Environment and Social Impact Assessment

100 MW (AC) Solar Power Project, Dhule
Maharashtra, India

Fourth Partner Energy Private Limited

22 June 2022

Quality information

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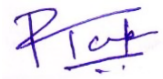			
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List of Abbreviations

SNo.	Abbreviation	Extension
1.	AC	Alternate Current
2.	AAQ	Ambient Air Quality
3.	AoI	Area of Influence
4.	CGWA	Central Ground Water Authority
5.	CPCB	Central Pollution Control Board
6.	CPR	Common Property Resource
7.	CTE	Consent to Establish
8.	CTO	Consent to Operate
9.	CSR	Corporate Social Responsibility
10.	CR	Critically Endangered
11.	DPR	Detailed Project Report
12.	DG	Diesel Generator
13.	DC	Direct Current
14.	FPEPL	Fourth Partner Energy Private Limited
15.	ERT	Emergency Response Team
16.	EN	Endangered
17.	EPC	Engineering, Procurement and Construction
18.	EPA	Environment (Protection) Act, 1986
19.	EAP	Environment Action Plan
20.	ESIA	Environment and Social Impact Assessment
21.	ESMP	Environment and Social Management Plan
22.	ESMS	Environment and Social Management System
23.	EMS	Environment Management System
24.	EHS	Environment, Health and Safety
25.	FGD	Focus Group Discussions
26.	GOM	Government of Maharashtra
27.	GP	Gram Panchayat
28.	GHG	Green House Gases
29.	GSS	Grid Sub -Station
30.	GRM	Grievance Redress Mechanism
31.	MPCB	Maharashtra Pollution Control Board
32.	MPCL	Maharashtra Power Corporation Limited
33.	MUVNL	Maharashtra Urja Vikas Nigam Limited
34.	HSE	Health, Safety and Environment
35.	ISA	Implementation and Support Agreement
36.	IMD	Indian Meteorological Department
37.	IP	Indigenous People
38.	IFC	International Finance Corporation
39.	IUCN	International Union for Nature and Natural Resources
40.	MW	Mega Watt
41.	MoEF&CC	Ministry of Environment, Forest and Climate Change
42.	MNRE	Ministry of New and Renewable Energy
43.	NOC	No Objection Certificate
44.	O&M	Operations and Maintenance
45.	PRI	Panchayati Raj Institution
46.	PPE	Personal Protective Equipment
47.	PV	Photo Voltaic
48.	PUC	Pollution Under Control
49.	PSS	Pooling Sub-station
50.	PPA	Power Purchase Agreement

SNo.	Abbreviation	Extension
51.	PIC	Prior Informed Consent
52.	SC	Scheduled Caste
53.	ST	Scheduled Tribe
54.	SPV	Special Purpose Vehicle
55.	TL	Transmission Line
56.	VU	Vulnerable
57.	WMP	Waste Management Plan
58.	WPA	Wildlife Protection Act

1. Introduction

Fourth Partner Energy Pvt. Ltd. (hereinafter referred to as FPEPL or client is India's leading solar energy company. FPEPL are committed to helping businesses switch to cleaner, cheaper solar power. Since inception in 2010, they have leveraged technology and innovation to become a one-stop renewable energy solutions platform for India's commercial and industrial sectors. Fourth Partner Energy offers onsite & offsite solar, energy trading, battery storage and electric vehicle infrastructure solutions. In the past decade, have progressed from being a leader in Solar EPC to having developed in-house, end-to-end services across evaluation, design, financing, procurement, construction, operation and maintenance of solar infrastructure, helping the company deliver the lowest total cost of ownership to the client. FPEPL gives a very wide range of solar solutions which includes on-site solar facilities (rooftop solar, ground mounted solar), off-site open access solar (group captive solar, captive solar and third party) and innovative solar solutions.

For executing the 100 MW (AC) Solar Power Project in Dhule, Maharashtra, India, special purpose vehicle (SPV) namely M/s Huoban Private Limited (hereinafter referred as 'Client') was formed by FPEPL. The 100 MW solar power plant (also referred to as the project or Solar Park) in Maharashtra is proposed to be set up on approximately 450 acres of land distributed along two land parcels, one in Nagpur village which is 150 acres and another 300 acres of land in Bhadgaon village in Dhule district of Maharashtra. This project will be completed in two phases, 70 MW in Phase -I and 30 MW in phase -II. Out of the 70 MW in Phase -I, construction is undergoing for establishing 34 MWp (DC).

AECOM India Private Limited (hereinafter referred to as 'AECOM') has been appointed by FPEPL to undertake the ESIA study to evaluate environment and social risks and impacts associated with the Project. The ESIA study comprised of a reconnaissance survey, baseline environmental monitoring, primary ecological survey, data analysis and consultations and discussions with relevant stakeholders.

Key project features of the project are as follows:

Table 1-1: Key Project Features Of The Project

Sr.No.	Description	Details
1.	Solar Park Developer - SPV	Huoban Private Limited
2.	Address	Plot No. N46, House No. 4-9-10, HMT Nagar, Hyderabad - 500076, Telangana, India
3.	Project location	Village: Nagpur & Bhadgaon, Taluka: Sakri, District Dhule, State: Maharashtra
4.	Solar Technology Proposed	Photo Voltaic Poly Crystalline
5.	Nearest Substation	220/132/33 KV MSETCL Substation Shivajinagar
6.	Power Evacuation	At 132 KV level-LILO on 132kV Shivaji Nagar Dhule MSETCL line.
7.	Estimated life of Solar Park	25 years
8.	Estimated Power Generation	Approx. 83 Million units per annum.

1.1 Project Background

The proposed project will be grid-connected ground mounted solar park. The purpose of the project is generation of electricity by harnessing solar energy through internationally and nationally accepted and proven Crystalline/ Mono PERC Silicon Photovoltaic (PV) Technology using power conditioners / inverter, along with other sub-systems components.

The Solar Park is proposed in Dhule District of Maharashtra state. falling in the western region of India. Maharashtra has been found to experience good irradiation of 5.5 to 6 KWh/m^2 in India and approximately 300 clear sunny days, an important climatic criterion that adds to successful power generation from a plant based on PV crystalline technology.

The PV Solar Park shall use proven crystalline silicon (c-Si) photovoltaic (PV) cell module. solar inverters and balance of plant (BOP) sub-systems I components for generating electricity from solar radiation.

The power generated from the Solar park is fed to MSETCL at 132 KV grid at a location under LILO arrangement. The electricity hence generated will add to the total renewable energy power generation base of Maharashtra and India. The energy generated shall be metered at the injection point of solar project pooling substation. The Solar Park execution shall be completed within 18 months from receipt of Grid Connectivity from MSETCL.

A solar power plant is a cleaner option for power generation in comparison to non-renewable fossil fuels. Ministry of Environment, Forest and Climate Change (MoEF&CC) in its Office Memorandum No. J-11013/41/2006-IA-II (I) dated 13 May 2011 (as provided in Appendix A) stated that the solar power projects are not covered under the ambit of Environmental Impact Assessment (EIA) Notification, 2006 and therefore does not require prior environmental clearance (EC).

1.2 Purpose and Scope of Work

The main purpose of the ESIA study is to identify, evaluate and manage environmental and social impacts that may arise during the development and operation of the project. The objectives of the ESIA study have been detailed below:

- Reconnaissance survey and primary site assessment to collect and review baseline environmental and social conditions;
- Collection of secondary environmental, social and demographic information;
- Identification and review of the applicable environment and social standards and identification of key issues;
- Assessment of potential environment and social impacts of the project and its components;
- Identifying key stakeholders and undertaking stakeholder consultations to assess the influence and impact of the proposed project on them;
- Preparing an ESIA Report encompassing all components of the baseline study, impacts assessed, documented consultations undertaken and management plans to mitigate the impacts assessed; and
- Developing an Environmental and Social Management Plan (ESMP) based on the impacts identified including monitoring aspects of the mitigation measures suggested.

1.3 Approach and Methodology

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

- The relevant project documents and detailed project report were reviewed to understand the project requirements;
- Regulatory review was undertaken to understand the applicable, local and national legislation and regulatory frameworks;
- A detailed social and environmental assessment of the site and surrounding areas was undertaken through the following:
  - Reconnaissance surveys to understand site specific issues;
  - Discussions with the local community;
  - Collation of secondary information on social aspects of the site, supplemented by consultations with the local communities to understand community perception with regard to the project and its activities;
  - Stakeholder mapping and Identification;
  - Focused group consultations;
  - Field surveys and data compilation;

  - Group/Community Consultations: Group meetings and consultations with local and community representatives; and

- Assessment of impacts based on understanding of the project activities and existing baseline status;
- Preparation of an Environment and Social Management Plan (ESMP).

1.3.1 Delineation of the Study Area/Area of Influence

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

IFC Sustainability Framework and Performance Standards (PS), World Bank EHS Guidelines and sector-specific (as applicable) environmental, health and safety guidelines as well as national regulatory requirements suggest that primary baseline data is to be collected so that it reflects the pollutants of concern associated with project processes. Since the proposed project is a renewable energy project and is located in the barren region of Bhadgaon village and Nagpur village, Dhule district in Maharashtra and is devoid of much habitation, industrial activity or other pollution sources, hence, primary impacts from the proposed solar power project have been assessed in and around a radius of 2 kilometres (km) around the Project Site and secondary impacts have been assessed in and around a radius of 5 km around the Project Site.

Therefore, for the purpose of the ESIA study, an area of 5 km (aerial distance) radius has been considered as the Area of Influence (AoI) for identification and assessment of potential environmental and social impacts around the proposed project.

- **Direct Impact Zone (Core Components):** The area covering the Project Site, internal transmission line corridor and direct access road to the project is designated as the area under the direct influence of the project for environmental, ecological and social impacts.
- **Indirect Impact Zone (Shared Facilities):** Area outside the direct impact zone of the project, up to a radius of 5 km, is considered as the indirect influence zone for the project for environmental, ecological and social impacts.

All the baseline environmental profiling, including environmental monitoring, socio-economic studies and public consultations, have been carried out within the AoI of 5 km.

In order to include the farthest anticipated direct receptors of biodiversity-related impacts, AoI for the biodiversity studies was delineated as the proposed Project Site, along with the area extending outward up to a radius of 5 km from the Project Site boundary.

1.3.2 Desktop Review

AECOM carried out a desk-based review of the information shared by the client prior to mobilizing for the site visit for undertaking the Impact assessment. As part of the review, the proposed project area was screened using Google Earth. Based on the review of Google Earth imagery, the environmental and social settings to be covered as part of the site visit were assessed and subsequently scoped in.

The desk-based review was primarily focussed on but was not limited to the following documents:

- Detailed project report (DPR);
- Site layout plan;
- Various land related documents;

- Organizational chart; and
- Other Project related documents.

1.3.3 Screening and Scoping

At the initial stage of the impact assessment, a preliminary level screening and scoping assessment of the project and its components, including an appraisal of the higher-level environment and social (E&S) risks, screening of the project site and shared facilities (including the access roads, transmission lines, substation, sources of raw material etc.) was undertaken. The screening and scoping study was conducted to identify the likely impacts that the development of the project will have on environment, biodiversity and social conditions in the AoI, to establish an understanding of the various linkages between the lifecycle phases of the project and the associated environmental, social and ecological aspects and development of the activity-impact matrix for the project, to identify the various stakeholders to be consulted for the ESIA study and develop a forward-going approach and methodology to be adopted including E&S baseline development, stakeholder engagement, impact assessment and development of the Environment and Social Management Plan (ESMP).

The screening and scoping assessment was undertaken based on the understanding of the objective and scope of work and AECOM's experience of working on renewable energy projects, especially the solar energy sector.

The AECOM team, comprising of one (1) EHS expert, one (1) Social expert and one (1) bio-diversity expert undertook a site visit to the project location between 21st February to 24th February 2022. As part of the site visit, the following key activities were undertaken:

- Meeting with the on-site project team;
- Site walk through the two land parcels (measuring 450 acres each) earmarked for the project;
- Site walk through the proposed site for the Pooling Substation (PSS) of the solar power park;
- Consultations with members of local communities near Nagpur and Bhadgaon villages;
- Preliminary biodiversity observations on habitats types

1.3.4 Site Survey

AECOM team conducted a site survey between 21st February to 24th February 2022. The following activities were undertaken during this visit:

- Undertake environmental assessments to gain an understanding of the following and consultations with site representatives:
  - Site setting assessment of 5 km study area for the project site;
  - Site setting assessment of transmission line corridor;
  - Study of key environmental receptors such as large water bodies, forest area, man-made sensitivities such as schools, colleges, hospitals etc.
- Undertake environmental monitoring and collection of baseline environmental data;
- Undertake social assessments and consultations in the form of individual interviews and focused group discussions (FGDs) with the following key stakeholder groups:
  - Local stakeholders; and
  - Institutional stakeholders/government departments.
- Collection of biodiversity baseline data and key stakeholder consultations (Forest department, local community, etc.).

1.3.5 Socio-Environment Baseline Data collection

Environmental baseline data was collected through primary monitoring and reconnaissance surveys of the study area (5 km distance around the project site). Secondary information through literature surveys was also collected for the study area. The baseline study included the following:

- Primary environmental baseline data collection within the study area. The primary environmental and social baseline data was collected with respect to ground water, ambient air quality (AAQ), ambient noise level, soil quality, and socio-economics profile. The ecology and biodiversity data were also collected as part of the primary data collection;
- The GIS mapping of the study area was done to present details on land use pattern, forest/ vegetation cover, settlements, water bodies, drainage pattern, spot heights and contours; and
- Information on geology, meteorological conditions, water and ecological resources, socio-economic status etc. was collected from secondary sources.

1.3.6 Stakeholder Consultation

During the site visit for ESIA, following groups of stakeholders were consulted with the objective of collecting baseline data/information:

- **Institutional Stakeholders:** Consultations with Panchayat President and Panchayat Members of Bhadgaon and Nagpur Villages, Private Medical Practitioner, Nagpur, Office of the Deputy Conservator of Forest (DCF), Dhule
- **Local communities**: Consultations with Landowners belong to both Bhadgaon and Nagpur sites, Shepherds, etc., were consulted; and
- **FPEPL site representative**: Consultations were undertaken with the FPEPL site team along with land aggregator during visit.

1.3.7 Impact Assessment

Impact identification and prediction were undertaken on the basis of environmental and social baseline data collected. The major processes involved are:

- Identification – to define the impacts associated with different phases of the project and the activities undertaken;
- Prediction – to forecast the nature, magnitude, type, duration, extent, scale, frequency likelihood and sensitivity of the major impacts identified; and
- Evaluation – to determine the significance of residual impacts i.e. taking into account how mitigation will reduce a predicted impact.

Professional judgement, experience and knowledge of similar projects were used for impact analysis. The extent and potential consequences of the impacts have been compared against applicable reference framework. Mitigation measures have been suggested for each of the identified adverse impacts.

1.3.8 Environment and Social Management Plan

This section delineates the roles and responsibility and timeline for implementing mitigation measures to prevent the significant impacts arising from activities during different phases of the project.

1.4 Layout of Report

The current ESIA Report has been arranged under the following chapters:

1. **Chapter One: Introduction** (This chapter provides a background of the project and the current Report, the objectives with which the study has been undertaken, the scope of work, etc.)
2. **Chapter Two: Project description** (This chapter provides details of the project location, key project components and utilities, land requirements, power purchase agreement, current project status, etc.)
3. **Chapter Three: Environment and Social Regulatory Framework** (This chapter encompasses the national administrative requirements, applicable permits, licences, approvals and consents and project categorisation as per Reference Framework)

4. **Chapter Four: Environmental and Socio-economic Baseline** (This chapter illustrates the environmental baseline, socio-economic baseline and Ecology baseline)
5. **Chapter Five: Stakeholder Engagement and Consultation** (This section presents the key stakeholders consulted during this study)
6. **Chapter Six: Analysis of Alternatives** (This section presents the analysis of alternatives for the proposed solar project)
7. **Chapter Seven: Impact Assessment** (This chapter highlights the impact assessment criteria, key environmental risks and key social risks)
8. **Chapter Eight: Environment and Social Management Plan** (This chapter highlights the organization structure, training, Inspection monitoring and audit and Documents and record keeping)
9. **Chapter Nine Conclusion and Recommendations**

1.5 Limitations

This report presents the observations made by AECOM's professionals based on the scope of work and agreed approach and methodology with client. The present report has been developed to identify the potential E&S issues and conditions associated with the activities of the project for which the assessment has been carried out. During the course of this assessment, AECOM has attempted to independently assess the potential presence of E&S issues or conditions within the limits of the established scope of work as described in the contract between client and AECOM.

The assessments is based on the information and documents received by AECOM, and the site conditions as witnessed by the AECOM team during the time of the inspection. As with any assessment exercise, there is a certain degree of dependence upon verbal information provided by the point of contact for assessment, limited number of documents available for review and information available in the public domain, which is not readily verifiable through visual observations or supported by any available written documentation. During the course of the site assessment, AECOM has attempted to independently assess the potential presence of such conditions within the limits of the established scope of work as described in the proposal. However, verification of potentially important facts is not always possible. AECOM shall not be held responsible for conditions or consequences arising from relevant facts that were concealed, withheld, or not fully disclosed by site representative at the time this assessment was performed. The assessment is based on sample site visits carried out by AECOM. This report is to be used to understand the overall E&S requirements of the project covered under this study rather than performance of overall entity.

This report has been prepared by AECOM for the benefit of its client. AECOM's client may release the information to third parties, who may use and rely upon the information at their discretion. However, any use of or reliance upon the information by any party shall be solely at the risk of such party and without legal recourse against AECOM, its parent, its subsidiaries and affiliates; or their respective employees, officers, or directors; regardless of whether the action in which recovery of damages is sought is based upon contract, tort (including the sole, concurrent, or other negligence and strict liability of AECOM), statute, or otherwise. This information shall not be used or relied upon by a party that does not agree to be bound by the above statement.

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The environmental and social assessment for client is based on the documents made available for review, discussions with site personnel and observations from the site walkthrough of the sample project sites as well as the potential project sites (where investment is probable) undertaken by AECOM professionals at the site during the assessment process. Wherever documentation, policies and procedures for evaluation were not available for review, it has been presented in the report at relevant sections. In addition, wherever AECOM has not been able to make a judgment or assess any process, it has been presented as an information gap and a way forward has been suggested.

2. Project Description

2.1 Project Location

The project is proposed on approximately 450 Acres of land in Bhadgaon and Nagpur villages in Dhule District. Line in Line out (LILO) point is 1.23 kms away from the 132/33kv switch yard between which a proposed 132kV line will be stretched. The project site can be accessed through SH 11 which starts from the Raipur village which will be 2.88kms away from the 132kV station to be constructed and 1.64 kms from the existing Lilo point. This road can be accessed via NH 753B from Sakri taluka. The nearest Airport from Dhule is Chikkalthana Airport, located at Aurangabad, roughly 156 Kms from Dhule. The airport is well connected to many major cities like Surat, Mumbai, Pune, Indore, Nagpur and New Delhi, etc.

The project site location has been depicted in the ***Figure 2-1*** below.

2.2 Site Settings

The Project site comprises of two (2) plots in Bhadgaon village and Nagpur village which are at distance of 2.5-3 kms from each other and total land is around 450 acres. Towards the North side of the land is the 125 MWp Sakri solar park which was constructed by MAHAGENCO and is approximately 1-2 kms away from Bhadgaon land parcel.

A major proportion of the Project sites constitute modified habitats represented by fallow arable land and the remaining site constitutes natural habitats represented by a seasonal stream and a patch of rocky area.

No physical structures were noted at the site during the site visit. The selected site is a relatively flat terrain with a mix of rocky pieces of land patch.

The access road running parallel to the site is an existing paved road (~3.5 m wide) and is well connected to nearby villages.

2.2.1 Access Roads

The project site can be accessed through SH 11 which starts from the Raipur village which will be 2.88 kms away from the 132kV station to be constructed and 1.64 kms from the existing Lilo point. This road can be accessed via NH 753B from Sakri taluka. This road further connects to Vehergaon and Behergaon village.

2.3 Status of the Project

For the purpose of the environmental and social impact assessment, a site visit was undertaken between 21st February to 24th February 2022. As on the day of site visit, the project was noted to be in pre-construction phase, and it was noticed that fencing work to demarcate the site boundary was being undertaken at the proposed project site. As per the information provided on land procurement, approximately 285 acres out of 450 acres is purchased and remaining is under process, out of these 285 acres purchased, around 180 acres is from Bhadgaon site and around 105 acres from Nagpur area . PPAs have been signed between individual project SPVs formed with individual energy offtakers under captive/group captive Open Access arrangements. The typical tenure of PPA is 25 years. As per the information shared by the client, there are currently three Engineering, Procurement and Construction (EPC) contractors for the project Radiant solar, Aditya Engineers and Tiranga Construction Ltd. for the purpose of solar panel deployment, switch yard construction and site boundary construction respectively. Approval for grid connectivity to 70MW solar power park was obtained from Maharashtra State Electricity Transmission Company Limited (MSETCL) on 29th April 2021. Grid connectivity approval for additional 30 MW solar project was also obtained on 28th February 2022.

Figure 2-1: View of the project site

Figure 2-2: Hospital in Sakri

Figure 2-3: View of the existing access road to site

Figure 2-4: Mandir under renovation at a distance of 500 m from site (Bhadgaon land parcel)

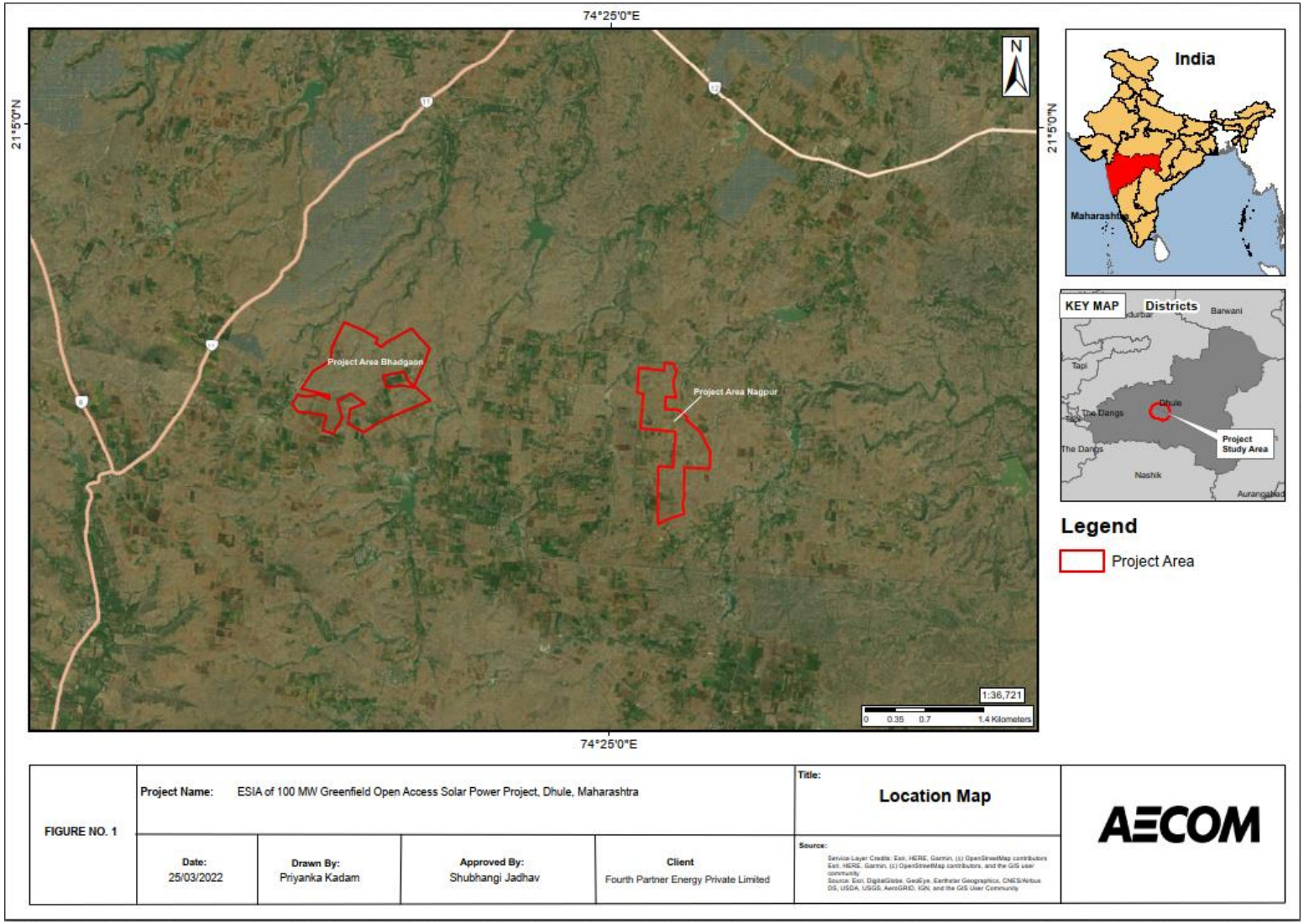


Figure 2-5: Map showing Project Location in Dhule

2.4 Project Overview

2.4.1 Project Components

The project components for a solar power plant include Solar PV array, transformer, inverter, substation, transmission line and shared infrastructures (office building, control room, guard room, etc.).

