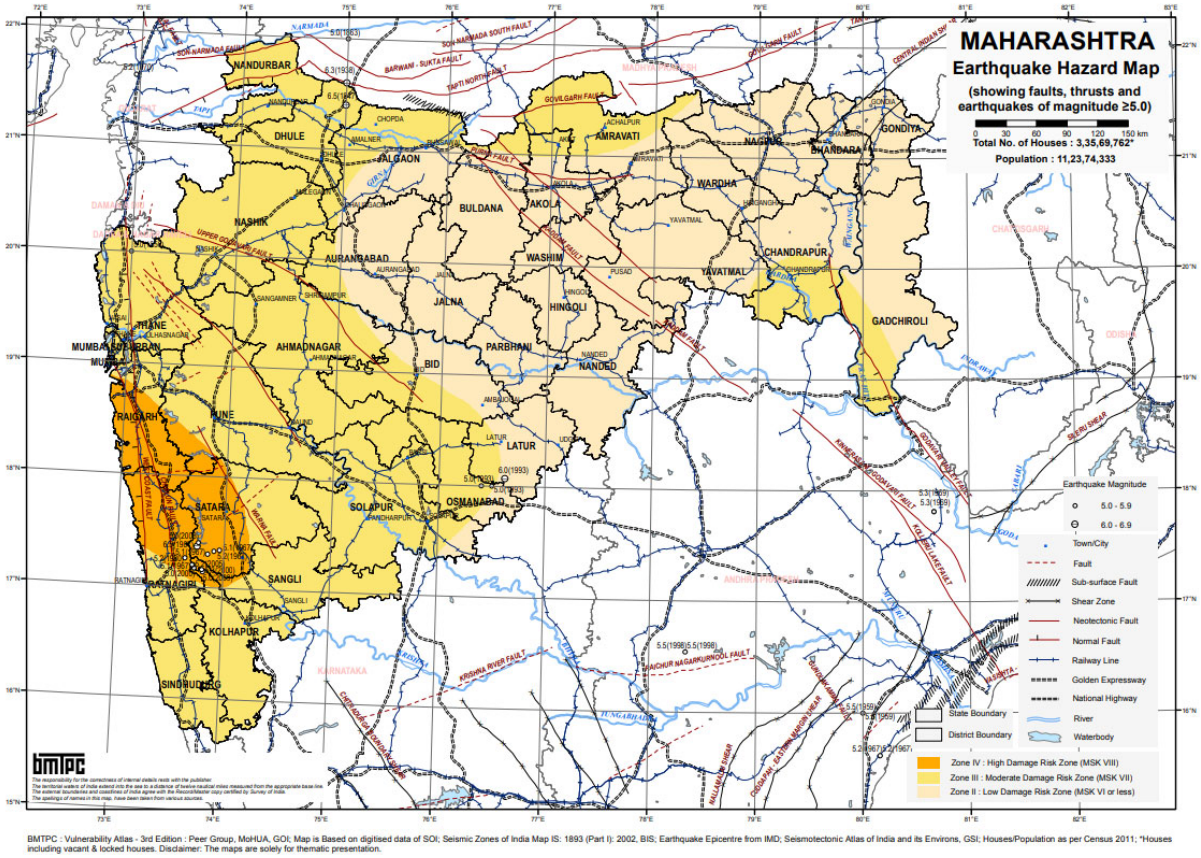
The Environmental and Social Management Plan (ESMP) describes mitigation measures for impacts specific to Project activities and also discuss implementation mechanism. To conclude, the implementation of ESMP will help Radiance in complying with its internal requirements as well as national/state regulatory framework in addition to meeting IFC requirements.