Solar power is trapped through the PV cells in the modules, which are connected to form an array to produce higher voltage. Since the power generated through the solar panels is a Direct Current (DC) and electrical appliances use the Alternating Current (AC), inverters are used to convert DC to AC generated in the solar farms. Transformers are then connected with the AC to step up the voltage to 33 kV for transmission to pooling substation and there it steps up to 132 KV voltage which will be fed to LILO point on the MSETCL grid.

Details on components of PV solar plant are presented in ***Table 2-1***.

Table 2-1: Components of Solar PV Plant

S. No.	Component	Description
1.	Solar PV modules	These convert solar radiation directly into electricity through the photovoltaic effect in a silent and clean process that requires no moving parts. The PV effect is a semiconductor effect whereby solar radiation falling onto the semiconductor PV cells generates electron movement. The output from a solar PV cell is direct current (DC) electricity. A PV power plant contains many cells connected in modules and many modules connected in strings[1] to produce the required DC power output.
2.	Inverters	These are required to convert the DC electricity to alternating current (AC) for connection to the utility grid. Many modules in series strings and parallel strings are connected to the inverters.
3.	Module mounting (or tracking) systems	These allow PV modules to be securely attached to the ground at a fixed tilt angle, or on sun-tracking frames.
4.	Step-up transformers	The output from the inverters generally requires a further step-up in voltage to reach the AC grid voltage level. The step-up transformer takes the output from the inverters to the required grid voltage (for example 33kV and 230 kV depending on the grid connection point and country standards).
5.	Grid connection interface	This is where the electricity is exported into the grid network. The substation will also have the required grid interface switchgear such as circuit breakers (CBs) and disconnects for protection and isolation of the PV power plant, as well as metering equipment. The substation and metering point are often external to the PV power plant boundary.

Source: Detailed Project Report (DPR)

Apart from the above basic components, the project system will consist of a main control room (MCR) and a switch yard within the project boundary.

The salient features of the project components have been presented in ***Table 2-2*** below and the details have been provided in subsequent sections.

Table 2-2: Technical Details 34 MWp Solar Project (under construction)

S.No.	Material Description	Units	Qty
1	MMS Structure		
a	Mounting Structure with 2 rows of 28 modules in portrait (Full tables)	No's	1,103
b	Mounting Structure with 2 rows of 14 modules in portrait (Half Tables)	No's	70
2	Supply of Monocrystalline 1500V, 540Wp Modules with 1.3 mtr cable		
a	1500V, 540Wp Modules with 1.3 mtr cable	No's	22316
b	1500V, 545Wp Modules with 1.3 mtr cable	No's	40292

[1] Modules may be connected together in a series to produce a string of modules. When connected in a series the voltage increases. Strings of modules connected in parallel increase the current output.

S.No.	Material Description	Units	Qty
3	String Inverters - SG250HX-IN-20 (220kVA ,800Vac)	No's	105
4	DC cables	Mtrs	95,129.6
5	LT cable from Inv to LT panel		
a	1.9/3.3 kV grade, AL conductor, XLPE insulated, Al armoured, overall PVC outer sheathed of following size: 3C x 185 sq.mm LT Cable (*Inverter to LV Panel)*	Mtrs	23,700
b	1.9/3.3 kV grade, AL conductor, XLPE insulated, Al armoured, overall PVC outer sheathed of following size: 3C x 240 sq.mm LT Cable (*Inverter to LV Panel)*	Mtrs	1,344
6	LT Panels	No's	6
7	COM-100	No's	4
8	UPS	No's	4
9	SCADA / Communication	No's	4
10	ITD Transformers (7.5 MVA - 2 No's, 5.5 MVA-1 No & 3MVA - 1 no)	No's	4
11	1.9/3.3 kV grade, AL conductor, XLPE insulated, Al armoured, overall PVC outer sheathed of following size: 1C x 400 sq.mm LT Cable (*LV Panel to Inverter Duty Transformer)*	Mtrs	6,648
12	33KV ICOG HT panels	No's	2
13	33KV RMU HT panels	No's	2
14	33kV HT cables		
a	19/33KV (36)(E), AL conductor, XLPE insulated, Al armoured, overall PVC outer sheathed of following sizes. 3C x 185sq.mm MV Cable (Inverter duty Transformer to ICOG panel to RMU Panel)	Mtrs	528
b	19/33KV (36)(E), AL conductor, XLPE insulated, Al armoured, overall PVC outer sheathed of following sizes. 3C x 240 sq.mm MV Cable (RMU Panel-2 to Metering kiosk)	Mtrs	1,152
15	Metering KIOSK with CT & ABT meter	No's	4
16	33KV HT panels at PSS	No's	2
17	BOS material		
	Auxiliary System		
A	*Auxiliary distribution system*		
i	10kVA, 0.8/.415kV Dyn11 Dry type auxiliary transformer with ACDB (IS)	Nos	3
ii	100kVA, 33/.415kV auxiliary transformer (MCR)	Nos	2
B	*Inverter Station UPS System*		
	3kVA UPS with 2hr power backup with required battery bank, with UPS DB, suitable for Outdoor Application IP55	Nos	3
C	*MCR UPS System*		
	10kVA UPS with 4hr power backup with required battery bank	Nos	2
D	*Battery Charger & Battery*		
i	110VDC, 120A, Dual float cum Boost charger with 3 hours of battery backup	Nos	1
ii	110VDC, 120A, 300AH, Battery with rack	Nos	2
iii	415V,3ph,4 wire ACDB consisting of incomers for 100kVA Transformers and TPN feeders with all control, protection, indication, other accessories & fittings as per specification.	Nos.	1
iv	415V, 3ph, 4 wire UPS DB consisting of DP feeders as per single line diagram provided complete with all control, protection, indication, other accessories & fittings as per specification. (For Inverter Station & MCR)	Nos.	5
v	415V, 3ph., 4 wire LDB consisting of SPN/TPN feeders as per single line diagram provided complete with all control, protection, indication, other accessories & fittings as per specification.	Nos.	4

Source: Detailed Project Report (DPR)

As per the PVsyst – simulation report on grid connected systems for 100 MW, some of the key information is mentioned in below.

Table 2-3: PV array characteristics details

PV array characteristics

PV Module		**Inverter**	
Manufacturer	JA Solar	Manufacturer	Sungrow
Module	JAM72S30-540/MR	Module	SG250HX-IN-20
Unit Nom. Power	540 Wp	Unit Nom. Power	220 KWac
Number of PV Modules	277788 units	Number of inverters	455 units
Nominal (STC)	150.0 MWp	Total power	100100 kWac
Modules	9921 strings X 28 in series	Operating voltage	500-1500 V
Total PV Power		**Total Inverter power**	
Nominal (STC)	150006 kWp	No. of Inverters	455 units
Module area	717911 m2		
Cell area	660824 m2		

Source: PVsyst Simulation report (Nov 2021)

2.4.2 Power Evacuation—Substation and Transmission Line

The PV crystalline silicon technologies have been a proven technology nationally and globally for the past 20+ years in solar market. Various aspects of these technologies have been practically analysed, like generation. requirement of O&M, probability of operational failure etc. Out of the various factors considered before finalizing this technology for current Solar Park, practical functionality of the technology was one of the major ones.

The total collector area in the Phase 1 of the project with capacity of the PV modules of 70 MW (AC) under average reception of 1961 kWh/m2 of solar irradiation as calculated in PV system, considering average monthly simulation data, is generating net electricity of about 83 million kWh per year against the pre-defined module efficiency

The direct current (DC) from PV modules shall be converted into alternating current (AC) by solar inverters. The output from solar inverters shall be stepped upto 33 kV and shall be connected through 132 kV overhead transmission line at LILO location, passing through the selected 220/132/33 kV MSETCL substation. This substation is at a distance of 5 kms from the Bhadgaon project site. 1.23 kms of transmission line will be developed by FPEPL connecting the Bhadgaon solar pooling substation with the existing LILO point which further connects to the MSETCL substation.

2.5 Resource Requirement and Procurement

2.5.1 Land requirement and Procurement process

The following project components were identified for which land will be required during the construction and/ or operation phase;

- Installation of Solar Modules;
- Site office;
- Invertor room;
- Stock yard; and
- Transmission line

The above information on the project components has been drawn based on discussions with the site representatives of FPEPL, consultations with the land aggregator, landowners, panchayat representatives and review of land-related documents shared by FPEPL.

2.5.1.1 Project-related land procurement and existing land procurement status

The proposed 100MW Solar power project is proposed to be developed in Nagpur and Bhadgaon villages of Sakri Taluk, Dhule District. The total land requirement for the proposed project would be around 450 acres which includes installation of Solar modules of 100MW capacity along with site office, inverter room, and other associated facilities. For the proposed project, private land owned by general community are given preference and does not involve any Tribal / land owned by Scheduled Tribe / nomadic tribe population.

Details and existing land procurement status for the project is as follows:

- **Extent of land:** The Project Site comprises of two (2) land parcels, each at Nagpur and Bhadgaon Villages, measuring 150 acres (60.7028 hectares) and 300 acres (121.4 hectares), respectively.
- **Mode of procurement:** The required land is being procured through the land aggregator on a Willing Buyer and Willing Seller basis.
- **Current procurement status:** As on the date of site visit (22nd Feb 2022), sale deeds were executed for 285 acres (105 acres of total 150 acres from Nagpur Village and 178 acres of 300 acres from Bhadgaon village) and land was transferred to the name of the project developer.
- **Farming and irrigation:** The entire project land sites were observed to be rocky, poor soil quality & lack of irrigation facilities which makes the land unfit for extensive farming. During site visit, only few patches of land parcels were cultivated which are reported to be planted during the monsoon season.
- **Access road:** The site can be accessed through State Highway (SH) 11 Sakri-Dondaicha Road which connects the Bhadgaon site parcel at 1.5 km and Nagpur site parcel at 7.3km. The sites located in both Bhadgaon and Nagpur villages are connected through the exiting government village roads and the same will be upgraded for the project use. Hence, no additional land is required for widening of the access road.
- **Transmission line:** Power generated from the project will be fed to the common Pooling Substation (PSS), which will be constructed western portion of the Bhadgaon site parcel and power will be further evacuated through a 132-kV transmission line measuring ~1.23 km connecting to the existing LILO point and thereby connecting to the existing GSS (Shivajinagar (Sakri) 220/132 kV Substation) at 6 km. As per the information available, the transmission line corridor is currently under planning stage. The 33kv transmission line B-Line connecting two land parcels and 132kv from the PSS to the LILO point are mostly passing through agricultural land parcels. The right of way (RoW) of the transmission line is majority finalised.
- **Grazing within and around the project site:** Grazing activities were observed adjacent to the Bhadgaon land parcel. Based on the consultation among shepherds involved in grazing, revealed that the project site land is not a designated grazing field. It was also reported that they are grazing in the region as the land is barren and it is enroute to the designated grazing land which is at a distance of about 2km from the project site and they also confirmed that there will not be any impact /shortfall of grazing land due to the upcoming solar power project.
- **No appropriation through the tools of acquisition:** It is to be noted that no appropriation of land using the tools of acquisition have been involved for the project. Consequently, the project does not have any impacts that are involuntary in nature.

2.5.1.2 Key Issues Aspects of Land Procurement

As indicated earlier, land required for the proposed project development is being procured through private landowners on a Willing Buyer and Willing Seller Basis and does not envisage any physical or economic displacement. The position of the project/ land procurement vis-à-vis key socio-economic issues are as follows:

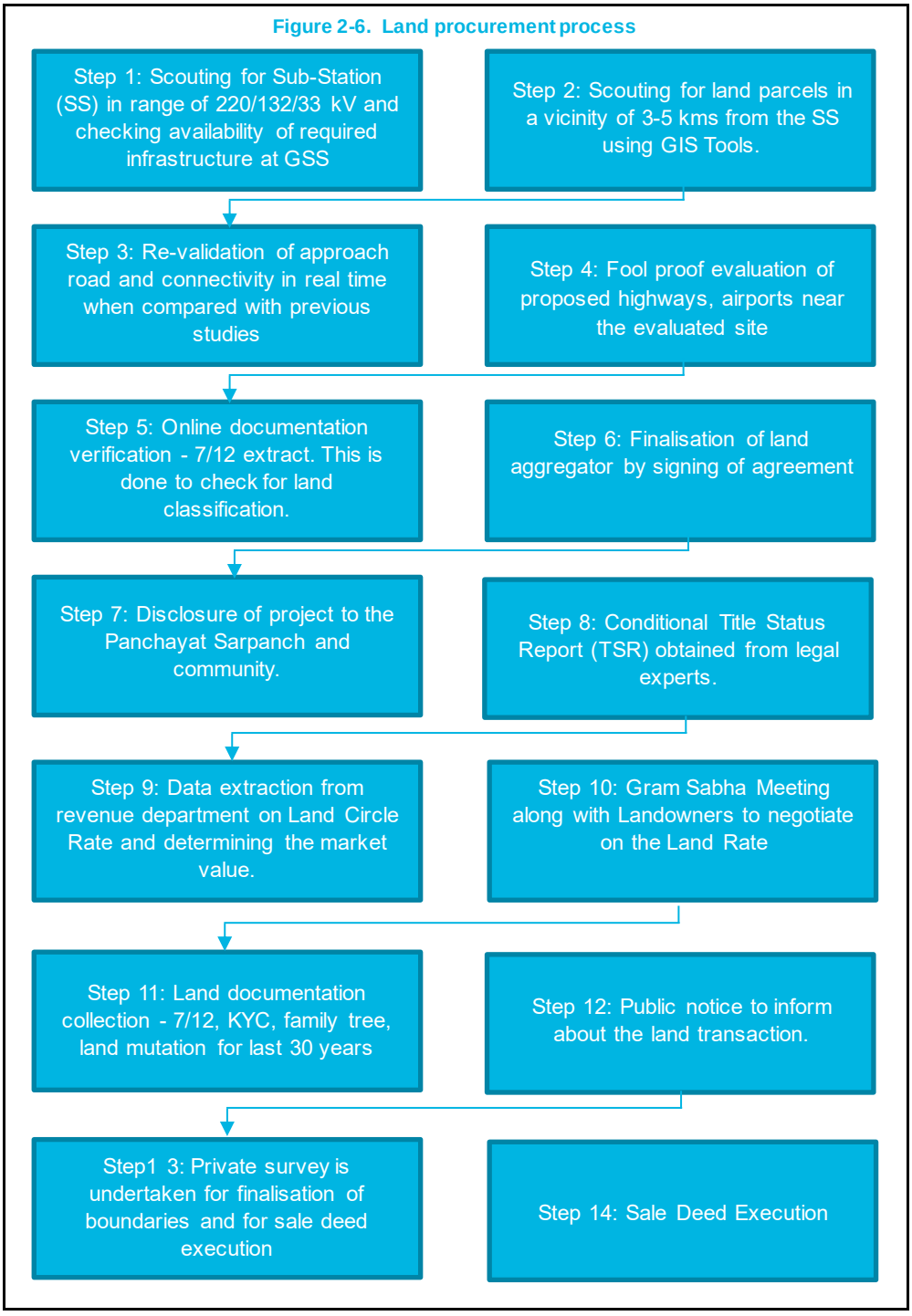
- **Tribal Land:** The land identified for the project does not comprise of any tribal land/ land parcels owned by members belonging to the Indigenous Peoples (IP). Moreover, the project does not have any impacts on IPs. It is to be noted that though there are presence of Nomadic tribes and Scheduled Tribe population in the study area, no land belonging to those tribes is involved in the project.

- **Forest land:** The project will be developed on private rainfed agriculture land. As reported, no forest land will be used for the project.
- **Common Property Resources (CPR):** No CPRs were reported on the project land parcels.
- **No Objection Certificate (NOC) from Panchayat:** Gram Panchayat NOCs from both Bhadgaon and Nagpur villages has been obtained.
- **Landlessness:** Based on the consultation with the sample landowners as part of ESIA, it was reported that the none of the landowners were made landless and most of them reinvested/plans to reinvest the compensation money by purchasing alternative land.
- **Encumbrance on Land/ Economic Impact:** No encumbrance or encroachment on the project land could be observed at site or reported during stakeholder consultations. Similarly, only few patches of land are used for agricultural activities as the soil quality and lack of irrigation facility makes the land unsuitable for extensive agriculture. The compensation for the land is determined based on mutual understanding between land aggregator and landowners during the Gram Sabha meeting, which is generally two times the government circle rate and above the prevailing market rate.
- **Cultural Heritage sites:** Within the project area there are no cultural or religious important place, however there is a small sacred place with an stone being worshiped by the neighbouring farmers. This sacred place is not a major religious facility and being worshiped by locals nearby. The project will have no bearing/ impact on the said scared place.

2.5.2 Land Procurement Process

Land required for the proposed project development is being procured through private landowners on a Willing Buyer and Willing Seller Basis and does not envisage any physical or economic displacement. The said land does not include any Notified tribal /land belonging to tribal/ Nomadic tribes or forest land. The procedure used for procurement of the said land has been highlighted in ***Figure 2-9***.

Figure 2-6. Land procurement process



2.5.3 Manpower requirement

As on date of site visit, procurement of land for the project was in process and no project-related construction activities had started except installation of fencing in Bhadgaon site. The EPC contractor for the project was yet to be appointed at the time of site visit. It was estimated that during the peak construction phase, approximately 200-300 workers will be employed for a duration of 6 months. Some of the key activities to be undertaken at site during the construction phase includes foundation work, civil construction work, electrical and structural work, etc. While most of the workers in the unskilled and semi-skilled categories will be hired from the neighbouring villages and from within the Dhule district, the manpower requirement in the skilled and highly skilled categories will be sourced by contractors. It was revealed by the site representative of FPEPL that migrant workers will be provided

accommodation in the one labour camp which will be constructed near the project site during the construction phase.

The manpower requirement during the operations phase was reportedly between 15-20 people who will be engaged through contractors mostly for module cleaning, tilting, housekeeping, security, gardening etc.

FPEPL manpower to be engaged during the construction and operations phases was reported to be between 10 – 15 (during construction) and 5-10 (during operations).

2.5.4 Water Requirement

Construction Phase

As per the information shared by the Client, water requirements were calculated for the work in phased manner and will be calculated for total 100 MWp accordingly. Water requirements will defer with each passing phase of the constructions and the requirement is thus segregated accordingly.

Water required per cum concrete – 200 ltr water per cum required.

Water required:

- First 10 days: 5000 litre/day water is required and 25 cu. Meter concrete /day. (50,000 Litre of water for 10 days).
- From 10 to 50 days: 850 Litre of water/day is required. Volume of concrete /day - 42.5 Cu. Meter of concrete been used. (3,25,000 Litre/40days).
- From 50 to 80 days: Water requirements/day - 3,333 Litre Approx. Total water requirement - 1 lakh litres (Approx 16 cubic meter concrete been used/day).
- From 81 to 120 days: 1500 Litre of water is required.

Total Water required for construction– 500000 Ltr
Total Water required for working labours – 300 Ltr

Operation Phase

The water requirements for the plant in operation phase will be predominantly for washing of solar PV modules periodically to remove dust and other dirt and for domestic use.

Water Required for Module cleaning –

- For Project 1 (30 MWp): 55,000 modules & For Project 2 (4 MWp): 7,350 modules
- Water quantity required per cleaning: 2 Ltr/module
- No. of cleaning cycles: 1.5 /month or 18 cycles per year
- Water requirement: For Project 1: 6 KLD and For Project 2: 0.8 KLD

As per the information provided by the Client, currently all the water requirements are met by the water tankers which RE procured from the local water provider and in future client has plan to dig a borewell/well.

2.6 Waste Generation

2.6.1 Wastewater

During construction phase, adequate number of portable toilets will be provided by the EPC contractor at site and a septic tank with soak pit will be provided for disposal of domestic wastewater generated. Wastewater from construction activity will be limited to cleaning and washing activities.

During the operation phase, domestic wastewater will be limited to domestic wastewater discharged from the site office. Toilets with a septic tank and soak pit will be provided for disposal of domestic wastewater generated at the site office.

2.6.2 Hazardous Waste

During construction phase, hazardous waste such as used oil from diesel generator (DG) sets, oil-soaked cotton, oil lined containers, paints, etc. will be generated at the site. The hazardous waste will be disposed through a State Pollution Control Board (SPCB) authorized hazardous waste recycler within 90 days of generation.

During operation phase, no DG set is proposed to be installed at the site and thus the hazardous waste generation will be limited to used oil from transformer. The oil will be reused after filtration and the waste oil will be disposed through SPCB approved hazardous waste recycler.

2.6.3 Solid Waste

Solid waste generation during the construction phase will consist primarily of scrapped building materials, excess concrete and cement, rejected components and materials, packing and shipping materials (pallets, crates, Styrofoam, plastics etc.). The municipal waste will be disposed by the EPC contractor through local vendors / local bodies and recyclables will be sold off to vendors.

Considering 300 worker in peak construction period and 20 during operation phase, approximately 60 kg/day and 4 kg/day of municipal waste will be generated.

During operation phase, the waste generated will be limited to paper, plastic waste and food waste from the site office. The waste shall be collected in designated bins at site and disposed at a regular interval by the O&M contractor through local vendors / local bodies and recyclables will be sold off to vendors

2.7 Implementation Schedule

FPEPL will engage an EPC contractor on turnkey basis for undertaking construction works. The construction works will comprise of carrying out geotechnical investigations, foundation works, installation of switch yard, array yard installation, SCADA system, inverters modules and equipment installation.

Once construction of the project is over, the project will be handed over to an Operation and Maintenance Contractor (O&M) which is yet to be finalised by FPEPL. The O&M contract will be for a period of twenty-five (25) years. As part of the O&M, the O&M contractor will be the in-charge of project management which includes financial and administrative control, overall project co-ordination, manpower selection for operation and maintenance etc.

2.7.1 Construction Activities

The site development activities for the proposed project will entail the following:

- soil investigations;
- site clearing;
- site levelling;
- construction of access roads;
- fencing of site; and
- laying of foundations.

All construction activities shall occur within the site boundary limits except for those activities related to the interconnections between the site and the common infrastructures, which will be performed by the FPEPL outside the boundary wall of the site. FPEPL shall only be responsible for site clearing and grading of the site as required for construction, operation, and maintenance of the plant.

2.7.2 Operation and Maintenance

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

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

Maintenance Requirement:

The main objective of the plant maintenance will be to keep the project running reliably and efficiently as long as possible. Efficient operation implies close control not only over the cost of production but also over the cost of maintenance.

Routine Maintenance:

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

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

Breakdown Maintenance

Breakdowns can occur due to lack of routine or preventive maintenance, bad climatic conditions, disturbance in utility grid, etc. As breakdowns affect energy generation and hence revenue generation, these kind of faults will be immediately corrected.

3. Environment and Social Regulatory Framework

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

3.1 National and Regional Enforcement Authorities

In India, Ministry of New and Renewable Energy (MNRE) is the nodal agency to manage the upcoming solar power projects and the environmental aspects are governed by Ministry of Environment, Forests and Climate Change (MoEF&CC), Central Pollution Control Board (CPCB), Central Electricity Authority (CEA) and Central Electricity Regulatory Commission (CERC). The social governance aspects at the micro level are addressed by institutions like *panchayats* and municipal bodies.

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

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

A brief description of the relevant enforcement agencies with respect to the institutional framework is described in ***Table 3-1*** below:

Table 3-1 Enforcement agencies relevant to the project

S. N.	Name of the Agency	Description
1.	MoEF&CC	MoEF&CC is the apex body in India which has been formulated to plan, promote, co-ordinate and oversee the implementation of India's environmental and forestry policies and programmes. Various acts like The Environment (Protection) Act 1986, as amended in April 2003, The Air (Prevention and Control of Pollution) Act, 1981, amended in 1987 and The Water (Prevention and Control of Pollution) Act, 1974, amended in 1988 have been developed. It is the responsibility of the apex body to ensure the compliance under the acts to maintain stipulated standards and environmental management through various supporting rules promulgated under the Acts.
2.	Central Pollution Control Board (CPCB)	The CPCB was established in September 1974, for the purpose of implementing provisions of the Water (Prevention and Control of Pollution) Act, 1974. The executive responsibilities for the industrial pollution prevention and control are primarily executed by the CPCB at the Central level, which is a statutory body, attached to the MoEF&CC. CPCB works towards control of water, air and noise pollution, land degradation and hazardous substances and waste management. CPCB will direct MPCB in case any violation is undertaken in complying with the conditions of Hazardous Waste Authorization.
3.	Maharashtra Pollution Control Board (MPCB)	Maharashtra Pollution Control Board was established on 7th September, 1970 under the provisions of Maharashtra Prevention of Water Pollution Act, 1969. The Water (P&CP) Act, 1974 that is a central legislation was adopted in Maharashtra on 1.6.81 and accordingly Maharashtra Pollution Control Board was formed under the provisions of section 4 of Water (P& CP) Act, 1974. The Air (P&CP) Act 1981 was adopted in the Maharashtra in 1983 and initially, some areas were declared as Air Pollution Control Area on 2.5.83. The entire state of Maharashtra has been declared as Air Pollution Control Area since 6.11.96. The Board is also functioning as the State Board under section 5 of the Air (P&CP) Act, 1981. The Board ensures proper implementation of the statutes, judicial and legislative pronouncements

S. N.	Name of the Agency	Description
		related to environmental protection within the State. Solar Farms fall under 'White Category' as per Final Document on Revised Classification of Industrial Sectors Under Red, Orange, Green and White Categories (February 29, 2016) issued by CPCB. There shall be no necessity of obtaining the Consent to Operate for White category of industries under the *Water (Prevention and Control of Pollution) Act, 1974* and the *Air (Prevention and control of pollution) Act, 1981*. Intimation to concerned SPCB / PCC shall suffice. White Category Units do not require a Hazardous waste authorization from the Board, however, hazardous and other wastes generated by such industries shall be handed over to the authorised actual users, waste collectors or disposal facilities.
4.	Petroleum and Explosives Safety Organisation (PESO)	The PESO is under the Department of Industrial Policy & Promotion, Ministry of Commerce and Industry, Government of India. The Chief Controller of explosives is responsible to deal with provisions of: *The Explosive Act, 1884* and *Rules, 2008, The Petroleum Act, 1934* and the *Rules 2002, The Static and Mobile pressure vessels (Unfired) Rules, 2016* and amended 2018, and *Manufacture, Storage and Import of Hazardous Chemical Rules, 1989* and *amendment 2000*. A petroleum license is required for possession of Petroleum Class B if the total quantity in possession exceeds 2500 liters and for any receptacle exceeding 1000L capacity. The site will store a small quantity of fuel during construction phase. However, in case fuel storage exceeds the above limit as stipulated in the Act, the project is required to obtain a license from PESO.
5.	Director Industrial Safety and Health (DISH)	The main objective of the DISH is to ensure safety, health, welfare and working conditions of workers working in factories and in construction works by effectively enforcing the provisions of the *Factories Act, 1948* the *Building & Other Construction Workers Act 1996* and other labour legislations. It is also to ensure the protection of rights of workers and to redress their grievances. Factory license is required as 'factory' means 'any premises having ten or more workers involved in a manufacturing process'. Factory License from the State Government or Chief Inspectorate of Factories, Maharashtra is required to be obtained for the project. Project proponent/ Construction contractor shall comply with all requirements of *Maharashtra Factories Rules 1963* and participate in periodic inspection. It is also to be ensured that no child labour is engaged during construction or operation phases of the project.
6.	Ministry of New and Renewable Energy (MNRE)	The MNRE is the nodal ministry of Government of India for all matters related to new and renewable energy. The broad aim is to develop and deploy new and renewable energy for supplementing the energy requirements of the country as stated on its website. The role of MNRE has been assuming importance in recent times with growing concerns of energy security. Energy self-sufficiency was identified as the major driver for new and renewable energy in the wake of the two oil shocks of 1970.
7.	Maharashtra Energy Development Agency (MEDA)	Maharashtra Energy Development Agency (MEDA) is shouldering the responsibility of a state nodal agency (SNA) for the Ministry of New and Renewable Energy Sources (MoNRE) and the state designated agency (SDA) for Bureau of Energy Efficiency (BEE). It aims to provide a platform to utilization of sustainable energy (renewable energy and energy efficient) technologies on mass scale to make them techno-economically and socio-culturally viable in the context of Maharashtra's energy scenario.
8.	Central Electricity Authority	CEA is a Statutory Body constituted under the erstwhile Electricity (Supply) Act, 1948, thereafter replaced by the Electricity Act, 2003, where similar provisions exist, the office of the CEA is an "Attached Office" of the Ministry of Power. The CEA is responsible for the technical coordination and supervision of programmes and is also entrusted with a number of statutory functions.
9.	Central Electricity Regulatory Commission	The Commission intends to promote competition, efficiency and economy in bulk power markets, improve the quality of supply, promote investments and advise government on the removal of institutional barriers to bridge the demand supply gap and thus foster the interests of consumers.
10.	Central Ground Water Authority (CGWA)	CGWA was constituted under Sub-section (3) of Section 3 of the Environment (Protection) Act, 1986 for the purposes of regulation and control of ground water development and

S. N.	Name of the Agency	Description
		management. As per CGWA's guidelines effective from 01 June 2019, NOC is required for ground water withdrawal for all infrastructure projects drawing/proposing to draw ground water through an energised means. (with effect from 16.11.2015). For the proposed project (falling in "safe" category) NOC is required for ground water, abstraction, NOC may be provided that the fresh water resources are not affected through such abstraction. No disposal of brine/contaminated ground water shall be allowed in the premise. In case there are any overlain/underlain by fresh water aquifers, NOC will only be granted after submission of a hydrogeological study, undertaken by a NABET accredited consultant.
11.	Gram Panchayat	Gram Sabha or the Panchayats are the local bodies which have been defined by the 73rd Constitutional Amendment Act, 1992. Panchayats have to be consulted before acquiring land in the Scheduled Areas for development projects and before re-settling or rehabilitating persons affected by such projects in the Scheduled Areas. The responsibilities that have been entrusted upon Panchayats comprises of the preparation of plans for economic development and social justice and the implementation of such schemes for economic development and social justice, as may be assigned to them.

3.2 Applicable Environment and Social Laws and Regulations

Table 3-3 summarizes the key regulations that are relevant to the project across its lifecycle. This table should be used to update/develop a comprehensive legal register for the Project.

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

S. No.	Aspect	Relevance	Applicable Legislation	Agency Responsible	Applicable Permits and Requirements
EHS Laws, Acts, Rules and Regulations					
1.	Environmental Protection	• Construction activities will generate air, water and noise emissions; and • Scattering of debris and construction material can contaminate the soil, water and surroundings.	• The Environment (Protection) Act 1986, as amended in April 2003; and • EPA Rules 1986, as amended in 2002.	MPCB	As per Section 7 of Environment Protection Act, 1986 and Rule 3 of the Environment Protection Rule, 1986, no person carrying on any industry, operation and process shall discharge or emit any environmental pollutant in excess of prescribed standards. Compliance under the rules to maintain stipulated standards and environmental management through various supporting rules promulgated under the Act. FPEPL and the EPC contractor are required to ensure that Project implementation adheres to the various clauses laid down in the Act
2.	Prevention and Control of Water Pollution	Wastewater generation during construction and operation of the Plant	The Water (Prevention and Control of Pollution) Act, 1974, amended in 1988	MPCB	As per the section 24 of the Water (Prevention and Control of Pollution) Act, 1974, amended in 1988 no person shall knowingly cause or permit any poisonous, noxious or polluting matter into any stream or well or sewer or on land.
3.	Prevention and Control of Air Pollution	Movement of vehicles, operation of diesel generators for power at campsite or other construction activities.	The Air (Prevention and Control of Pollution) Act, 1981, amended in 1987.	MPCB	As per section 22 of The Air (Prevention and Control of Pollution) Act, 1981, amended in 1987, no person operating any industrial plant, in any air pollution control area shall discharge or cause or permit to be discharged the emission of any air pollutant in excess of the standards laid down by the MPCB. A solar power plant is clean option for power generation in comparison to non-renewable fossil fuels. Ministry of Environment, Forest and Climate Change (MoEF&CC) in its Office Memorandum No. J-11013/41/2006-IA-II (I) dated 13th May 2011 stated that the solar power projects are not covered under the ambit of EIA Notification, 2006 and therefore does not require prior environmental clearance. In addition to this, CPCB issued notification regarding harmonization of classification of industrial sectors under Red/Orange/Green/White categories which states that 'solar renewable power plants of all capacities' is classified as a "White Industry" (Part-A, Serial Number 35) and does not require Consent to Establish and Consent to Operate. Only intimation to the concerned regional officer of State Pollution Control Board (SPCB) shall suffice [2]

[2] *As per latest directions of Central Pollution Control Board, dated March 2016, Final report on revised categorization of industrial sectors under Red/ Orange/ Green/ White, solar power projects have been classified under White category of industries. As per the CPCB's direction to SPCB/PPCs, "there shall be no necessity of obtaining Consent to Operate for White Category of industries and intimation to the concerned SPCB/PPC shall suffice.*

S. No.	Aspect	Relevance	Applicable Legislation	Agency Responsible	Applicable Permits and Requirements
4.	NOC And Consent to Establish and Operate for Batching Plant	Batching plant operation would lead to emission of fugitives. It also envisages wastewater generation which could lead to contamination of land and water resources. In addition, there would be generation of noise disturbance to the neighbouring villages.	The Water (Prevention and Control of Pollution) Act, 1974; The Air (Prevention and Control of Pollution) Act, 1981 & The Noise Pollution (Regulation and Control) Rules, 2000 and subsequent amendments.	MPCB	Applicable. Needs to be obtained before the construction work is commenced.
5.	License under Factories Act, 1948	Factory license is required as the project is generating, transforming or transmitting power.	Chapter I of The Factories Act, 1948	Directorate, Industrial Safety and Health, Government of Maharashtra	As per the section 6 of The Factories Act, 194, FPEPL would have to obtain registration of the power plant from the State Government or Chief Inspectorate of Factories, Maharashtra if 10 or more workers are engaged, triggering the applicability of the Factories Act.
6.	Noise Emissions	Noise generated from operation of construction machinery	• The Noise (Regulation & Control) Rules, 2000 as amended in October 2002; and • As per the Environment (Protection) Act (EPA) 1986 the ambient noise levels are to be maintained as stipulated by CPCB for different categories of areas like, commercial, residential and silence zones etc.	MPCB	As per the Rules 3 and 4 of the Noise (Regulation & Control) Rules, 2000 as amended in October 2002, noise emissions in the project area should not exceed standards specified in the Schedule.
7.	Hazardous Wastes Management	• The proposed project will generate waste oil from diesel generator during construction phase and used transformer oil during operation phase; • Solvents and chemicals used or cleaning etc.; and Management of damaged solar modules.	Hazardous and Other Wastes (Management and Trans boundary Movement) Rules, 2016 as amended in 2019	MPCB	As per the Hazardous Waste and Other Wastes (Management and Trans boundary Movement) Rules 2016 and its amendment in 2019 the Rule 6 after sub-rule (1) states that: [3] An occupier shall not be required obtain an authorisation under this rule, from the State Pollution Control Board, in case the consent to establish or consent to operate, is not required from the State Pollution Control Board or Pollution Control Committee under the Water (Prevention and Control of Pollution) Act, 1974 (25 of 1974) and Air (Prevention and Control of Pollution) Act, 1981 (21 of 1981); Provided that the hazardous and other wastes generated by the occupier shall be given to the actual user, waste collector or operator of the disposal facility, in accordance with the Central Pollution Control Board guidelines. However, as per the Rules 4, 6, 8, 17, 18, 19 and 20 of the Hazardous and Other Wastes (Management and Transboundary Movement) rules following compliances are to be ensured by FPEPL:

[3] https://kspcb.gov.in/Hazardous%20and%20Other%20Wastes%20Amendment%20Rules,%202019_25-03-2019.pdf

S. No.	Aspect	Relevance	Applicable Legislation	Agency Responsible	Applicable Permits and Requirements
					• Authorization for collection, reception, storage, transportation and disposal of hazardous wastes; • Liability of the occupier, transporter and operator of a facility: The occupier, transporter and operator of a facility shall be liable for damages caused to the environment resulting due to improper handling and disposal of hazardous waste listed in schedules to the Rules; and • The occupier and operator of a facility shall also be liable to reinstate or restore damaged or destroyed elements of the environment.
8.	Construction and Demolition Waste	Collection, segregation, storage and disposal of construction and demolition (C&D) waste at construction phase of the project.	Construction and Demolition Waste Management Rules, 2016	Gram Panchayat	As per the Construction and Demolition Waste Management Rules, 2016, if waste more than 20 tons or more in one day or 300 tons per project in a month is generated then FPEPL shall submit waste management plan and get appropriate approvals from the local authority before starting construction or demolition work. FPEPL should also ensure responsible collection, store and disposal of the C&D waste.
9.	Electricity Distribution License	Private sector projects to obtain distribution Licenses from the State Electricity Regulation Committee and to have open access to the transmission lines	• The Electricity Act 2003; and • The Central Electricity Authority (Measures relating to Safety and Electricity Supply) Regulations, 2010	Electricity Regulatory Commission	As per section 14 of The Electricity Act, 2003, FPEPL shall obtain license under the act. Under rules 12 and 7, FPEPL and the Contractors to ensure preventive measures for health and safety of humans and plant.
10.	Storage of Petroleum products	There will be storage of Diesel at site for operation of generators during construction phase.	• The Petroleum Act 1934, as amended in August 1976 • The Petroleum Rules 1976, as amended in March 2002.	PESO (Chief Controller of Explosives)	As per Section 3 of The Petroleum Act 1934 and Rule 116 of The Petroleum Rules 1976, FPEPL will be required to obtain a license from PESO, if the quantity of the fuel stored exceeds thresholds given in regulation.
11.	Surface Transportation	Movement of construction vehicles and other vehicles for transportation of workers	• The Motor Vehicles Act 1988, as amended by Motor Vehicles (Amendment) Act 2000, dated 14th August 2000. • The Central Motor Vehicles Rules 1989, as amended through 20th October 2004 by the Central Motor Vehicles (Fourth Amendment) Rules 2004.	State Transport Authority	FPEPL to ensure compliance of the Section 39, Motor Vehicle Act, 1988 as amended in 2017 and Rule 47, Motor Vehicle Rule, 1989.

Biodiversity related laws

S. No.	Aspect	Relevance	Applicable Legislation	Agency Responsible	Applicable Permits and Requirements
12.	Forest Protection	Presence of legally protected forest areas in proximity to the project site	The Indian Forest Act, 1927	Maharashtra State Forest Department	Approval of the Forest Department is required if project-related infrastructure, activities or personnel occur within a legally protected forest area. As reported, no project components are planned in forest land.
13.	Wildlife Conservation	Presence of wildlife habitats, including those of Schedule I species, in and around the project site	The Wildlife (Protection) Act, 1972	National Board for Wildlife	Approval of the National Board for Wildlife is required if project-related infrastructure, activities or personnel occur within national parks and sanctuaries. As reported, no project components are planned in notified wildlife habitats.
14.	Forest Conservation	Presence of legally protected forest areas in proximity to the project site	The Forest (Conservation) Act, 1980	Maharashtra State Forest Department	Approval of the Forest Department is required if the project uses legally protected forest land for any non-forest purpose. As reported, no project components are planned in forest land.
Social and labour-related Laws, Regulations and Acts					
15.	Labour	Engagement of workers for construction and operation of the plant	The Factories Act, 1948 and Maharashtra Factories Rules, 1963	Department of Labour, Government of Maharashtra	FPEPL / EPC Contractor shall comply with all requirements of Factories Rules and participate in periodic inspection.
16.	Contract Workers	Engagement of contract workers	The Contract Labour (Regulation and Abolition) Act, 1970 as amended in 2017	Department of Labour, Government of Maharashtra	As per Section 12 of the Contract Labour (Regulation and Abolition) Act, 1970 a contractor executing any contract work by engaging 20 or more contract labourers has to obtain a licence under the Act.
17.	Child Labour	Engagement of Child Labour at site	The Child Labour (Prohibition and Regulation) Act, 1986	Department of Labour, Government of Maharashtra	Section 3 under the Child Labour (Prohibition and Regulation) Act, 1986 (CLA, 1986) including amendment in 2016. No child below the age of 14 years shall be employed in any establishment mentioned in Schedule Part A and Part B of the CLA, 1986.
18.	Bonded Labour	Engagement of Bonded Labour at site	Bonded Labour (Abolition) Act 1976	Department of Labour, Government of Maharashtra	Rule 4 of the Bonded Labour System (Abolition) Act, 1976 specifies "After the commencement of this Act, no person shall- • make any advance under, or in pursuance of, the bonded labour system, or compel any person to render any bonded labour or other form of forced labour."
19.	Payment of Wages	Provision of wages to labour engaged at the site	Minimum Wages Act, 1948	Department of Labour, Government of Maharashtra	Section 12 of the Minimum Wages Act, 1948: The employer shall pay to every employee engaged in a scheduled employment under him wages at a rate not less than the minimum rate of wages fixed by the appropriate Government Authority for that class of employees in that employment without any deductions except as may be authorized within such time and subject to such conditions as may be prescribed.

S. No.	Aspect	Relevance	Applicable Legislation	Agency Responsible	Applicable Permits and Requirements
					Every employer shall be responsible for the payment to persons employed by him of all wages required to be paid under this Act.
20.	Payment of Wages.	Equal wages to male and female workers at site	Equal Remuneration Act 1976	Department of Labour, Government of Maharashtra	It is the duty of an employer to pay equal remuneration to men and women workers for same work or work of a similar nature.
21.	Payment of Wages	Engagement of Labour at site	Workmen's Compensation Act, 1923	Department of Labour, Government of Maharashtra	Requires if personal injury is caused to a workman by accident arising out of and in the course of his employment, his employer shall be liable to pay compensation in accordance with the provisions of this Act.
22.	Women at Workplace	Engagement of Female Labour at site	Maternity Benefit Act, 1961	Department of Labour, Government of Maharashtra	Section 4 of the Maternity Benefit Act, 1961 including amendment as in Maternity Benefit (Amendment) Act, 2017: - • "No employer shall knowingly employ a woman in any establishment during the six weeks immediately following the day of her delivery or her miscarriage; • No woman shall work in any establishment during the six weeks immediately following the day of her delivery or her miscarriage; and • Without prejudice to the provisions of section 6, no pregnant woman shall, on a request being made by her in this behalf, be required by her employer to do during the period specified in sub- section (4) any work which is of an arduous nature or which involves long hours of standing, or which in any way is likely to interfere with her pregnancy or the normal development of the foetus, or is likely to cause her miscarriage or otherwise to adversely affect her health." Section 5 of the Maternity Benefit Act, 1961 including as amended in 2017. "As per the amendment in 2017, • Subject to the provisions of this Act, every woman shall be entitled to, and her employer shall be liable for, the payment of maternity benefit at the rate of the average daily wage for the period of her actual absence, that is to say, the period immediately preceding the day of her delivery, the actual day of her delivery and any period immediately following that day; • No woman shall be entitled to maternity benefit unless she has actually worked in an establishment of the employer from whom she claims maternity benefit, for a period of not less than eighty days in the twelve months immediately preceding the date of her expected delivery; • The maximum period for which any woman shall be entitled to maternity benefit shall be twenty-six weeks of which not more

S. No.	Aspect	Relevance	Applicable Legislation	Agency Responsible	Applicable Permits and Requirements
					than eight weeks shall precede the date of her expected delivery; • A woman who legally adopts a child below the age of three months or a commissioning mother shall be entitled to maternity benefit for a period of twelve weeks from the date the child is handed over to the adopting mother or the commissioning mother, as the case maybe; and In case where the nature of work assigned to a woman is of such nature that she may work from home, the employer may allow her to do so after availing of the maternity benefit for such periods and on such conditions as the employer and the woman may mutually agree."
23.	Contractor Labour License	Contractors or third parties to be involved in the construction works for the proposed project, if required, will also be engaged only subject to availability of valid registration.	Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996 and Contract Labour (Regulation and Abolition) Act, 1970.	Department of Labour, Government of Maharashtra	Section 7 of the Act mandates the registration of establishments. FPEPL should ensure that contractor/ sub-contractors have a valid registration under the Building and Other Construction Works Act and Contract Labour (Regulation and Abolition) Act, 1970.
24.	Contract Labour	Principal Employer registration for engaging contract labour through third party is required.	The Contract Labour (Regulation and Abolition) Act, 1970	Department of Labour, Government of Maharashtra	Section 7 of the Act mandates the Principal Employer registration for engaging contract labour through third party.
25.	Migrant Workmen	Principal Employer registration for engaging migrant labour is required for direct/indirect labour.	The Inter-State Migrant Workmen (Regulation of Employment and conditions of service) Act, 1979	Department of Labour, Government of Maharashtra	Section 4 of the Act mandates that the Principal Employer registration should be obtained for engaging migrant labour through third party.
26.	Working Conditions	Working conditions of contracted Labour working at the site	Contract Labour (Regulations and Abolition) Act, 1970	Department of Labour, Government of Maharashtra	Section 16,17,18,19,20 and 21 of the said Act mandates the provision of the principal employer to ensure that all the contracted workers are provided with condition of services, rate of wages, holidays, hours of work as stipulated in the act and rules.

3.3 Policy Framework in India

Policies with respect to the renewable energy in India and Maharashtra, focusing on the solar power, as released by the Government of India and Government of Maharashtra from time to time and applicable to the project are discussed briefly in ***Table 3-4:***

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

S. N.	Name of the Policy	Description
1.	National Electricity Policy 2005	The National Electricity Policy 2005 states that environmental concerns would be suitably addressed through appropriate advance action by way of comprehensive Environmental Impact Assessment and implementation of Environment Action Plan (EAP). As per the policy, adequate safeguards for environmental protection with suitable mechanism for monitoring of implementation of Environmental Action Plan and R&R Schemes should be put in place. Open access in transmission has been introduced to promote competition amongst the generating companies who can now sell to different distribution licensees across the country. This should lead to availability of cheaper power.
2.	National Solar Mission (JNNSM)	The objective of the Jawaharlal Nehru National Solar Mission (JNNSM) under the brand 'Solar India' is to establish India as a global leader in solar energy, by creating the policy conditions for its diffusion across the country as quickly as possible. The Mission has set a target of 20,000 MW and stipulates implementation and achievement of the target in 3 phases (first phase up to 2012-13, second phase from 2013 to 2017 and the third phase from 2017 to 2022) for various components, including grid connected solar power. The successful implementation of the JNNSM requires the identification of resources to overcome the financial, investment, technology, institutional and other related barriers which confront solar power development in India. The penetration of solar power, therefore, requires substantial support. The policy framework of the Mission will facilitate the process of achieving grid parity by 2022.
3.	National Environmental Policy, 2006	Government of India released the National Environment Policy in 2006. The policy aims at mainstreaming environmental concerns into all developmental activities. It emphasises conservation of resources, and points that the best way to aid conservation is to ensure that people dependent on resources obtain better livelihoods from conservation, than from degradation of the resources.
4.	Maharashtra Integrated Non-Conventional Energy Generation Policy 2020, issued on 31 December 2020	Maharashtra Integrated Non-Conventional Energy Generation Policy 202010 was issued on 31st December 2020 and will remain effective till 31st March, 2025. The policy promotes single window web portal will be developed to get permits, approvals, consents, etc. from various administrative departments. Further, the policy deals with land availability provisions, detailing different models of procurement of private and public land. It also has provisions to allow the use of seasonal partially submerged lands for project development. In addition, solar projects can be installed to supply water in urban and rural areas, resulting in lesser dependency of local bodies on DISCOM power and shifting such load to day time.