APPENDIX A INDIA SOLAR RESOURCE MAP


India Solar Resource
Global Horizontal Irradiance - Annual Average
This map depicts model estimates of annual average global horizontal irradiance (GHI) at 10 km resolution based on hourly estimates of radiation over 10 years (2002-2011). The inputs are visible imagery from geostationary satellites, aerosol optical depth, water vapor, and ozone. The country boundary shown is that which is officially sanctioned by the Republic of India.
Srinagar
Amritsar
Shimla
Chandigarh
Dehradun
New Delhi
Jaipur
Kanpur
Lucknow
Patna
Varanasi
Gangtok
Itanagar
Dispur
Shillong
Kohima
Imphal
Agartala
Aizawl
Gandhinagar
Ahmedabad
Bhopal
Ranchi
Kolkata
Nagpur
Raipur
Daman
Silvassa
Mumbai
Pune
Bhubaneshwar
Hyderabad
Vishakhapatnam
Bay of Bengal
Panaji
Arabian Sea
Mangalore
Bangalore
Chennai
Pondicherry
Kavaratti
Madurai
Cochin
Trivandrum
Port Blair
Country Capital
State Capital
Other City
Solar Resource (KWh/m²/Day)
6.0-6.5
5.5-6.0
5.0-5.5
4.5-5.0
4.0-4.5
3.5-4.0
3.0-3.5
0 .3 .6 .9 1.2 1.5
Land Area (Million km²)
Solar Energy Centre
0 mi 500 1,000 mi
0 500 1,000 1,500 km
NREL
NATIONAL RENEWABLE ENERGY LABORATORY
Anthony Lopez, Billy Roberts ; April 25, 2013

APPENDIX B HAZARD MAPS OF MAHARASHTRA

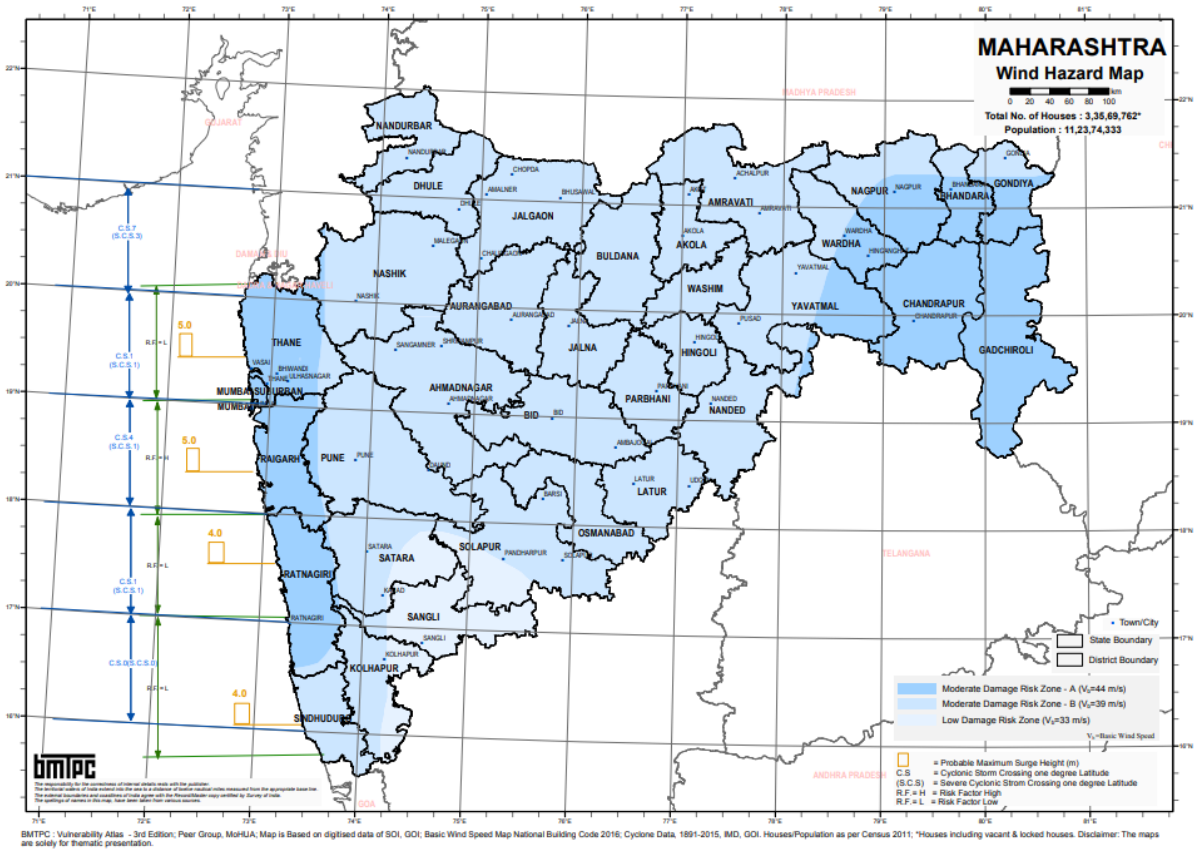
Figure B1 Earthquake Hazard Map – Maharashtra



BMTPC : Vulnerability Atlas - 3rd Edition : Peer Group, MoHUA, GOI; Map is Based on digitised data of SOI; Seismic Zones of India Map IS: 1893 (Part I): 2002, BIS; Earthquake Epicentre from IMD; Seismotectonic Atlas of India and its Environs, GSI; Houses/Population as per Census 2011; *Houses including vacant & locked houses. Disclaimer: The maps are solely for thematic presentation.