3.4 Applicable International Standards and Guidelines

3.4.1 IFC Performance Standards

The performance standards stipulate that any proposed project shall meet the following requirements throughout the life of an investment by IFC or other relevant financial institution: -

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

These Performance Standards and guidelines provide ways and means to identify impacts and affected stakeholders and lay down processes for management and mitigation of adverse impacts. The applicability of the Performance Standards is discussed in ***Table 3-4***.

Table 3-4 Applicability of IFC Performance Standards

S. No.	Performance Standard	Description and Applicability
1.	PS1 – Assessment and Management of Environmental and Social Risks and Impacts	**APPLICABLE** PS 1 establishes the importance of: • Integrated assessment to identify the environmental and social impacts, risks, and opportunities of projects; • Effective community engagement through disclosure of project-related information and consultation with local communities on matters that directly affect them; and • The project proponent's management of environmental and social performance throughout the life of the project. The PS 1 is applicable to projects with environment and/or social risks and/or impacts. The proposed project is a solar power project and will have environmental and social impacts such as stress on existing water resources, construction activities, direct or indirect impact on communities, etc.
2.	PS2 – Labour and Working Conditions	**APPLICABLE** PS-2 recognizes that the pursuit of economic growth through employment creation and income generation should be accompanied by protection of the fundamental rights of workers.
3.	PS3 - Resource Efficiency and Pollution Prevention	**APPLICABLE** PS3 recognizes that increased economic activity and urbanization often generate increased levels of pollution to air, water, and land, and consume finite resources in a manner that may threaten people and the environment at the local, regional, and global levels. The objectives of PS 3 are: • To avoid or minimize adverse impacts on human health and the environment by avoiding or minimizing pollution from project activities. • To promote more sustainable use of resources, including energy and water. • To reduce project-related GHG emissions. The proposed project is a clean energy project and will not have major pollution sources associated with it. The construction works for the development of project will entail generation of wastes like air emissions, wastewater, used oil from DG sets and construction debris. The operation phase will result in generation of minor quantities of waste such as used transformer oil, broken and defunct solar panels and waste water from cleaning of solar panels.
4.	PS4 – Community Health, Safety and Security	**APPLICABLE** PS 4 recognizes that project activities, equipment, and infrastructure can increase community exposure to risks and impacts. Its main stress is to ensure that the safeguarding of personnel and property is carried out in accordance with relevant human rights principles and in a manner that avoids or minimizes risks to the Affected Communities. Objectives of PS 4 thus are: • To anticipate and avoid any adverse impacts on the health and safety of the Affected Community during the project life from both routine and non-routine circumstances. • To ensure that the safeguarding of personnel and property is carried out in accordance with relevant human rights principles and in a manner that avoids or minimizes risks to the Affected Communities. The proposed project will involve transportation of construction material and movement of construction machinery which may pose safety risks to the affected communities.
5.	PS5 – Land Acquisition and Involuntary Resettlement	**NOT APPLICABLE** PS 5 recognizes that project-related land acquisition and restrictions on land use can have adverse impacts on communities and persons that use this land. Its main aim is to

S. No.	Performance Standard	Description and Applicability
		anticipate and avoid, or where avoidance is not possible, minimize adverse social and economic impacts from land acquisition or restrictions on land use by providing compensation for loss of assets at replacement cost and ensuring that resettlement activities are implemented with appropriate disclosure of Information, consultation, and the informed participation of those affected. The PS is not applicable for the project as land for the solar park in question has not been acquired by the government. The privately owned land is being purchased by willing buyer and will seller method. Stakeholder consultations at site confirmed that there were no economic/ livelihood activities on the concerned land prior to its allotment to players for setting up their solar plant. This land is not favoured for agriculture activities.
6.	PS6 – Biodiversity Conservation and Sustainable Management of Living Natural Resources	**APPLICABLE** PS6 recognizes that protecting and conserving biodiversity, maintaining ecosystem services, and sustainably managing living natural resources are fundamental to sustainable development. The objectives of PS6 are: ▪ To protect and conserve biodiversity ▪ To maintain the benefits from ecosystem services ▪ To promote the sustainable management of living natural resources through the adoption of practices that integrate conservation needs and development priorities. The Project Site, as well as the area of influence of the project, contain natural and near-natural habitats, besides modified habitats. The Project Site and the area of influence of the project provide important ecosystem services to the local community, including priority provisioning services in the form of water resources and pasture for livestock. The proposed project infrastructure and activities, such as removal of vegetation, levelling of land, laying of access roads, vehicular movement, artificial illumination and installation of solar panelling and power transmission cables, are expected to cause loss or degradation of habitats and ecosystem services, as well as, fragmentation of habitats, and possibly, promote further spread of already introduced invasive alien species. There is no designated area situated within the Project Site, but there are 3 designated areas in significant proximity to the Project Site. Therefore, PS6 is applicable to the Project.
7.	PS7 – Indigenous People	**NOT APPLICABLE** Performance Standard 7 recognizes that Indigenous Peoples, as social groups with identities that are distinct from mainstream groups in national societies, are often among the most marginalized and vulnerable segments of the population. In many cases, their economic, social, and legal status limits their capacity to defend their rights to, and interests in, lands and natural and cultural resources, and may restrict their ability to participate in and benefit from development. The PS 7 is not applicable to the project as; • There is no presence of Scheduled Tribes in the block and district in which the project is located; • No tribal land has been procured for the project; • No livelihood dependence on the land has been reported of tribal or non-tribal; and • With regards to ethnic composition, only 3 (0.17 %) out of the total population of 1,732 in Radhanesda village are Scheduled Castes (SC), as per the Census of India Report 2011. No presence of Scheduled Tribes (ST) is recorded in the village.
8.	PS8 – Cultural Heritage	**NOT APPLICABLE** For the purposes of this Performance Standard, cultural heritage refers to tangible forms of cultural heritage, such as tangible moveable or immovable objects, property, sites, structures, or groups of structures, having archaeological (prehistoric), paleontological, historical, cultural, artistic, and religious values. The PS is not applicable to the project as; • The land on which the project is being setup does not contain any structures bearing cultural, historical, religious or spiritual significance; and • No sites bearing cultural, historical, religious or spiritual significance has been impacted by the project

3.4.2 IFC EHS Guidelines

IFC has released the following environmental, health and safety guidelines on 30th April 2007:

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

The key requirements stated in the EHS guidelines have been discussed in below.

ENVIRONMENTAL ATTRIBUTES

- Air Emissions and Ambient Air Quality,
- Energy Conservation,
- Wastewater and Water Quality,
- Water Conservation,
- Hazardous Materials Management,
- Waste Management,
- Noise and
- Contaminated Land

OCCUPATIONAL HEALTH AND SAFETY

- General Facility Design and Operation,
- Communication and Training,
- Physical/Chemical/Biological Hazards,
- Personal Protective Equipment (PPE) and
- Monitoring.

COMMUNITY HEALTH AND SAFETY

- Water Quality and Availability,
- Structural Safety of Project Infrastructure,
- Life and Fire Safety (L&FS),
- Traffic Safety,
- Transport of Hazardous Materials,
- Disease Prevention and
- Emergency Preparedness and Response.

CONSTRUCTION AND DECOMMISSIONING

- Environment Baseline environmental,
- Occupational Health and Safety and
- Community Health and Safety.

3.4.3 Applicable International Conventions

Environmental problems which migrate beyond the jurisdiction (Trans-boundary) require power to control such issues through international co-operation by either becoming a Contracting Party (CP) i.e. ratifying treaties or as

a Signatory by officially signing the treaties and agreeing to carry out provisions of various treaties on environment and social safeguards. The relevant international conventions are as provided in ***Table 3-7***.

Table 3-7: Relevant International Conventions

S. N.	International Conventions	Salient Features
1.	Montreal Protocol on Substances That Deplete the Ozone Layer (and subsequent Amendments)	India signed the Montreal Protocol along with its London Amendment on 17-9-1992 and also ratified the Copenhagen, Montreal and Beijing Amendments on 3rd March 2003.
2.	Kyoto Protocol	The Kyoto protocol was signed by India in August 2002 and ratified in February 2005. The convention pertains to the United Nations framework on Climate Change. The 3rd Conference of the Parties to the Framework Convention on Climate Change (FCCC) in Kyoto in December 1997 introduced the Clean Development Mechanism (CDM) as a new concept for voluntary greenhouse-gas emission reduction agreements between industrialized and developing countries on the project level.
3.	International Labour Organization conventions	India has ratified many of the International Labour Organization conventions, some of the key covenants are: - C1 Hours of Work (Industry) Convention, 1919 (14:07:1921, ratified); - C5 Minimum Age (Industry) Convention, 1919 (09:09:1955, ratified): - C11 Right of Association (Agriculture) Convention, 1921 (11:05:1923, ratified): - C14 Weekly Rest (Industry) Convention, 1921 (11:05:1923, ratified); - C29 Forced Labour Convention, 1930 (30:11:1954, ratified) & C105 Abolition of Forced Labour Convention, 1957 (18:05:2000, ratified); - C100 Equal Remuneration Convention, 1951 (25:09:1958, ratified); - C107 Indigenous and Tribal Populations Convention, 1957 - C111 discrimination (Employment and Occupation) Convention, 1958 (03:06:1960, ratified)
4.	UN Guiding principles on Business and Human Right	The United Nations (UN) Guiding Principles on Business and Human Rights (GPs), which were endorsed by the Human Rights Council (HRC) in June 2011, are built on three pillars: states' duty to protect human rights, corporate responsibility to respect human rights, and access to effective remedies. All three pillars of the GPs – especially Pillar 1 and Pillar 3 – require states to take a number of measures to ensure that business enterprises do not violate human rights and that effective remedies are available in cases of violation. The UN Working Group on the issue of human rights and transnational corporations and other business enterprises (UNWG) 'strongly encourages all states to develop, enact and update' a national action plan (NAP) on business and human rights (BHR) as part of states' responsibility to disseminate and implement the GPs. In June 2014, the HRC passed a resolution calling upon states to develop NAPs. As of 29 February 2016, ten states have drawn up NAPs of which India was a party wherein it reaffirms India's commitments towards realization of human rights and promotion of socially responsible businesses in the country.
5.	Convention on Biological Diversity, 1992 (CBD or Rio Convention)	India is a Party to CBD since 1994. The objectives of the CBD are the conservation of biological diversity, the sustainable use of its components, and the fair and equitable sharing of the benefits arising from commercial and other utilization of genetic resources. The agreement covers all ecosystems, species, and genetic resources.
6.	Convention on the Conservation of Migratory Species of Wild Animals, 1983 (CMS or "Bonn Convention")	India is a Party to CMS since 1983. CMS is an intergovernmental treaty aimed at conservation and sustainable use of migratory animals and their habitats. It brings together Range States through which migratory animals pass and lays the legal foundation for internationally coordinated conservation measures throughout a migratory range. Parties strive towards protecting migratory species, conserving or restoring the places where they live, mitigating obstacles to migration and controlling other factors that might endanger them.
7.	Convention on Wetlands of International Importance especially as Waterfowl Habitat, 1971 (Ramsar Convention)	India is a Contracting Party to the Ramsar Convention since 1982. It is an intergovernmental treaty that provides a framework for the conservation and wise use of wetlands and their resources. It includes all lakes and rivers, underground aquifers, swamps and marshes, wet grasslands, peatlands, oases, estuaries, deltas and tidal flats, mangroves and other coastal areas, coral reefs, as also, human-made sites, such as fish ponds, rice paddies, reservoirs and salt pans. Contracting Parties commit to work towards the wise

S. N.	International Conventions	Salient Features
		use of all their wetlands, designate suitable wetlands for the list of Wetlands of International Importance (the "Ramsar List") and ensure their effective management, as well as, cooperate internationally on transboundary wetlands, shared wetland systems and shared species
8.	Convention on International Trade in Endangered Species of Wild Flora and Fauna, 1975 (CITES)	India is a Party to CITES since 1976. It is an international agreement between governments aimed at ensuring that international trade in specimens of wild animals and plants does not threaten the survival of such species. Each CITES Party is expected to adapt its domestic legislation to ensure that the CITES framework is implemented at the national level.
9.	Convention Concerning the Protection of World Cultural and Natural Heritage, 1972 (UNESCO World Heritage Convention) (WHC).	India has been a State Party to the WHC since 1977. The WHC aims to identify and protect the world's natural and cultural heritage considered to be of outstanding universal value. State Parties to the WHC are expected to identify and nominate properties on their national territory to be considered for inscription on the World Heritage List, giving details of how a property is protected and providing a management plan for its upkeep. States Parties are also expected to protect the World Heritage values of the properties inscribed.
10.	The Rotterdam Convention on the Prior Informed Consent (PIC) Procedure	The Rotterdam Convention on the Prior Informed Consent (PIC) Procedure for Certain Hazardous Chemicals & Pesticides in international Trade was adopted by India at the Conference of Plenipotentiaries at Rotterdam in 1998.

3.5 Categorisation of Project

3.5.1 Classification as per MoEF&CC, India

MoEF&CC had brought out notifications in 1989, with the purpose of prohibition/ restriction of operations of certain industries to protect ecologically sensitive Doon Valley. The notification introduced the concept of categorization of industries as "Red", "Orange "and "Green" with the purpose of facilitating decisions related to location of these industries. Subsequently, the application of this concept was extended in other parts of the country not only for the purpose of location of industries, but also for the purpose of Consent management and formulation of norms related to surveillance / inspection of industries.

According to the Final Document on Revised Classification of Industrial Sectors under Red, Orange, Green and White Categories; February 29,2016; Central Pollution Control Board; Table G-5: Final List of White Category of Industries, Sl. No 79 Solar power generation through solar photovoltaic cell, wind power and mini hydel power has been classified under White Category.

- Newly introduced White category contains 36 industrial sectors which are practically non-polluting: and
- There shall be no necessity of obtaining the Consent to Operate" for White category of industries. An intimation to concerned SPCB / PCC shall suffice[4].

3.5.2 Classification as per IFC Performance Standards

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

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

[4] Final Document on Revised Classification of Industrial Sectors under Red, Orange, Green White Categories; February 29,2016; Central Pollution Control Board;

4. ***Category FI Projects***: All FI projects excluding those that are Category C projects.

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

Based on the data available for the project at this stage and applying the criteria stipulated stipulated by the IFC Policy on Environmental and Social Sustainability for environmental and social categorization of projects, FPEPL's proposed 100 MW solar project may be assigned as '***Category B***' with respect to environmental and social impacts. This is so basis the primary data available to date which indicates that the environmental and social risks and impacts of the proposed project activities are expected to be few in number, generally site-specific, largely reversible, and readily addressed through mitigation measures, which supports the *'**Category B**'* classification.

Additional rationale for the above categorization is as below[5]:

- Solar power project is a clean technology project using solar energy for generation of electricity;
- No harmful emissions are expected from the project operations;
- The Project Site does not coincide or overlap with any Designated Area;
- The project land of 450 acres (182.109 hectares) is proposed to be procured through Willing Buyer and Willing Seller Basis. 100% of said land belongs to private landowners and does not include any notified tribal land/ land belonging to Tribal / Nomadic tribes or forest land; and
- Available data suggests that the construction, operation and decommissioning of the proposed solar project are likely to have limited environmental and social impacts which can be readily addressed with mitigation measures.

3.6 Applicable Environmental Standards

3.6.1 Ambient Air Quality

As per the IFC EHS guidelines (April 2007), "the ambient air quality standards are ambient air quality levels established and published through national legislative and regulatory processes and ambient quality guidelines refer to ambient quality levels primarily developed through clinical, toxicological, and epidemiological evidence (such as those published by the World Health Organization)". National Ambient Air Quality Standards (NAAQS), as notified under Environment (Protection) Rules 1986 and revised through Environment (Protection) Seventh Amendment Rules, 2009 are given ***Table 3-8***:

Table 3-8: National Ambient Air Quality Standards

Pollutant	Time Weighted Average	Concentration in Ambient Air	
		Industrial, Residential, Rural and other Areas	Ecologically Sensitive Area (notified by Central Government)
Sulphur Dioxide (SO_2), µg/m^3	Annual*	50	20
	24 Hours**	80	80
Nitrogen Dioxide (NO_2), µg/m^3	Annual*	40	30

[5] As the land procurement was not complete till preparation of this ESIA report, the above project categorization is liable to revision depending on any changes mentioned in above aspects has potential to change project catgorisation.

Pollutant	Time Weighted Average	Concentration in Ambient Air	
		Industrial, Residential, Rural and other Areas	Ecologically Sensitive Area (notified by Central Government)
	24 Hours**	80	80
Particulate Matter (size less than 10 µm) or PM_{10}, µg/m^3	Annual*	60	60
	24 Hours**	100	100
Particulate Matter (size less than 2.5 µm) or $PM_{2.5}$, µg/m^3	Annual*	40	40
	24 Hours**	60	60
Ozone (O_3), µg/m^3	8 Hours**	100	100
	1 Hour**	180	180
Lead (Pb), µg/m^3	Annual*	0.5	0.5
	24 Hours**	1	1
Carbon Monoxide (CO), mg/m^3	8 Hours**	2	2
	1 Hour**	4	4
Ammonia (NH_3), µg/m^3	Annual*	100	100
	24 Hours**	400	400
Benzene (C_6H_6), µg/m^3	Annual*	5	5
Benzo (O) Pyrene (BaP), particulate phase only, ng/m^3	Annual*	1	1
Arsenic (As), ng/m^3	Annual*	6	6
Nickel (Ni), ng/m^3	Annual*	20	20

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

***24 hourly or 8 hourly or 1 hourly value as applicable shall be complied with 98% of the time in a year. 2% of the time they may exceed, but not on 2 consecutive days. Note: Whenever and wherever monitoring results on two consecutive days of monitoring exceed the limits specified above for the respective category, it shall be considered adequate reason to institute regular or continuous monitoring and further investigation.*

3.6.2 Ambient Noise Standards

As per the EHS guidelines of IFC, for residential, institutional and educational area, the one hourly equivalent noise level (Leq hourly) for daytime (6.00 a.m. to 10.00 p.m.) is **55 dB (A)** while the Leq hourly for night time (10.00 p.m. to 6.00 a.m.) is prescribed as **45 dB (A).** Noise standards notified by the MoEF&CC vide gazette notification dated 14th February 2000 based on the *A- weighted equivalent noise level (Leq)* are as presented in ***Table 3-9***.

Table 3-9: Ambient Noise Standards

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

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

3.6.3 Noise Standards for Occupational Exposure

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

Table 3-10: Standards for Occupational Noise Exposure

Total Time of Exposure per Day in Hours (Continuous or Short-term Exposure)	Sound Pressure Level in dB(A)
8	90
6	92
4	95
3	97
2	100
3/2	102
1	105
¾	107
½	110
¼	115
Never	>115

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

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

3.6.4 Water Quality Standards

The designated best use classification as prescribed by CPCB for surface water is as given in ***Table 3-11***.

Table 3-11: Primary Water Quality Criteria for Designated Best Use Classes

Designated-Best-Use	Class	Criteria
Drinking Water Source without conventional treatment but after disinfection	A	• Total Coliforms Organism MPN/100ml shall be 50 or less • pH between 6.5 and 8.5 • Dissolved Oxygen 6mg/l or more • Biochemical Oxygen Demand 5 days 20°C 2mg/l or less
Outdoor bathing (Organised)	B	• Total Coliforms Organism MPN/100ml shall be 500 or less • pH between 6.5 and 8.5 • Dissolved Oxygen 5mg/l or more • Biochemical Oxygen Demand 5 days 20°C 3mg/l or less
Drinking water source after conventional treatment and disinfection	C	• Total Coliforms Organism MPN/100ml shall be 5000 or less • pH between 6 to 9 • Dissolved Oxygen 4mg/l or more • Biochemical Oxygen Demand 5 days 20°C 3mg/l or less
Propagation of Wild life and Fisheries	D	• pH between 6.5 to 8.5 • Dissolved Oxygen 4mg/l or more • Free Ammonia (as N) 1.2 mg/l or less
Irrigation, Industrial Cooling, Controlled Waste disposal	E	• pH between 6.0 to 8.5 • Electrical Conductivity at 25°C micro mhos/cm Max.2250 • Sodium absorption Ratio Max. 26

Designated-Best-Use	Class	Criteria
		• Boron Max. 2mg/l
	Below-E	• Not Meeting A, B, C, D & E Criteria

Source: Central Pollution Control Board

3.6.5 Drinking Water Quality Standards / Ground Water Quality

In India, 'IS 10500 (2012): Drinking Water' is used as drinking water quality standards. If ground water is used for drinking purpose, then this standard is used for checking suitability of ground water for the same. This standard specifies the acceptable limits and the permissible limits in the absence of alternate source. It is recommended that the acceptable limit is to be implemented as values in excess of those mentioned under 'Acceptable' render the water not suitable. Such a value may, however, be tolerated in the absence of an alternative source. However, if the value exceeds the limits indicated under 'permissible limit in the absence of alternate source' in col 4 of Tables 1 to 4, the sources will have to be rejected.

4. Environmental and Socio-Economic Baseline

This section of the report presents information on the baseline condition of the physical, chemical, biological and social environment within the project area. Primary baseline information was collected on site from project area and area of influence. Existing information sourced from scientific literature (both published and unpublished), engineering studies, technical reports and community socio-economic studies were used wherever available. Activities that facilitated establishment of the baseline data in the report include: site survey, ecological survey, social consultations and interviews, environmental monitoring, processing of satellite imagery and secondary data review from established sources such as Indian Meteorological Department (IMD) and Census of India amongst others.

4.1 Environmental Baseline

Area in the 5-kilometre (km) radius from the project is considered as AoI of the project, for primary data collection. AoI covers project area, area traversed by project transmission line. Nearby villages which fall under AoI are Bhadgaon village, Vardhane village, Vehergaon village, Lakhmapur village, and Nagpur village. Primary data was collected in the month of February 2022. Environmental baseline monitoring was undertaken for ambient air quality, surface water quality, drinking water quality, ground water quality, ambient noise levels, soil quality and traffic survey. Parameters monitored under environmental aspects are given in ***Table 4-1***. One (01) time samples for ground water, surface water, drinking water, and soil were collected for analysis, two (2) time samples for traffic survey, five (05) (24 hrs) monitoring locations for air samples was conducted, and (05) monitoring stations for continuous ambient noise data was collected on site.

Table 4-1: Environmental Parameters Monitored for Baseline Data Collection

S. No.	Aspect	Details
1.	Micro-Meteorology	Available information on meteorology for the area representative of the site was collected from publicly available data of Meteorology Department, like ambient temperature, wind direction, wind speed, relative humidity, and rainfall.
2.	Ambient Air Quality	Information on ambient air quality was collected through monitoring of ambient air quality. Monitoring was performed at 5 different locations and for 2 days per location. Monitoring locations were selected based on the wind directions in the area. Parameters such as Particulate Matter (PM-10), PM-2.5, Oxides of Nitrogen (NO_x), Sulphur Dioxide (SO_2), O_3, Ammonia, CO, Lead, Benzene, Benzo Alpha Pyrene, Arsenic, Nickel were recorded for assessment.
3.	Water Quality	Ground water and surface water and drinking water samples from 3 different locations were collected for analyses of following parameters: - Organoleptic and physical parameters: Colour, Odour, pH, Taste, Turbidity, Total Dissolved Solids (TDS), Electrical Conductivity (EC); and - General parameters: Total Hardness, Total Alkalinity, Aluminium (as Al), Ammonia, Anionic detergents (as MBAS), Barium (as Ba), Boron (as B), Calcium (as Ca), Free residual Chlorine (as Cl_2), Chloramines, Chloride (as Cl), Copper (as Cu), Fluoride (as F), Iron (as Fe), Magnesium (as Mg), Manganese (as Mn), Nitrate (as NO_3), Phosphorus (as P), Selenium (as Se), Silver (as Ag), Sulphate (as SO_4), Sulphide (as S^{2-}), Zinc (as Zn), Cadmium (as Cd), Cyanide (as CN), Lead (as Pb), Mercury (as Hg), Molybdenum (as Mo), Nickel (as Ni), Pesticides, Polychlorinated Biphenyls, Total arsenic (as As), Total chromium (as Cr), Phenolic Compounds, Mineral Oil, PAHs.
4.	Soil Quality	1 Soil sample was collected and analysed for the following parameters: - Physical Parameters: Particle Size Distribution, Texture, pH, and Permeability, Porosity, Electrical Conductivity, etc.; and - Chemical Parameters: Total Nitrogen, Phosphorus, Sodium, Potassium, Cation Exchange Capacity.
5.	Ambient Noise Quality	Ambient noise quality was monitored at 5 locations to determine hourly equivalent noise levels. The noise sampling was done during the study period continuously for 24 hours, selected on the basis of the site sensitivities within the study area. The results of the findings were analysed to work out Leq hourly, Leq day and Leq night.

S. No.	Aspect	Details
6.	Traffic monitoring analysis	Traffic data was monitored at both the land parcels (Bhadgaon and Nagpur) for 24 hrs. Monitoring was performed for the vehicles using the village road or NH and also the vehicles turning into the road used for project purpose.

Environmental monitoring locations have been represented in ***Table 4-2*** and ***Figure 4-1***.

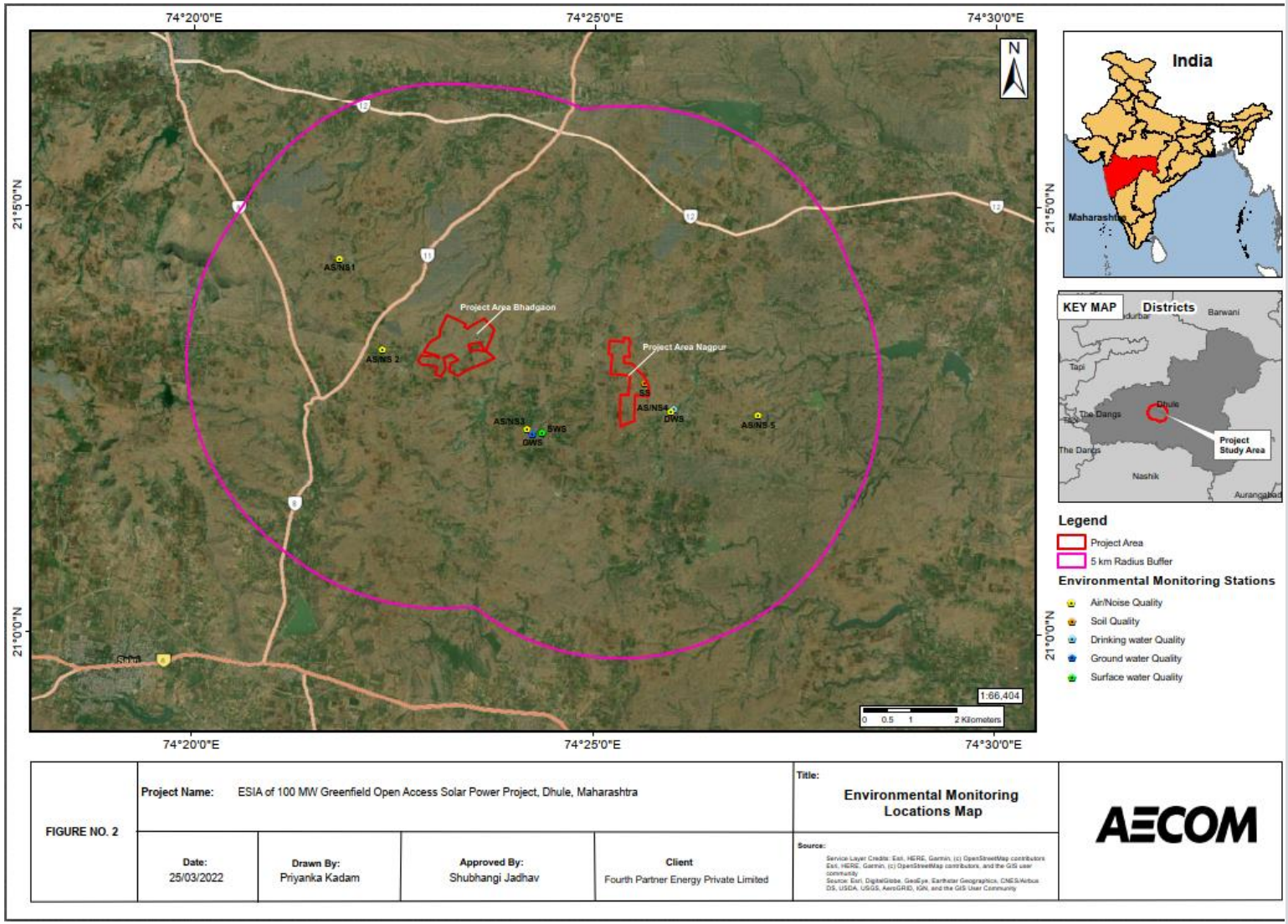


Figure 4-1: Map showing Environment and Traffic Monitoring Locations

Table 4-2: Environmental Monitoring Locations

S. No.	Aspect	Monitoring Location/ Code	Latitude/Longitude	Monitoring Location	Direction from the project site	Rationale
1.	Ambient Air	AAQ 1	21°4'22.90"N 74°21'49.22"E	Vehergaon village	North of Bhadgaon Land parcel	Baseline air quality at project site (Upwind of site)
		AAQ 2	21° 3'14.71"N 74°23'6.87"E	Site boundary	Bhadgaon Land parcel	Crosswind to project site
		AAQ 3	21° 2'25.19"N 74°24'13.74"E	Vardhane village	In-between both site land parcels	Downwind to Bhadagaon and upwind to Nagpur land parcels
		AAQ 4	21° 2'45.73"N 74°25'25.64"E	Site boundary	Nagpur land parcel	Crosswind to project site
		AAQ 5	21° 2'35.74"N 74°26'4.12"E	Lakhmapur village	Southeast of Nagpur land parcel	Baseline air quality at project site Downwind of site.
2.	Ground Water	GW 1	21° 2'26.53" N 74° 24'18.16" E	Vardhane village in-between two land parcels	in-between two land parcels	Monitoring of ground water quality in the vicinity of the project area
3.	Surface water	SW	21° 2'21.36" N 74° 24'21.48" E	Vardhane Village	In-between both site land parcels	Monitoring of surface water quality in the vicinity of the project area
4.	Drinking water	DW	21° 2'20.46" N 74° 24'14.292" E	Vardhane Village	In-between both site land parcels	Monitoring of drinking water quality in the vicinity of the project area
5.	Ambient Noise	NQ 1	21°4'22.90"N 74°21'49.22"E	Vehergaon village	North of Bhadgaon Land parcel	Noise level at the north of project site
		NQ 2	21° 3'14.71"N 74°23'6.87"E	Site boundary	Bhadgaon Land parcel	Noise level near project area
		NQ 3	21° 2'25.19"N 74°24'13.74"E	Vardhane village	In-between both site land parcels	Noise level in between the two project areas
		NQ 4	21° 2'45.73"N 74°25'25.64"E	Site boundary	Nagpur land parcel	Noise level near project area
		NQ 5	21° 2'35.74"N 74°26'4.12"E	Lakhmapur village	Southeast of Nagpur land parcel	Noise level at the south of project area
6.	Soil Quality	SQ 1	21° 2'57.19"N 74°25'29.36"E	Within project boundary	Project Area (Nagpur land parcel)	Soil quality of Project Area
7.	Traffic Survey	TM 1	21° 3'21.24"N 74°22'10.08"E	Intersection of State Highway (SH) 11 and Bhadgaon project site road	West of the project site	Access road to be used for carrying construction equipment and material
		TM 2	21° 2'39.21"N 74°25'48.96"E	Intersection of project site road and village road	South of the project site	Access road to be used for carrying construction equipment and material

4.1.1 Physiography

Dhule district can be broadly divided into 2 physiographic units namely Tapi valley proper and the region of the dykes and residual hills of the Sahyadri Spurs with eastward trending streams in between. The Tapi River valley is observed on both sides of Tapi River in parts of Shirpur and Sindkhedtalukas, whereas the region of dykes and residual hills of the Sahyadri Spurs comprises southern part of Sindkheda and entire Sakri and Dhule talukas. The district is drained by Tapi River and its tributaries. Tapi River flows westward through the central part of the district. Panjra and Aner rivers are the main tributaries of Tapi flowing northward and southward respectively to join Tapi River.

Except for a small area in the extreme north-west which drains into the Narmada River, the district as a whole lies in the drainage basin of the Tapi. Parallel with the Tapi are three well marked belts of country running east to west; in the centre the rich Tapi valley, in the north the high and wild Satpura mountain range, and the south and southwest bare ridges and well-watered valleys separated by spurs of the Sahyadri ranges and innumerable dykes. The district may be broadly divided into the following natural regions: the Satpuda region, ii) the Tapi valley proper, iii) the region of dykes and residual hills of the Sahyadri spurs with eastward trending streams in between and, iv) Navapur and western Nandurbar region with a westerly aspect below the Sahyadri scarps

The Satpura region -North of the Tapi, the whole length of the rich alluvial plain is bounded by the steep southern face of the Satpuras, a belt of mountain land about 30 kilometres broad. Much of this hilly country, now with only a few scattered Bhil tribe hamlets, was once peopled. In the wide valleys of Aner river and Arunavati river are the brushwood covered ruins of temples, mosques, wells and single storeyed houses of what once had been considerable towns. Though much is deserted, in the north and north-west the Akrani uplands are well tilled and prosperous, peopled by the Pavras, skilful and hardworking peasants, whose homesteads, each in its plot of fields, are sheltered by well-kept mango and moha groves.

Tapi Valley: The soils of this region are extremely fertile except in some portions near the main river and its tributaries, which have cut down the land very badly and removed the top soil. Otherwise the soils grade from the deep fertile soils to coarse shallow to stony soils away from the river either northwards towards the Satpuras or southwards towards the residual hills and dykes.

Region of dykes and residual hills: This comprises the southern part of Nandurbar and Sindkheda and the whole of Sakri and Dhulia talukas. This region consists of residual hills and dykes of poor dry and stony soils intervened by well watered valleys of the eastward trending upper courses of streams with somewhat better soils and intense agricultural activity based on canal and well irrigation. This region is one of the few regions in Maharashtra with well developed canal irrigation even in pre-British times, probably on account of the rivers flowing in a region of light soils derived from the slow weathering of the dykes. On account of the general inferiority of the soils, the predominant crop is kharif bajra. Cotton and groundnut are also widely grown. In the irrigated valley sections, especially in the Panjhra valley, sugarcane, Cambodia cotton and wheat are raised. In the western section with higher rainfall, along with the above crops, ragi and rice and a little gram are also grown.

Navapur and western Nandurbar region: This region with a westerly aspect below the Sahyadrian scarps is full of steep hill ranges covered with forests, broken here and there by casual tillage which surrounds the Bhil hamlets. The Sahyadris come to an end in the north-east corner of this sub-region and though they gradually fall away towards the Tapi they form a noticeable feature from the plain lands to the east. The westerly aspect accounts for the higher rainfall of this area (75 to 100 cms) as compared to the rest of the district. The rivers afford a good supply of water throughout the year. In the kharif season rice, tur and jowar are sown in mixtures; after the dry rice is harvested, jowar and tur continue to grow to be harvested later. Ragi (locally known as nagali) is a fourth crop of this region. In the rabi season irrigated and unirrigated wheat and Bengal gram are grown. No groundnut is grown in this sub-region. Project also falls under this region.[6]

[6] https://www.indianetzone.com/47/geography_dhule_district.htm

4.1.2 Geology

The major part of the district is occupied by Basaltic flows commonly known as Deccan Traps intruded by dykes of Upper Cretaceous-Lower Eocene age. Tapi Alluvial deposits are observed in Tapi River valley occupying parts of Sindkhed and Shirpur talukas. A small patch of Bagh Beds is exposed in northwestern portion of the district[7].

4.1.3 Drainage

In Dhule district, river Tapi traverses through the north and middle of the District for about 65 km. It is joined by rivers / streams both on the left and right banks. Panjhra and Kan rivers rise from the Western Ghats and the later joins the former near village Sakri of Sakri Tahsil and flows towards the east. Near Dhule town, it turns northwards almost at right angles to meet the Tapi River. Other important tributaries are Bori and Amravati, which also originate in the Western Ghats and flow northwards till they meet the Tapi River. These rivers have been crossed by small dams and are widely used for irrigation. On the northern side, a number of streams join the Tapi River. Of them Aner and Kordi are amongst the more important. These are short in length and are not of much use.

Bhadgaon land parcel has one seasonal natural stream crossing it, whereas one seasonal drain passes from the Nagpur project area. The drainage map of the project site has been represented below in the ***Figure 4-3.***

[7] http://cgwb.gov.in/AQM/NAQUIM_REPORT/Maharshtra/Dhule%20&%20Sakri%20blocks,%20Dhule%20district.pdf

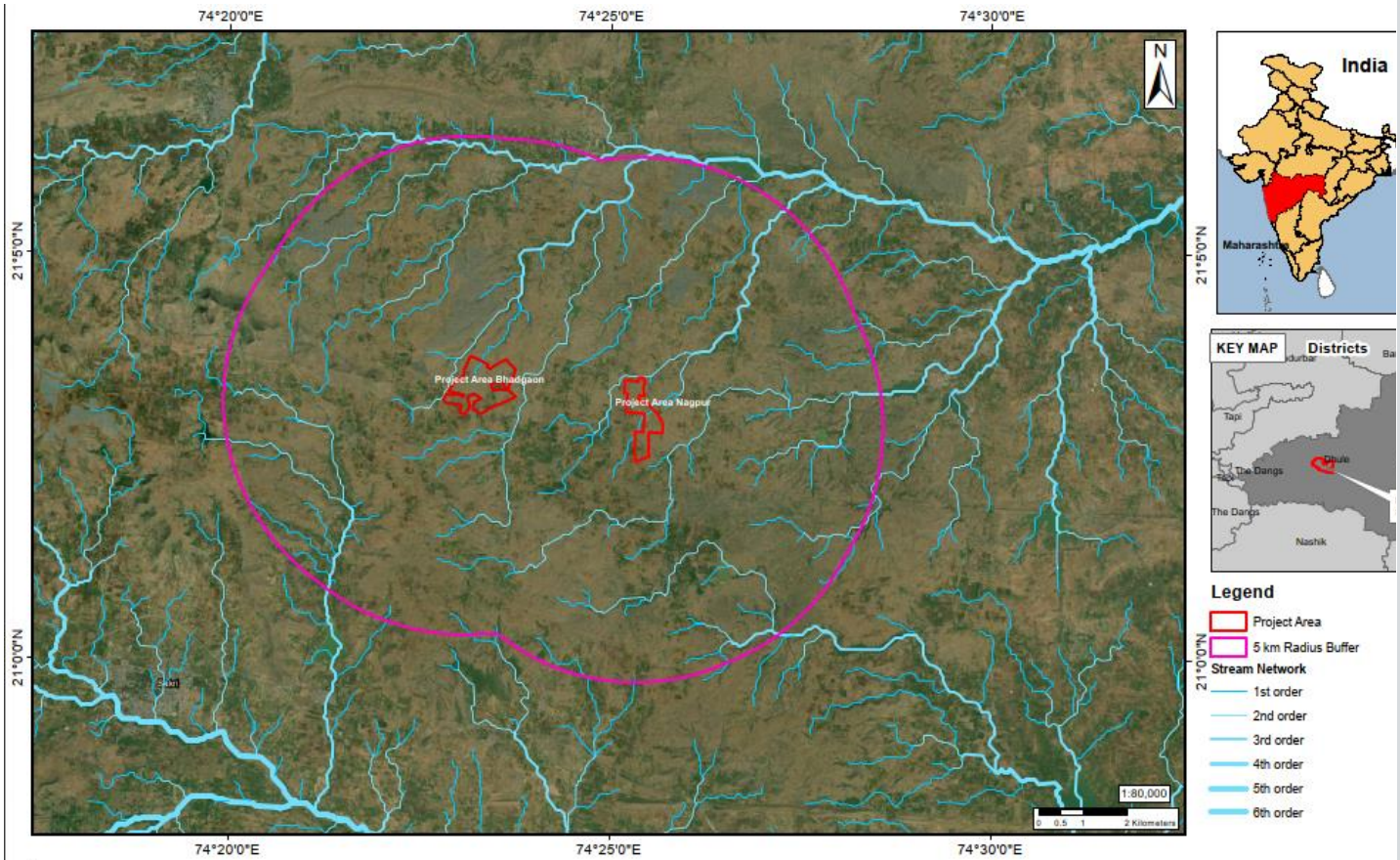


Figure 4-2: Map representing Drainage within 5 km radius of site

4.1.4 Land use and Land Cover

The District is surrounded by Jalgaon District to its east, Nashik District to its south, Nandurbar District to its western side and Mewed District of Madhya Pradesh State on its Northern side.

The headquarters of Dhule District is located at Dhule, a city with population of 3,75,559 as per Census, 2011. Dhule city is situated on the southern bank of the Panjhra River, 57 kms., to the north of Chalisgaon on the Mumbai-Nagpur route of the Central Railway with which it is connected by a broad-gauge line. The Mumbai-Agra National Highway also passes through Dhule. The total geographical area of the district was 7195 sq.km. As per the District Census Handbook, Dhule (2011), in the district 18.8% area is covered under the forest area, 63.1% of the total geographic area is cultivable land however only 14.1% was covered under the irrigation. The density of the population is 285 persons per sq.km.

The land use pattern of the district has been provided in the ***Table 4-3*** below:

Table 4-3: Landuse classification of Dhule district

S. No.	Classification	Area (in hectares)	% Coverage
1.	Forests	122726.1	18.8%
2.	Area Under Non-Agriculture Uses	30813.85	4.7%
3.	Barren and Un-cultivable Land	38044.73	5.8%
4.	Permanent pastures and Other Grazing Lands	15200.94	2.3%
5.	Land Under Miscellaneous Tree Crops etc.	2787.48	0.4%
6.	Cultivable Waste Land	10845.92	1.7%
7.	Fallow Lands other than Current Fallows	9602	1.5%
8.	Current Fallows	11122.64	1.7%
9.	Net Area Shown	412404.15	63.1%
10.	Total Geographic Area	653696.81	100%

Source: District Census Handbook, Dhule (2011)

Total geographical area of the Bhadgaon and Nagpur village, where the project site falls is 2237.79 hectares.

The Project site specific Land use within 5 km radius of the proposed project site and the land use of the project site has been presented in the following ***Table 4-4*** and ***Figure 4-4.***

Table 4-4: Land use specific to Project Area and Site

S. No.	Land use Type	Land use within 5 km radius of Project Site		Land use of Project Site	
		Area in Hectares	% of the total area	Area in Hectares	% of the total area
1.	Forests	5808.96	35.9%	458.45	20.5%
2.	Area Under Non-Agriculture Uses	976.99	6.0%	48	2.1%
3.	Barren and Un-cultivable Land	913	5.6%	16.96	0.8%
4.	Permanent pastures and Other Grazing Lands	50.64	0.3%	4.61	0.2%
5.	Land Under Miscellaneous Tree Crops etc.	35.33	0.2%	0	0.0%
6.	Cultivable Waste Land	78.26	0.5%	398.67	17.8%
7	Fallow Lands other than Current Fallows	360.29	2.2%	0	0.0%
8	Current Fallows	42.62	0.3%	0	0.0%
9	Net Area Shown	16173.38	100.0%	2237.79	100.0%
10	Total Geographic Area	5808.96	35.9%	458.45	20.5%

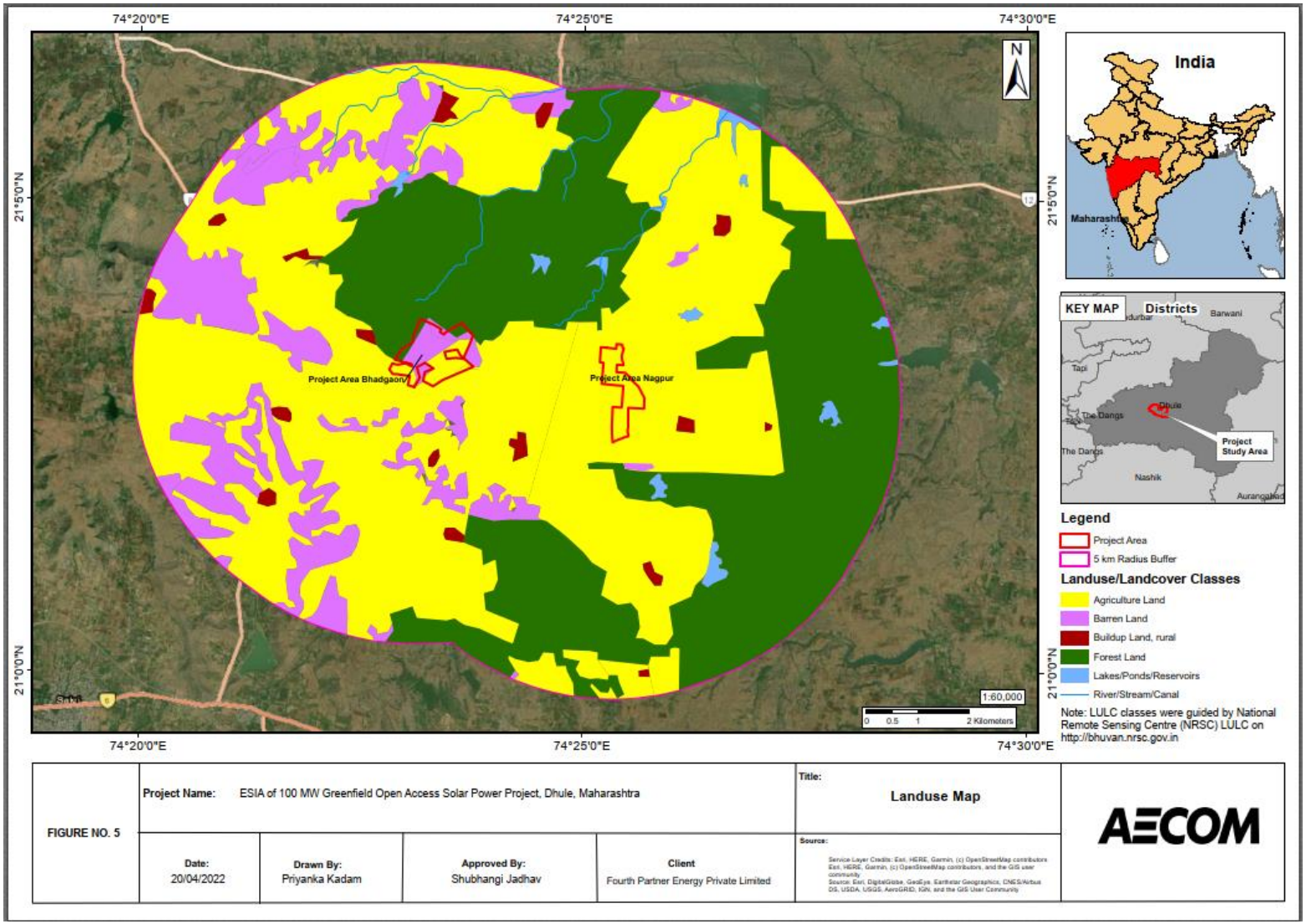


Figure 4-3: Map showing Landuse within 5 km radius of the Proposed Project site

4.1.5 Soil Types

Dhule district can be broadly divided into 2 physiographic units namely Tapi valley proper and the region of the dykes and residual hills of the Sahyadri Spurs with eastward trending streams in between. The Tapi River valley is observed on both sides of Tapi River in parts of Shirpur and Sindkhedtalukas, whereas the region of dykes and residual hills of the Sahyadri Spurs comprises southern part of Sindkheda and entire Sakri and Dhule talukas. The district is drained by Tapi River and its tributaries. Tapi River flows westward through the central part of the district. Panjra and Aner rivers are the main tributaries of Tapi flowing northward and southward respectively to join Tapi River

In the Tapi valley proper, the soils are deep black and extremely fertile except in some portions near the main river and its tributaries, which have cut down the land very badly and removed the top soil. Otherwise the soils grade from the deep fertile soils to coarse shallow to stony soils away from the river either northwards towards the Satpudas or south ward towards the residual hills and dykes.