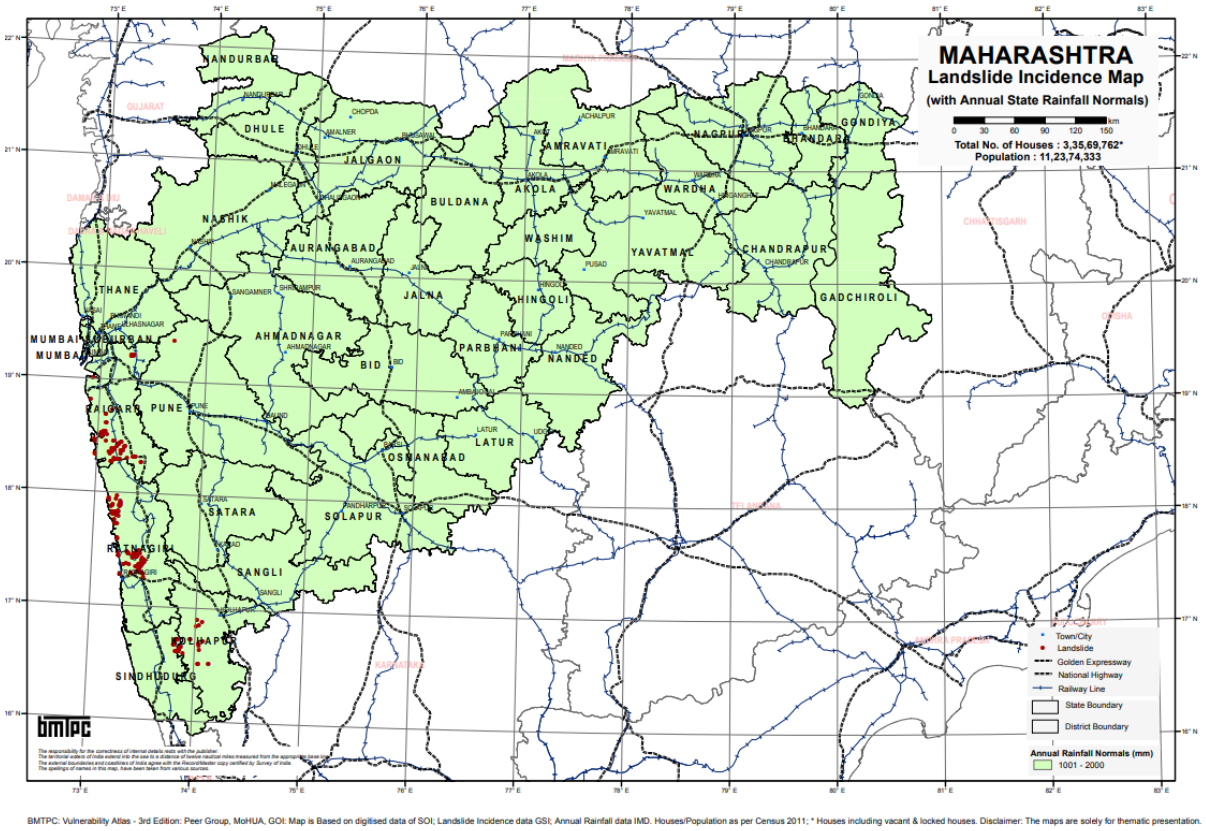
Source: Building Material and technology Promotion Council (BMTPC)

Figure B2 Wind and Cyclone Hazard Map – Maharashtra



Source: Building Material and technology Promotion Council (BMTPC)

Figure B3 Land Slide Incidence Map – Maharashtra



BMTPC: Vulnerability Atlas - 3rd Edition: Peer Group, MoHUA, GOI: Map is Based on digitised data of SOI; Landslide Incidence data GSI; Annual Rainfall data IMD. Houses/Population as per Census 2011; * Houses including vacant & locked houses. Disclaimer: The maps are solely for thematic presentation.

Source: Building Material and technology Promotion Council (BMTPC)

APPENDIX C SITE VISIT PICTURES

	
Beginning of construction activities on site	Discussion with locals, labours and site representatives

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