Project site is located in a region where light black type soil is found.

Map representing the type of soil in Maharashtra state is presented in the ***Figure 4-6*** below.

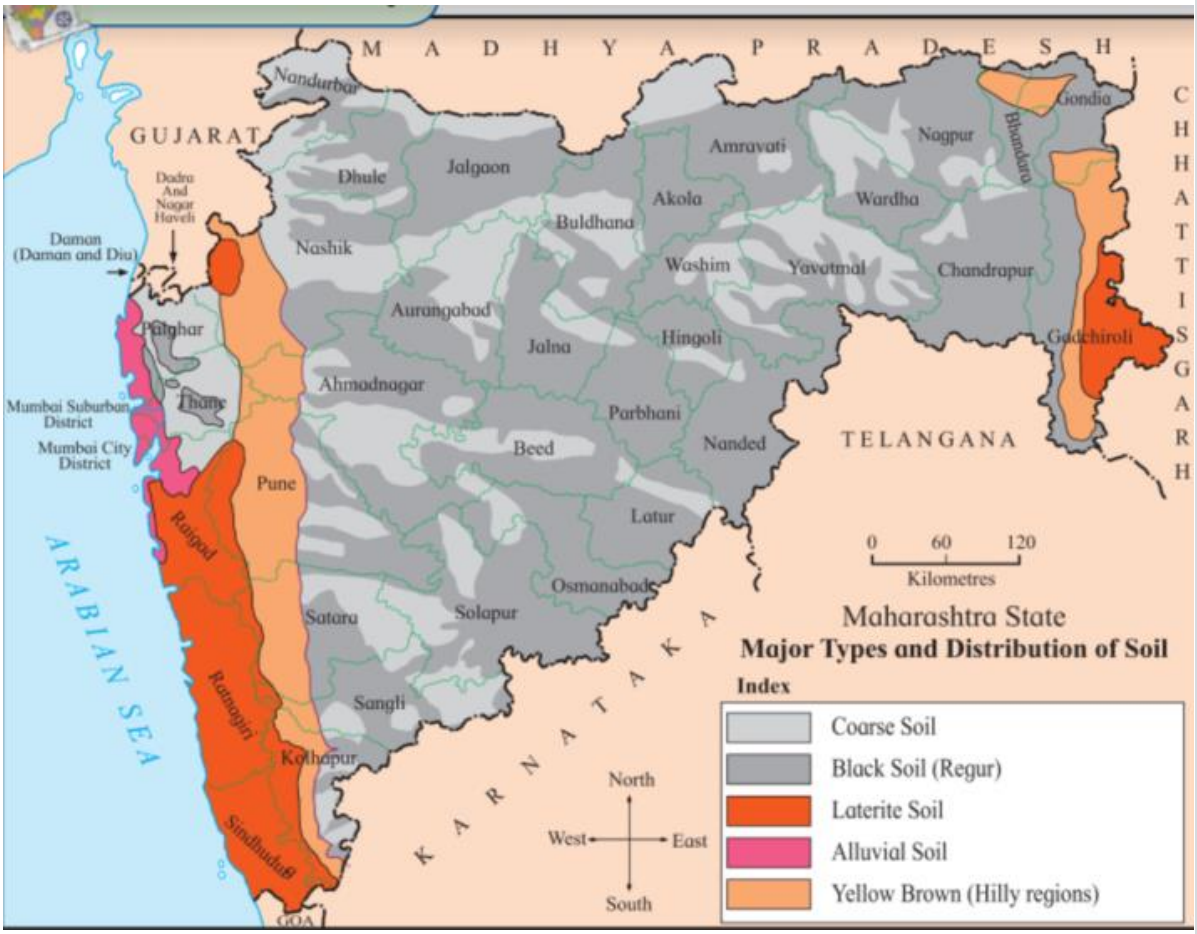


Figure 4-4: Soil Map of Maharashtra State[8]

4.1.6 Hydrogeology

A major part of the district occupying northern parts of Shirpur, southern parts of Sindkhed and entire Dhule and Sakri talukas is covered by Basaltic flows commonly known as Deccan Traps intruded by dykes of Upper Cretaceous-Lower Eocene age. Tapi Alluvial deposits are observed in Tapi River valley occupying parts of Sindkhed and Shirpur talukas.

Hard Rock Areas: Deccan Trap Basalt
The Deccan Trap includes several flows of Basalt which are supposed to have extruded from fissure volcanoes. The flows have been intruded by large number of dykes of doleritic composition. The dykes are aligned in an ENE-WSW direction and a few gave N-S or WNE-ESE trends. Basalt includes the “pahoehoe” and the “aa” types of flows, the former being very common.

The ground water occurs in the near surface strata down to the depth of 20 m under unconfined conditions in the weathered zone, vesicular/amygdaloidal Basalt, jointed and fractured massive Basalt. The water bearing strata occurring below 30 m depth, beneath the red bole and dense massive Basalt exhibit semiconfined to confined conditions. On the elevated plateau tops having good areal extent, local water table develops in topmost layers and the wells in such areas show rapid decline water levels in post monsoon season and go dry during peak 5 summer. In the foothills zone the water table is relatively shallow near the water courses and deep away from it and near the water divides. In the valleys and plains of river basin the water table aquifer occurs at shallow depth and the wells in such areas do not go dry and sustain perennial yield except in extreme summer or drought conditions. The yield of the dug wells varies from 60 to 125 m^3 /day, whereas those of borewells varies from 2 to > 20 m^3 /hr, however in most of the borewells it ranges between 2 to 10 m^3 /hr.

[8] soil map of maharashtra - Google Search

Soft Rock Areas Alluvium:
Alluvial deposits of Tapi River valley occurs in long narrow basin, which are probably caused by faulting. About a 15% of the district is occupied by Alluvium. It consists of clays, silt, sand, gravels and boulders etc. The beds of sand and gravels are discontinuous and lenticular and pinch out laterally within short distance. They are mixed with large proportions of clayey material rendering delimiting of individuals granular horizons difficult. As per ground water exploration data Alluvium is encountered down to 100 m depth. Ground water occurs under water table, semi-confined and confined conditions in inter granular pore spaces of gravel and sand. The yield of the dugwells varies between 150 and 200 m^3 /day, whereas that of exploratory wells varies from 1.50 to 6.00 lps as per exploration data. The yields of the tubewells drilled by State ground water department/agency ranges from 20 to 250 m^3/hr. [9]The hydrogeological of the project area is a hard rock (basalt) represented below in the ***Figure 4-7*** below.

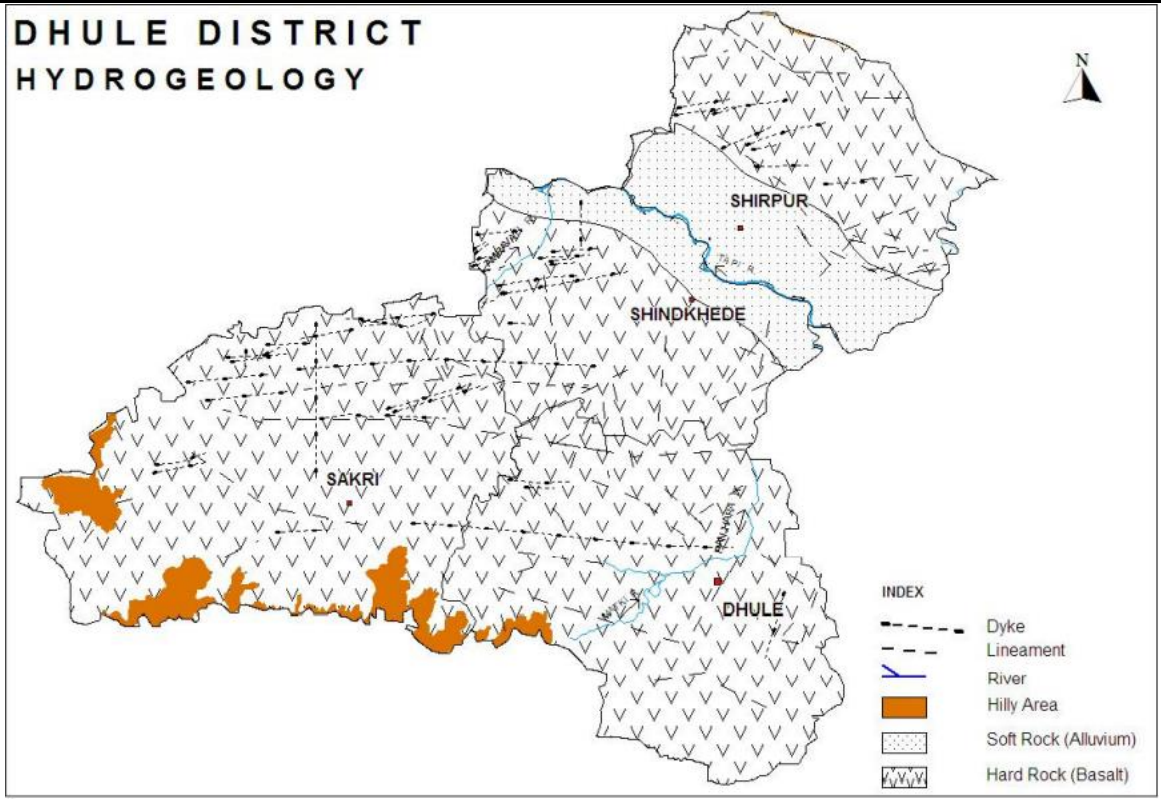


Figure 4-5: Hydrogeological map of Dhule district

Source: Dhule.pdf (cgwb.gov.in)

4.1.7 Climate and Meteorology

The climate of the district is characterized by a hot summer and general dryness throughout the year except during the south-west monsoon season, i.e., June to September. The daily mean minimum temperature was 16°C and mean maximum temperature was 45°C. The annual average rain fall in mm ranges from 499 to 864.

The decadal average of annual rainfall is identified to be lowest in Dhule taluka (589 mm) and highest Shirpur taluka (875 mm). It is the minimum in the central parts of the district around Dhule and Sakri and Sindkhed and increases northwards and westwards. The study of negative departures of the annual rainfall over normal reveals that western and southern parts of the district experienced moderate and severe drought conditions for more than 20% of years. Hence these parts occupying parts of Sakri and Dhule talukas can be categorized as drought area.

[9] Dhule.pdf (cgwb.gov.in)

4.1.7.1 Rainfall

The southwest monsoon season varies anywhere in between 3 to 4 months from June to mid-October followed by post monsoon. The year can be divided into four seasons. The cold season from December to February is followed by the hot season from March to May. The south-west monsoon season that follows afterwards lasts until September, and October and November constitute the post-monsoon season. The average annual rainfall in the district is 674.0 millimetres (26.54 in).

Recent data for last five (05) years collected from India Meteorological Department (IMD), Dhule shows large variation in rainfall as shown in ***Table 4-5.***

Table 4-5: Average Annual Rainfall (in mm) for Dhule District

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
2016	0.0	0.0	4.0	0.0	2.4	91.0	124.0	93.7	110.9	73.1	0.0	
2017	0.0	0.0	0.0	0.0	0.0	108.3	135.8	162.9	105.6	76.0	0.0	14.3
2018	0.0	0.0	0.0	0.0	0.5	134.0	98.7	143.8	34.8	0.0		
2019						107.4	218.4	316.5	325.5	120.9	17.3	4.8
2020	0.0	0.0	0.0	0.4	0.0	182.6	259.0	204.9	140.6	38.4	0.0	34.7

Source: IMD (http://hydro.imd.gov.in/hydrometweb/(S(rzx21qm1n5eyvwabunouztag))/DistrictRaifall.aspx)

Note:
(1) The District Rainfall in millimeters (R/F) shown are the arithmetic averages of Rainfall of Stations under the District.
(2) Blank Spaces show non-availability of Data

4.1.7.2 Wind Speed & Windrose

Winds are generally light to moderate with some increase in strength in the latter part of summer and early part of the monsoon season. In the period from April to September, winds blow mostly from directions between south and west, south to westerly and westerly predominating. Winds speeds follow a bell-shaped curve with peak/crest of the curve in June and the two troughs in month of April and September. In the month of June where wind speed is recorded to be maximum, more than 12 miles per hour is recorded for 17-18 days of the month whereas for 9-10 days it can even touch or exceed 17 miles per hour. Whereas for May and July month 12 miles per hour touches 20 days. [10]

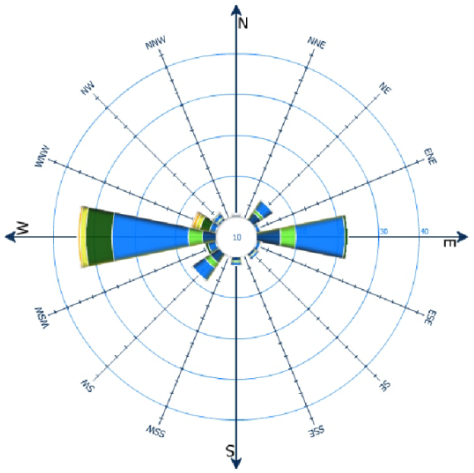
Wind speeds recorded at the nearest IMD station, Malegaon, for the period 1981-2008 is mentioned in the below table

Table 4-6 Windspeed (in kmph) for the region

Month	No. of days with wind speed (kmph)			
	62 or more	**20-61**	**1-19**	**0**
January	0	0	8	54
February	0	0	10	46
March	0	0	12	50
April	0	0	16	44
May	0	0	27	45
June	0	0	31	29
July	0	0	30	32
August	0	0	24	48
September	0	0	15	45
October	0	0	10	52
November	0	0	8	52
December	0	0	7	55

The windrose for Jalgaon IMD station (year 1971-2000) shows that prominent wind is from west direction.

[10] Simulated historical climate & weather data for Dhule - meteoblue



m/s
>25
20-25
17-20
14-17
11-14
9-11
7-9
4.5-7
1.5-4.5
1-1.5
0.5-1
0.01-0.5
Calm

DIR. (Degrees)	SPEED OF 10-MN MEAN WIND meters per second												
	0.0 - 0.5	0.5 - 1.0	1.0 - 1.5	1.5 - 4.5	4.5 - 7.0	7.0 - 9.0	9.0 - 11.0	11.0 - 14.0	14.0 - 17.0	17.0 - 20.0	20.0 - 25.0	>=25.0	total
348-11		0.4	0.2	0.2									0.8
11-33		0.0	0.0	0.0									0.0
33-56		2.3	0.8	2.7	0.1	0.0							5.9
56-78		0.1	0.1	0.8	0.2	0.0							1.2
78-101		5.9	3.8	12.0	0.7								22.4
101-123		0.1	0.1	0.8	0.2								1.2
123-146		0.8	0.3	0.6	0.0								1.7
146-168		0.0		0.0									0.0
168-191		0.9	0.5	0.7	0.0								2.1
191-213		0.0	0.0	0.3	0.0								0.3
213-236		2.7	1.5	3.7	0.2	0.0	0.0						8.1
236-258		0.2	0.1	1.9	0.7	0.1	0.0						3.0
258-281		3.3	3.5	18.8	6.5	1.4	0.5	0.1	0.0				34.1
281-303		0.1	0.2	1.5	2.4	1.2	0.7	0.4					6.5
303-326		0.5	0.4	1.0	0.4	0.2	0.1	0.1					2.7
326-348		0.0		0.0									0.0
Total	0.0	17.3	11.5	45.0	11.4	2.9	1.3	0.6	0.0	0.0	0.0	0.0	89.7
Calm:	10.3	Total data used:10948 Total missing data: 557											

Figure 4-6: Windrose for Jalgaon IMD Station

4.1.8 Natural Hazards

4.1.8.1 Wind Hazard

Dhule district is not that prone to wind and cyclone hazard and lie in A-Zone of moderate damage risk category with wind speed (V_b)= 39 m/sec. as seen in the ***Figure 4-8*** below.

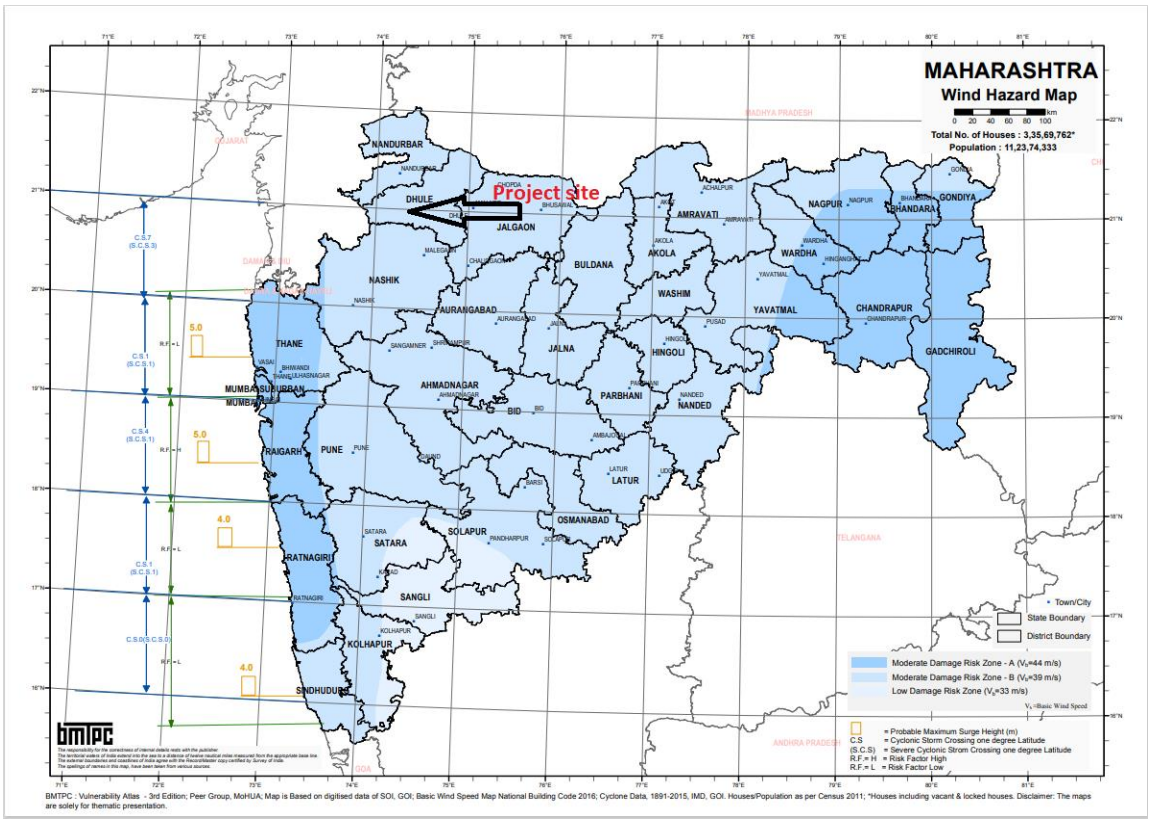


Figure 4-7: Wind Hazard map of Maharashtra state

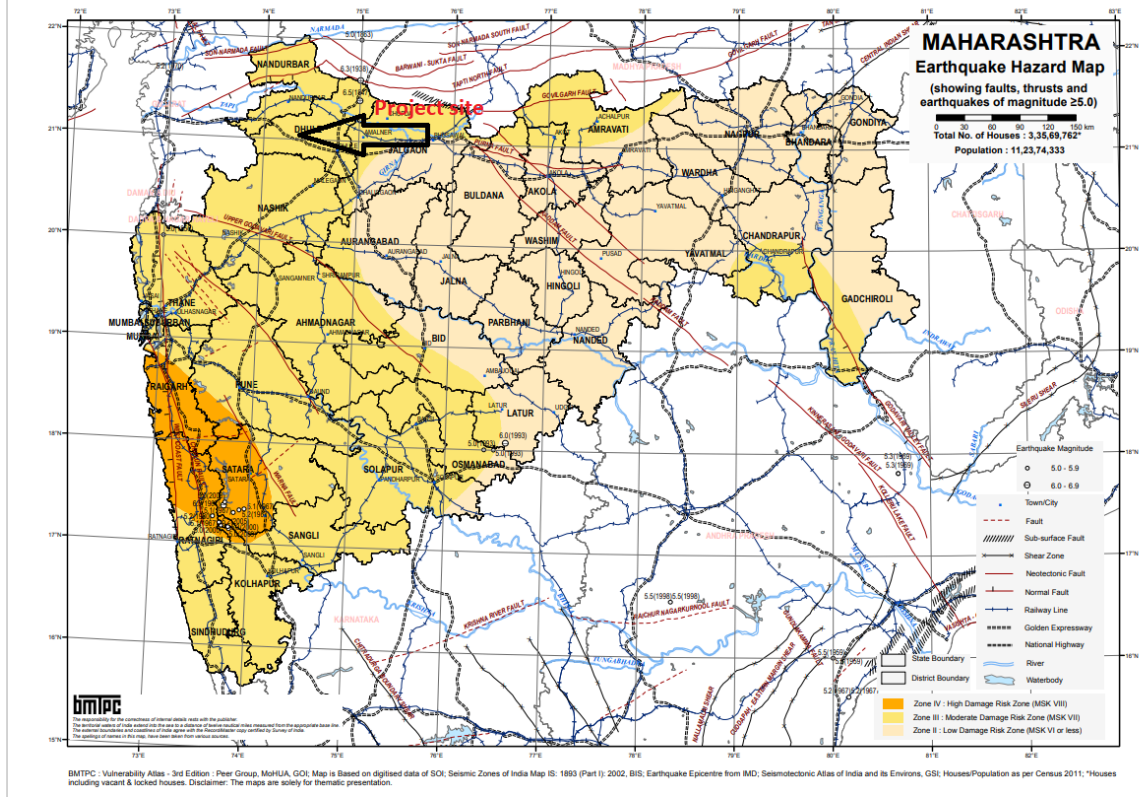
Source: Building materials and technology promotion council (BMTPC)[11]

[11] https://vai.bmtpc.org/map/windmap/WIND_MAHARASHTRA1.pdf

4.1.8.2 Seismicity

Earthquake risk is high in the state of Maharashtra and as per the seismicity map of India, Maharashtra state mainly has zone-II (least active) and zone-III (moderate) with some portions lying in zone -IV (High). Dhule district lies in zone -III i.e., moderate seismicity zone along with nearby districts like Jalgaon, Latur, Nandurbar, etc. [12]

The proposed project site in Bhadgaon and Nagpur villages in Dhule district falls under Seismic Zone – III and can be seen in the ***Figure 4-10*** below:



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.

Figure 4-8: Earthquake Hazard Map of Maharashtra state

Source: Building materials and technology promotion council (BMTPC)[13]

4.2 Air, Water, Noise and Soil Baseline

In order to evaluate the environmental quality in the study area, monitoring was carried out for one (1) week between 23rd February to 28th February 2022 at all the identified locations during site survey by an external laboratory, M/s Netel (India) Limited, which is accredited to National Accreditation Board for Testing and Calibration Laboratories (NABL) in accordance with ISO/IEC 17025:2017.

4.2.1 Ambient Air Quality

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

[12] ZONE III (bmtpc.org)
[13] https://vai.bmtpc.org/map/eqmap/EQ_MAHARASTRA.pdf

Ambient air was monitored in the project area for the month of February to estimate the quality of ambient air around the project site. The air quality was analysed at Five (05) locations as mentioned in ***Table 4-2*** to estimate the concentration of primary pollutants in the ambient air. The sampling locations were selected considering the presence of habitation nearby and their accessibility. The ambient air quality results were compared to the National Ambient Air Quality Standards (NAAQS, 2009) for rural and residential area and the analysis results of air quality have been presented below in the ***Table 4-6***.

Table 4-7: Results of Ambient Air Monitoring

Pollutant	Time Weighted Average	Concentration in Ambient Air (Industrial, Residential, Rural and Other Areas)	AAQ-1	AAQ-2	AAQ-3	AAQ-4	AAQ-5
Sulphur Dioxide (SO_2), µg/m3	24 Hours	80	9.65	8.75	7.6	8.75	8.95
Nitrogen Dioxide (NO_2), µg/m^3	24 Hours	80	14.4	14.05	11.95	13.6	14.9
Particulate Matter (size less than 10 µm) or PM_{10}, µg/m^3	24 Hours	100	53.7	65.3	61.3	58.65	55.25
Particulate Matter (size less than 2.5 µm) or $PM_{2.5}$, µg/m^3	24 Hours	60	25.6	29.1	30.6	28.85	26.7
Ozone (O_3), µg/m^3	8 Hours	100	2.8	1.85	1.75	1.45	2.25
Lead (Pb), µg/m^3	24 Hours	1	0.25	0.24	0.22	0.18	0.19
Carbon Monoxide (CO), mg/m^3	8 Hours	2	0.51	0.51	0.41	0.49	0.58
Ammonia (NH_3), µg/m^3	24 Hours	400	16.15	21.85	21.9	17.75	19.05
Benzene (C_6H_6), µg/m^3	Annual	5	9.65	8.75	9.2	10.4	8.65
Benzo (O) Pyrene (BaP), particulate phase only, ng/m^3	Annual	1	<0.5	<0.5	<0.5	<0.5	<0.5
Arsenic (As), ng/m^3	Annual	6	<0.1	<0.1	<0.1	<0.1	<0.1
Nickel (Ni), ng/m^3	Annual	20	<0.1	<0.1	<0.1	<0.1	<0.1

Source: Laboratory Results, February 2022

BDL: Below Detectable Limit

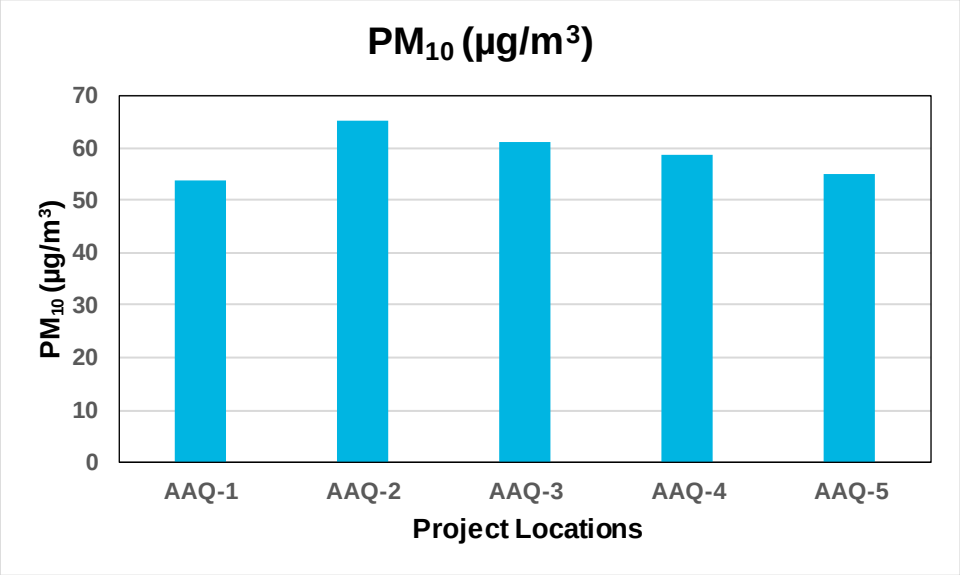


Figure 4-9: PM_{10} concentration comparison for different locations

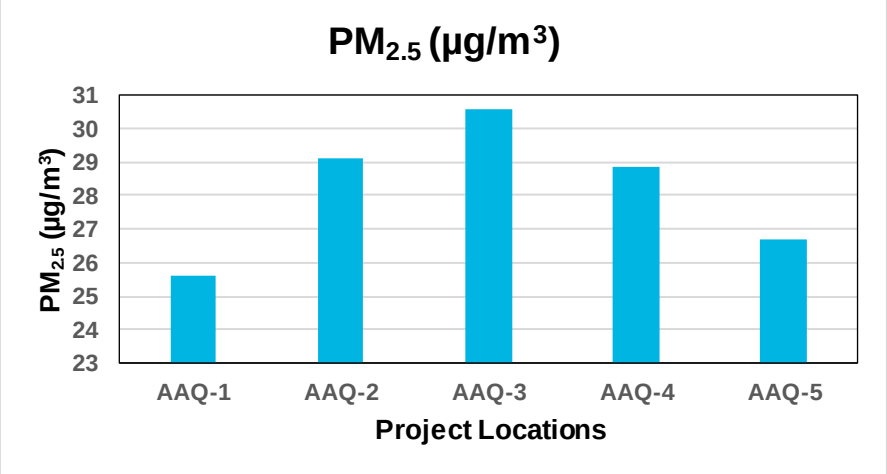


Figure 4-10: $PM_{2.5}$ concentration comparison for different locations

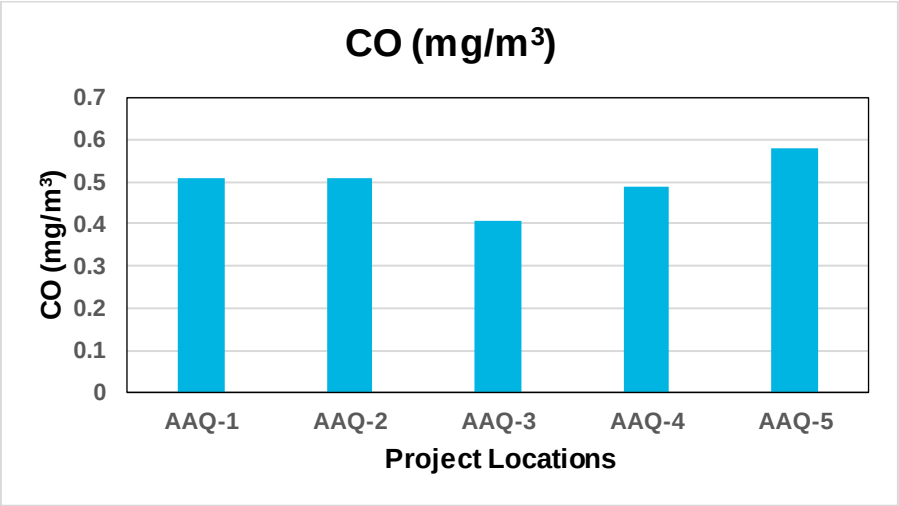


Figure 4-11: CO concentration comparison for different locations

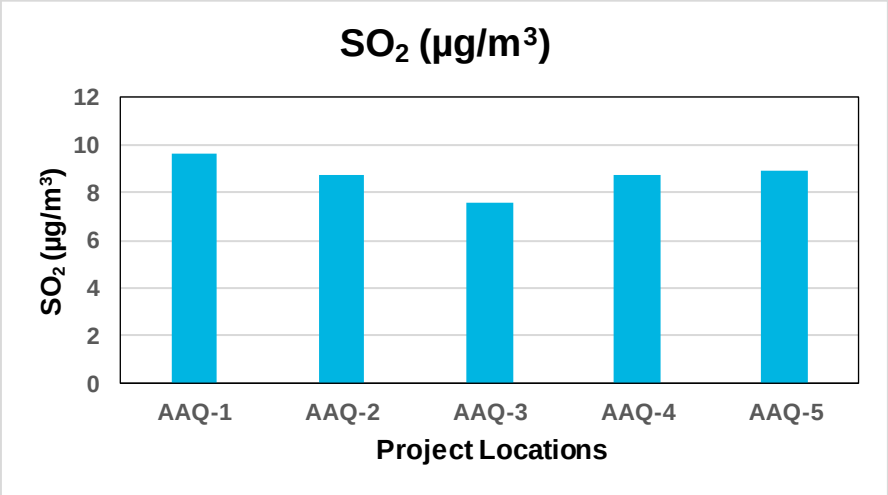


Figure 4-12: SO_2 concentration comparison for different locations

Inference

The project site is situated in a rural setting and there are no industries and significant emission sources within 5 km radius of the Project Site. The parameters measured for ambient air quality were noted to be well within the permissible limits of the National Ambient Air Quality Standards (NAAQS), as defined by MoEF&CC. $PM_{2.5}$, PM_{10}, SO_2, CO, NH_3, Lead and Ozone were detected in all the samples but were noted to be well within the permissible limits.

4.2.2 Ambient Noise Quality

Ambient Noise level was monitored continuously for 24 hours at five (05) locations once on weekday and weekend around the project area using Sound Level Meter at the identified receptor locations mentioned in ***Table 4-2***. The noise levels obtained were analysed to arrive at the equivalent continuous noise level (Leq) for day and night-time. The day and night-time hours ranged from 06:00 to 22:00 hrs and 22:00 to 06:00 hrs respectively.

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

Table 4-8: Results of Ambient Noise level Monitoring on weekday

Location Code	*Noise Standard (Residential Area)*	NQ-1	NQ-2	NQ-3	NQ-4	NQ-5
L_{min}		41.95	51.2	41.45	44.6	37
L_{max}		60.05	62.8	60.8	58.7	60.05
L_{90}		55.6	59.75	54.5	55.25	54.25
L_{eq} Day dB (A)	*55*	48.2	54.7	47.4	49.3	50.25
L_{eq} Night dB (A)	*45*	56.6	62.1	55.8	57.15	57.25
L_{DN}		41.95	51.2	41.45	44.60	37.0

Source: Laboratory Results, February 2022

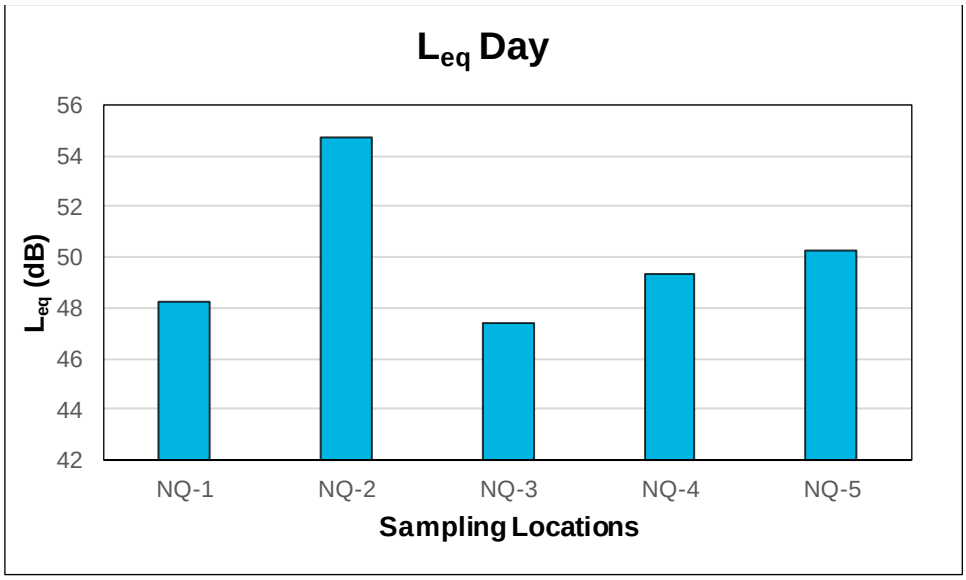


Figure 4-13: Noise level (L_{eq}) day comparison at different locations

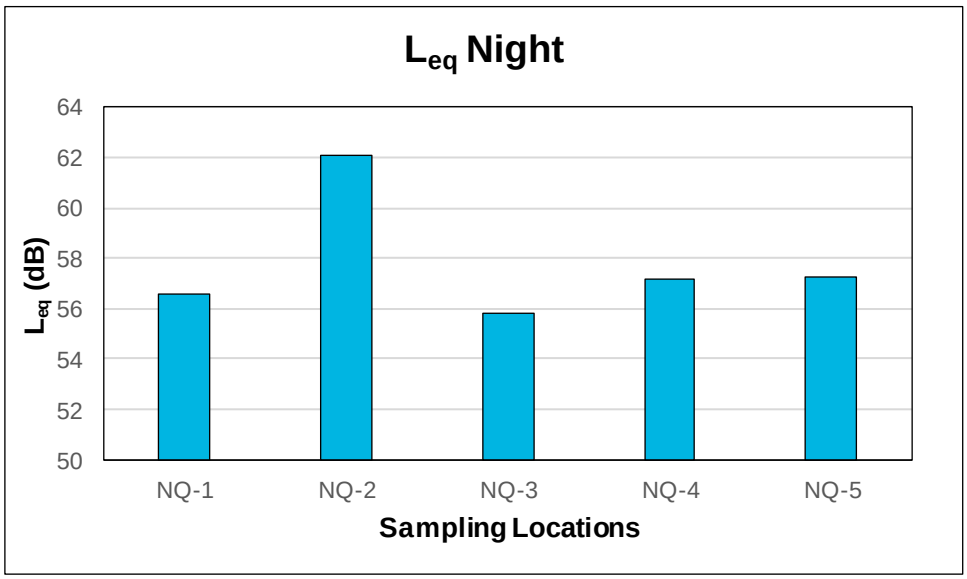


Figure 4-14: Noise level (L_{eq}) night comparison at different locations

Inference

The ambient noise level at location NQ-2 i.e. near the Bhadgaon site location was noted to be higher than permissible standards of noise levels prescribed by CPCB for day time and all location for night time. The high noise level can be attributed to vehicular movements, ground levelling work being undertaken nearby the site and high wind movement on the day of monitoring.

4.2.3 Water Quality

Ground water is an essential and vital component of our life support system. The ground water resources are being utilized for drinking, irrigation and industrial purposes. However, due to rapid growth of population, urbanization, industrialization and agricultural activities, ground water resources are under stress. Overexploitation of ground water may result in increase in salinity and contamination of ground water.

One (01) sample each of ground water, surface water and drinking water were collected to assess the water quality at site and around the project area. Sample of groundwater was examined for physico-chemical, heavy metals and biological parameters as per standard testing procedures and compared to Drinking Water Standards, IS 10500: 2012.

Table 4-8 presents the results of analysis of the ground water sample which are compared with acceptable and permissible limits as specified in the drinking water standards IS 10500:2012.

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

S. No.	Parameters	Unit	GW	AL(PL)	SW
1.	Colour	Hazen	<5.0	5 (15)	34.7
2.	Odour	-	Agreeable	Agreeable	Odourless
3.	Taste	-	Agreeable	Agreeable	Unobjectionable
4.	Turbidity	NTU	<1.0	1(5)	84.1
5.	pH	-	7.48	6.5-8.5 (NR)	7.59
6.	Biological Oxygen Demand (BOD)	mg/l	<5	-	14
7.	Chemical Oxygen Demand (COD)	mg/l	12	-	48
8.	Total Dissolved Solids	mg/l	502.0	500 (2000)	456
9.	Total Alkalinity as $CaCO_3$	mg/l	260.8	200 (600)	196.7
10.	Total Hardness as $CaCO_3$	mg/l	410	200 (600)	204
11.	Chloride as Cl	mg/l	39.4	250 (1000)	202
12.	Sulphate as SO_4	mg/l	62	200 (600)	64.4
13.	Fluoride as F	mg/l	0.6	200 (600)	0.4
14.	Nitrate as NO_3	mg/l	12.3	250 (1000)	<0.5
15.	Phenolic Compound as C_6H_5OH	mg/l	BDL	0.001 (0.002)	
16.	Sulphide as S^{2-}	mg/l	<0.2	0.05 (NR)	
17.	Calcium as Ca	mg/l	100	75 (200)	16.0
18.	Magnesium as Mg	mg/l	38.4	30 (100)	39.4
19.	Iron as Fe	mg/l	<0.1	0.3 (NR)	0.15
20.	Mercury as Hg	mg/l	<0.001	0.001 (NR)	
21.	Cadmium as Cd	mg/l	<0.0003	0.003 (NR)	<0.003
22.	Arsenic as	mg/l	<0.01	0.01 (0.05)	<0.01
23.	Lead as Pb	mg/l	<0.01	0.01 (NR)	

S. No.	Parameters	Unit	GW	AL(PL)	SW
24.	Manganese as Mn	mg/l	<0.1	0.1 (0.3)	<0.1
25.	Zinc as Zn	mg/l	<0.05	5 (15)	<0.05
26.	Total Chromium as Cr	mg/l	<0.01	0.05 (NR)	
27.	Copper as Cu	mg/l	<0.04	0.05 (1.5)	<0.04
28.	Boron as B	mg/l	<0.4	0.5 (1.0)	<0.4
29.	Nickel as Ni	mg/l	<0.01	0.02 (NR)	<0.01
30.	Selenium as Se	mg/l	<0.01	0.01 (NR)	<0.01
31.	Free Residual Chlorine	mg/l	<0.1	0.2 (1.0)	<0.1
32.	Aluminium as Al	mg/l	<0.03	0.03 (0.2)	<0.03
33.	Ammonia as N	mg/l	6.3	0.5 (NR)	6.3
34.	Barium as Ba	mg/l	<5	0.7 (NR)	<5
35.	Pesticides	-	ND	- (NR)	
36.	Mineral Oil	mg/l	ND	0.2 (NR)	
37.	Silver as Ag	mg/l	<0.05	0.1 (NR)	
38.	Cyanide as CN	mg/l	<0.05	0.01 (NR)	<0.05
39.	Molybdenum as Mo	mg/l	<0.05	0.07 (NR)	<0.05
40.	Chloramines as Cl_2	mg/l	<4	4.0 (NR)	<4
41.	Polychlorinated Biphenyl (PCB)	mg/l	<0.0005	0.005 (NR)	
42.	Polynuclear aromatic hydrocarbons (PAH)	mg/l	BDL	0.0001 (NR)	
43.	Anionic Detergents as MBAS	mg/l	<0.2	0.2 (1.0)	<0.2
44.	Total Coliform	MPN/100 ml	<0.01	Shall not be detectable in any 100 ml sample	0
45.	E. Coli	-	Absent	Shall not be detectable in any 100 ml sample	Absent

Source: Laboratory Results, February 2022, ND- Not Detected

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

Table 4-10: Results of Drinking water Analysis

Sr. No.	Parameters	Unit	Nagpur Village
---	Date of Sampling	---	27.02.2022
---	Sample Code	---	NIL/W /02/22/289
1	pH	---	7.4
2	Colour	Hazen	<5
3	Odour	---	Agreeable
4	Taste	---	Agreeable
5	Turbidity	NTU	<1.0
6	Total Dissolved Solids	mg/lit	368
7	Total Hardness	mg/lit	256
8	Total Alkalinity	mg/lit	265
9	Chloride	mg/lit	25.6
10	Calcium	mg/lit	64
11	Magnesium	mg/lit	23
12	Fluoride	mg/lit	0.8
13	Nitrate	mg/lit	<0.5
14	Sulphate	mg/lit	40.7
15	Residual Free Chlorine	mg/lit	<0.1

16	Chloramines	mg/lit	<4
17	Cyanide	mg/lit	<0.05
18	Total Phosphorus	mg/lit	<3.0
19	Ammonia	mg/lit	<0.4
20	BOD	mg/lit	<5
21	COD	mg/lit	12
22	Anionic Detergents	mg/lit	<0.2
23	Aluminium	mg/lit	<1
24	Manganese	mg/lit	<0.1
25	Iron	mg/lit	<0.1
26	Nickel	mg/lit	<0.01
27	Copper	mg/lit	<0.04
28	Boron	mg/lit	<0.4
29	Zinc	mg/lit	<0.1
30	Arsenic	mg/lit	<0.001
31	Selenium	mg/lit	<0.01
32	Molybdenum	mg/lit	<0.05
33	Cadmium	mg/lit	<0.003
34	Silver	mg/lit	<0.05
35	Barium	mg/lit	<0.1
36	Sulphide	mg/lit	<0.2
37	Lead	mg/lit	<0.01
38	Mercury	mg/lit	<0.001
39	Polychlorinated Biphenyls	mg/lit	<0.0005
40	Chromium (as Cr)	mg/lit	<0.01
41	E Coli	--	Absent
42	Total Coliform	MPN/100ml	<1.8
43	Pesticides		
i	Alachlor	µg/l	BDL
ii	Atrazine	µg/l	BDL
iii	Aldrin	µg/l	BDL
iv	Alpha HCH	µg/l	BDL
v	Beta HCH	µg/l	BDL
vi	Butachlor	µg/l	BDL
vii	Chlorpyriphos	µg/l	BDL
viii	Delta HCH	µg/l	BDL
ix	Gamma-HCH	µg/l	BDL
x	2,4-Dichlorophrnoxyacetic acid	µg/l	BDL
xi	DDT	µg/l	BDL
xii	Endosulfan	µg/l	BDL
xiii	Ethion	µg/l	BDL
xiv	Isoproturon	µg/l	BDL
xv	Malathion	µg/l	BDL
xvi	Methyl parathion	µg/l	BDL
xvii	Monocrotophos	µg/l	BDL
xviii	Phorate	µg/l	BDL

Source: Laboratory Results, February 2022, ND- Not Detected

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

Inference

Table above gives the results of the surface and ground water testing and it can be seen that the pH value of the sample was observed to be within the prescribed range, indicating neutral balance. The hardness and total dissolved solids (TDS) value in the groundwater sample exceeds the permissible limit. Chemical parameters such as sulphide and magnesium were noted to be exceeding the permissible limit. Calcium was noted to be

exceeding the acceptable limit but is within the permissible limit. Other heavy metal parameters such as Selenium, Fluoride, boron was detected in the groundwater sample but were noted to be within acceptable limit. The groundwater sample does not show the presence of faecal coliforms implying that there is no faecal contamination in the groundwater. All other parameters were observed to be within the acceptable limits as specified in the drinking water standard of IS 10500:2012

For the drinking water parameters, total hardness and alkalinity were on the higher side of acceptable limit. Thus treatment of water will be required before its usage as drinking water.

4.2.4 Soil Environment

Soil samples from one (01) location as mentioned in ***Table 4-2*** were collected and analysed to evaluate the soil quality for physio-chemicals and heavy metals concentration in soil in the environment study area.

The physical and chemical characteristics of the soil samples were evaluated and compared with the standard soil classification provided by the Indian Council of Agricultural Research (ICAR) as depicted in the ***Table 4-9*** below***:***

Table 4-11: Standard Soil Classification

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

Source: Indian Council of Agricultural Research, New Delhi

The results of soil quality analysis have been presented in the ***Table 4-10*** below:

Table 4-12: Results of Soil quality analysis

S. No.	Parameters	Unit	Concentration
1	pH at 25ºC	-	7.50
2	Electrical Conductivity	mmhos/cm	117.2
3	Texture	-	Solid
4	Phosphate (as PO_4)	Mg/kg	26.8
5	Potassium (as K)	mg/kg	137.57
6	Sodium (as Na)	mg/kg	4546.8
7	Copper (as Cu)	Mg/kg	133.3
8	Zinc (as Zn)	Mg/kg	109.3
9	Iron (as Fe)	Mg/kg	51360
10	Manganese (as Mn)	Mg/kg	1419
11	Lead (Pb)	Mg/kg	17.9
12	Nickel (Ni)	Mg/kg	44.1
13	Barium (Ba)	Mg/kg	<1
14	Arsenic (As)	Mg/kg	BDL
15	Cadmium (Cd)	Mg/kg	<5

16	Chromium (Cr)	Mg/kg	67.9
17	Mercury (Hg)	Mg/kg	BDL
18	Nitrates	Mg/kg	5.38
19	Nitrites	Mg/kg	0.45
20	Cation Exchange Capacity	Meq/100g	83.23
21	Permeability	Cm/sec	0.03
22	Porosity	%	16.55
23	**Particle Size Distribution**		
	Sand	%	93.14
	Silt	%	4.72
	clay	%	2.14

Source: Laboratory Results, February 2022 BDL = Below Detection Limit

Inference

It can be inferred from the results that the soil samples show different characteristics. The pH values of the soil sample is 7.50 and the samples indicate soil to be in saline conditions. Electrical conductivity of soil samples indicates that soil at the project site can be injurious to most crops and thus indicates high salinity of soil and the soil around the project site falls under Normal category. The Phosphate value in the samples is under a healthy category which falls in between 25-50 ppm. Nitrate values in the samples ranges from 5.38 mg/kg whereas Nitrites were detected in a very small quantity, which is a good thing because this can be. Nitrate and nitrite dissolve easily in water and will therefore move quickly through the soil into surface water and groundwater. The relatively high Sodium concentration in Soil sample at the project site indicates highly sodic soil and indicates that the soil has poor soil structure with low infiltration rate and aeration and thus the soil is not suitable for cultivation of many crops. High sodium concentration in soil can also be attributed to salty groundwater at the site. Heavy metals such as chromium, cadmium, were detected.

As per the Soil texture diagram (shown below in the ***Figure 4-10***) prescribed by the United States Department of Agriculture (USDA), it can be deciphered that the texture of soil sample (around the Project site) is “Sandy”.

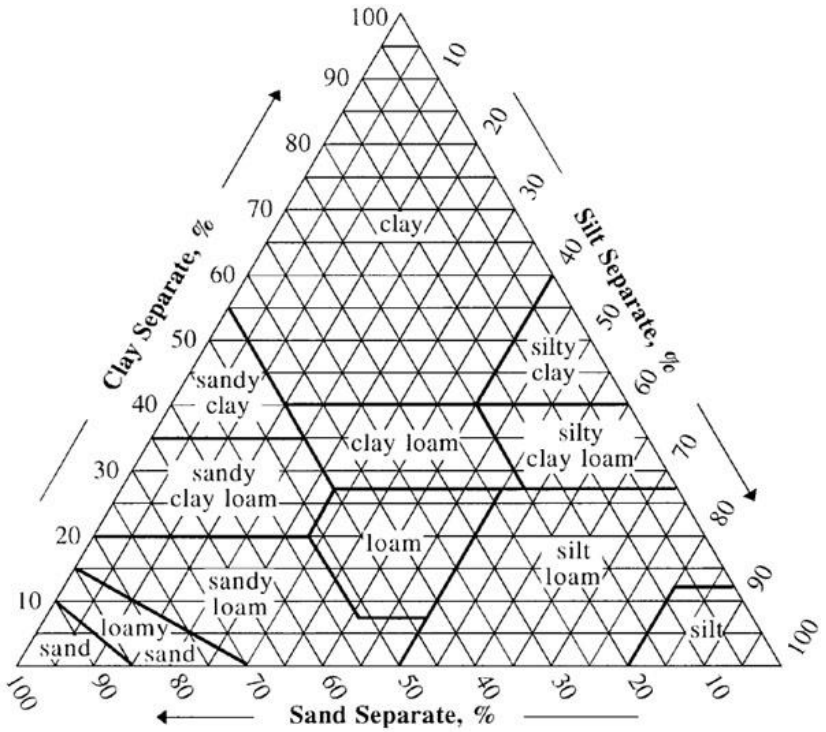


Figure 4-15: Soil Texture Diagram

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

4.2.5 Traffic

The project will involve transportation of solar panels and other components on trucks/trailers through village roads during peak construction phase. During the operation phase, traffic movement for the project activities will be restricted only to the movement of project vehicles and materials for maintenance. The proposed Solar Project is connected through State Highway 11 (SH-11) which passes through the Raipur village and connects to Bhadgaon village at 2.88 km from the site.

Assessment of existing traffic conditions in the project area was undertaken to identify the problems with respect to traffic movement and to formulate the possible alternative solutions and the need for organizing the same in an efficient and economical manner. A traffic volume count survey was conducted at two locations,

- at the intersection of the state highway (SH-11) and gravel road to Bhadgaon village site location and;
- similarly at the Nagpur village where the village road to where the project site is located.

These roads will be used for transportation of the construction materials during construction phase and is the main connecting road for the site. The two-way traffic volume counts were recorded for twenty-four hours (8:00 am to 8:00 pm), once during the study period to assess the existing traffic composition.

The traffic monitored has been divided into the following four (4) categories/classes:

- Two wheelers (motor cycle, scooters);
- Three wheelers (auto rickshaw, motorized cart);
- Light commercial vehicle (LCV);
- High commercial vehicle (HCV);

- Non motor vehicle;

Since the vehicles are of different types, a factor needs to be accounted for each of them in order to express them at par in single unit terms. The factors, commonly known as Passenger Car Unit (PCU) factors that are generally adopted have been given in the following ***Table 4-11***.

Table 4-13: PCU Factors adopted for Traffic Volume Survey

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

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

The hourly traffic volume counts have been furnished in the following ***Table 4-12 and Figure 4-11*** below.

Table 4-14: Hourly Traffic Volumes (Bhadgaon Site location)

Location: State highway connecting Bhadgaon land parcel

Date of Monitoring: 12/04/2022

TIME	PCU's IN 24 Hrs, (Hourly Data)				
	TWO WHEELERS	THREE WHEELERS	LCV'S	HCV'S	NON-MOTOR VEHICLE
06:00 - 07:00	20.25	4.8	17	18.5	0
07:00 - 08:00	33.75	1.2	12	18.5	4
08:00 - 09:00	58.5	7.2	35	48.1	2
09:00 - 10:00	83.25	7.2	35	37	6
10:00 - 11:00	74.25	8.4	32	14.8	0
11:00 - 12:00	67.5	2.4	32	18.5	0
12:00 - 13:00	56.25	4.8	25	33.3	2
13:00 - 14:00	51	2.4	30	22.2	0
14:00 - 15:00	35.25	4.8	27	37	0
15:00 - 16:00	35.25	3.6	29	22.2	0
16:00 - 17:00	36	1.2	31	48.1	2
17:00 - 18:00	50.25	4.8	26	18.5	6
18:00 - 19:00	63.75	2.4	36	18.5	0
19:00 - 20:00	64.5	0	23	22.2	0
20:00 - 21:00	35.25	1.2	20	18.5	0
21:00 - 22:00	24	1.2	26	18.5	0
22:00 - 23:00	10.5	0	15	3.7	0

Location: State highway connecting Bhadgaon land parcel

Date of Monitoring: 12/04/2022

TIME	PCU's IN 24 Hrs, (Hourly Data)				
	TWO WHEELERS	THREE WHEELERS	LCV'S	HCV'S	NON-MOTOR VEHICLE
23:00 - 00:00	17.25	0	9	7.4	0
00:00 - 01:00	8.25	0	10	22.2	0
01:00 - 02:00	3	0	10	0	0
02:00 - 03:00	0	0	6	11.1	0
03:00 - 04:00	1.5	0	5	7.4	0
04:00 - 05:00	14.25	1.2	12	22.2	0
05:00 - 06:00	14.25	1.2	10	3.7	0

Source: Laboratory Results, 2020

Table 4-15: *Hourly Traffic Volumes (Nagpur Site location)*

Location: Village Road connecting Nagpur land parcel

Date of Monitoring: 12/04/2022

TIME	PCUs IN 24 Hrs, (Hourly Data)				
	TWO WHEELERS	THREE WHEELERS	LCV'S	HCV'S	NON-MOTOR VEHICLE
06:00 - 07:00	4.5	2.4	9	0	0
07:00 - 08:00	19.5	4.8	11	7.4	4
08:00 - 09:00	20.25	2.4	12	7.4	0
09:00 - 10:00	13.5	3.6	15	11.1	2
10:00 - 11:00	19.5	0	11	0	0
11:00 - 12:00	12	2.4	8	7.4	2
12:00 - 13:00	10.5	1.2	7	22.2	0
13:00 - 14:00	11.25	2.4	7	0	4
14:00 - 15:00	5.25	0	1	0	2
15:00 - 16:00	14.25	2.4	2	0	4
16:00 - 17:00	21.75	1.2	7	3.7	2
17:00 - 18:00	30.75	3.6	14	0	4
18:00 - 19:00	20.25	3.6	13	3.7	2
19:00 - 20:00	13.5	1.2	7	0	0
20:00 - 21:00	6	0	8	3.7	0
21:00 - 22:00	13.5	0	4	7.4	0
22:00 - 23:00	4.5	0	5	3.7	0

Location: Village Road connecting Nagpur land parcel

Date of Monitoring: 12/04/2022

TIME	PCUs IN 24 Hrs, (Hourly Data)				
	TWO WHEELERS	THREE WHEELERS	LCV'S	HCV'S	NON-MOTOR VEHICLE
23:00 - 00:00	3	0	3	0	0
00:00 - 01:00	0	0	0	0	0
01:00 - 02:00	0	0	0	0	0
02:00 - 03:00	0	0	0	0	0
03:00 - 04:00	0	0	0	0	0
04:00 - 05:00	1.5	0	0	0	0
05:00 - 06:00	8.25	0	2	0	0

Table 4-16: Hourly Traffic Volumes (Bhadgaon Site location)

Location: Gravel road to Bhadgaon land parcel

Date of Monitoring: 13/04/2022

TIME	PCUs IN 24 Hrs, (Hourly Data)				
	TWO WHEELERS	THREE WHEELERS	LCV'S	HCV'S	NON-MOTOR VEHICLE
06:00 - 07:00	1.5	0	0	7.4	2
07:00 - 08:00	4.5	0	4	3.7	2
08:00 - 09:00	6.75	0	11	3.7	4
09:00 - 10:00	2.25	0	3	3.7	2
10:00 - 11:00	11.25	0	2	7.4	0
11:00 - 12:00	8.25	0	2	11.1	0
12:00 - 13:00	6	0	9	7.4	0
13:00 - 14:00	1.5	0	2	11.1	0
14:00 - 15:00	5.25	0	4	11.1	0
15:00 - 16:00	8.25	0	3	7.4	4
16:00 - 17:00	6	0	8	25.9	2
17:00 - 18:00	6.75	0	6	3.7	4
18:00 - 19:00	3	0	1	7.4	0
19:00 - 20:00	4.5	0	4	0	0
20:00 - 21:00	0.75	0	2	7.4	0
21:00 - 22:00	0.75	0	0	0	0
22:00 - 23:00	1.5	0	0	0	0
23:00 - 00:00	0.75	0	0	0	0

Location: Gravel road to Bhadgaon land parcel

Date of Monitoring: 13/04/2022

TIME	PCUs IN 24 Hrs, (Hourly Data)				
	TWO WHEELERS	THREE WHEELERS	LCV'S	HCV'S	NON-MOTOR VEHICLE
00:00 - 01:00	0	0	0	0	0
01:00 - 02:00	0	0	0	0	0
02:00 - 03:00	0	0	0	0	0
03:00 - 04:00	0	0	0	0	0
04:00 - 05:00	0	0	0	0	0
05:00 - 06:00	3.75	0	2	0	0

Table 4-17: Hourly Traffic Volumes (Nagpur Site location)

Location: Gravel road to Nagpur land parcel

Date of Monitoring: 13/04/2022

TIME	PCUs IN 24 Hrs, (Hourly Data)				
	TWO WHEELERS	THREE WHEELERS	LCV'S	HCV'S	NON-MOTOR VEHICLE
06:00 - 07:00	0	0	0	0	0
07:00 - 08:00	1.5	0	0	0	0
08:00 - 09:00	3	0	0	0	0
09:00 - 10:00	0	0	0	0	4
10:00 - 11:00	0.75	0	0	0	0
11:00 - 12:00	0	0	0	0	0
12:00 - 13:00	1.5	0	0	0	0
13:00 - 14:00	0	0	0	0	0
14:00 - 15:00	5.25	0	0	0	0
15:00 - 16:00	3.75	0	0	0	4
16:00 - 17:00	3	0	0	0	2
17:00 - 18:00	5.25	0	0	0	0
18:00 - 19:00	2.25	0	0	0	0
19:00 - 20:00	0.75	0	0	0	0
20:00 - 21:00	0	0	0	0	0
21:00 - 22:00	0	0	0	0	0
22:00 - 23:00	0	0	0	0	0
23:00 - 00:00	0	0	0	0	0
00:00 - 01:00	0	0	0	0	0

Location: Gravel road to Nagpur land parcel

Date of Monitoring: 13/04/2022

TIME	PCUs IN 24 Hrs, (Hourly Data)				
	TWO WHEELERS	THREE WHEELERS	LCV'S	HCV'S	NON-MOTOR VEHICLE
01:00 - 02:00	0	0	0	0	0
02:00 - 03:00	0	0	0	0	0
03:00 - 04:00	0	0	0	0	0
04:00 - 05:00	0	0	0	0	0
05:00 - 06:00	0	0	0	0	0

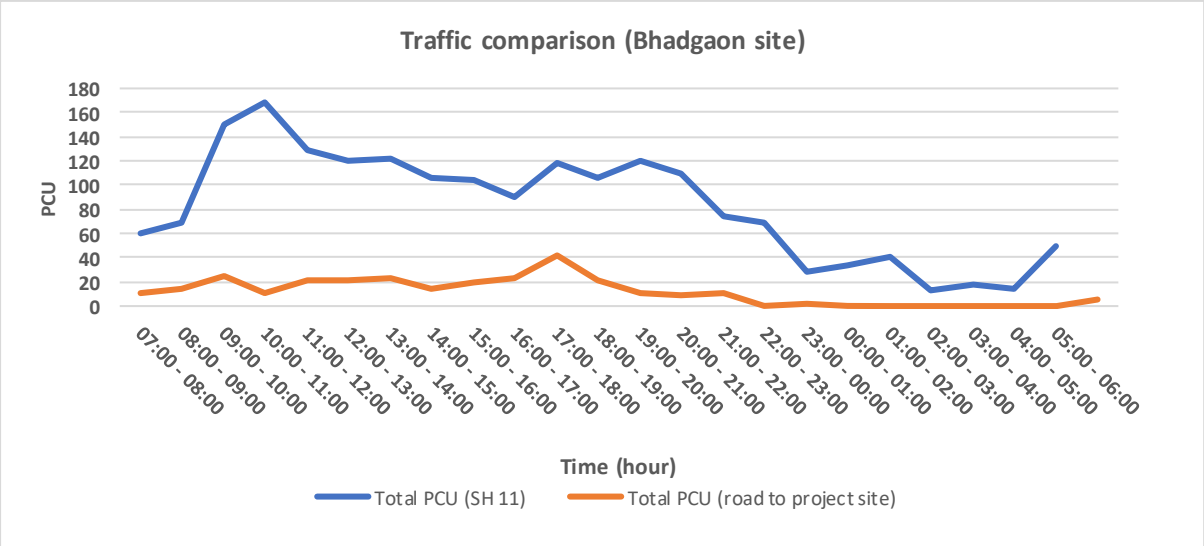


Figure 4-16: Hourly traffic comparison at Bhadgaon site

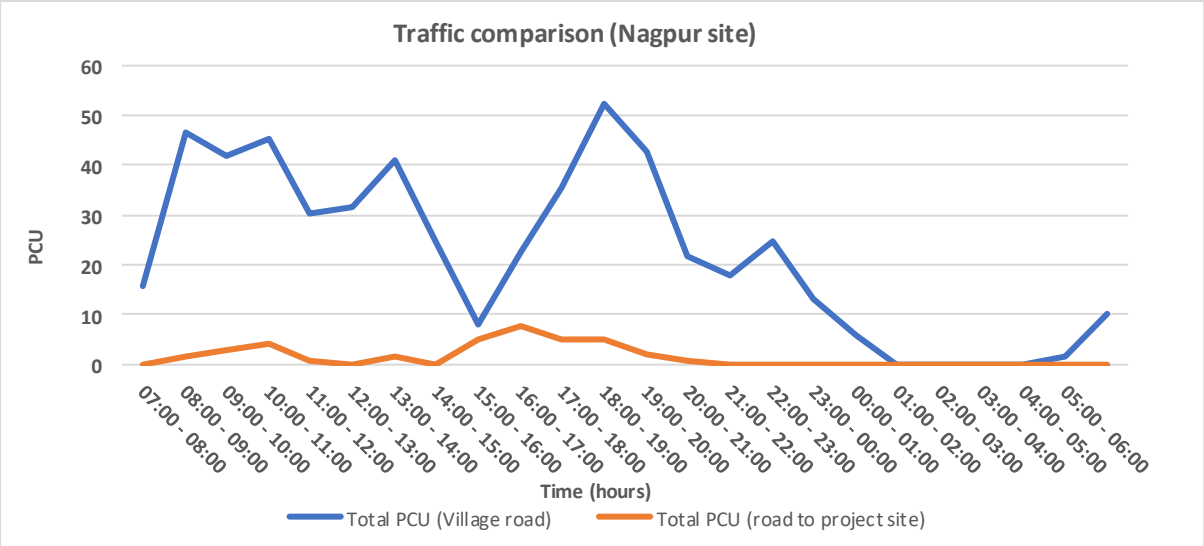


Figure 4-17: Hourly traffic comparison at Nagpur site

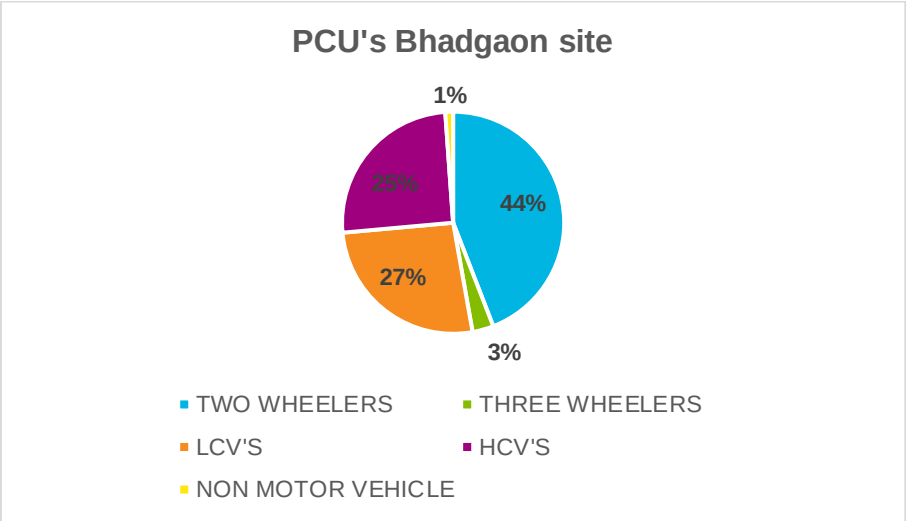


Figure 4-18: Passenger car unit comparison (PCU) of different categories

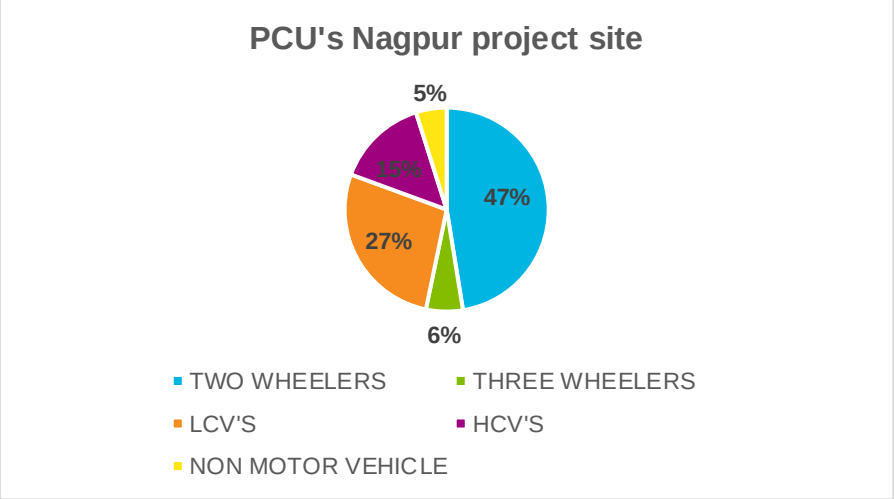


Figure 4-19: Passenger car unit comparison (PCU) of different categories

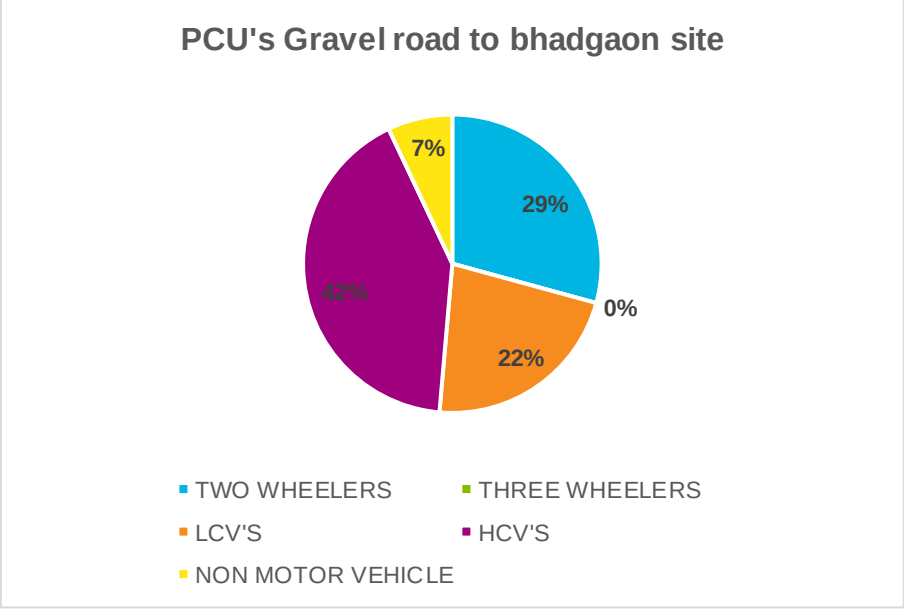


Figure 4-20: Passenger car unit comparison (PCU) of different categories

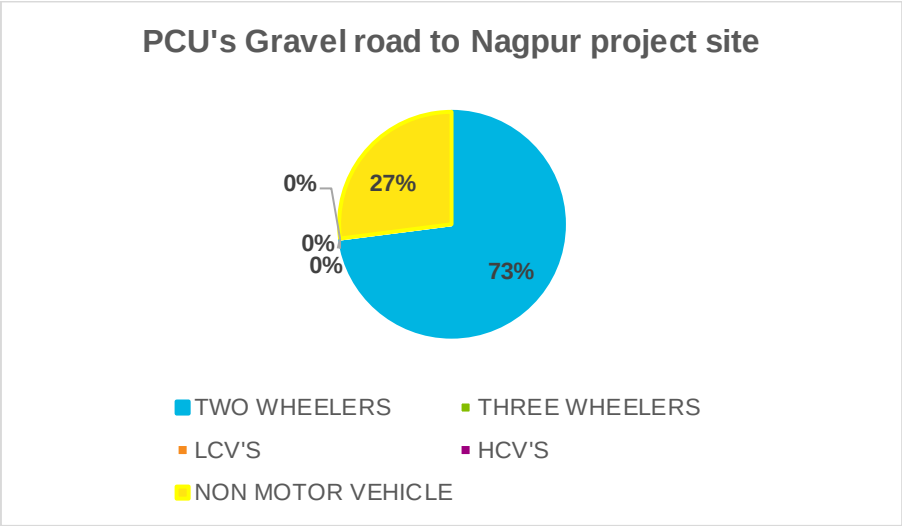


Figure 4-21: Passenger car unit comparison (PCU) of different categories

Inference

Tables above give the hourly recorded data at the locations mentioned. Figures are the graphs which compares the traffic volume between the village/state highway road and the gravel road mostly used for the project purpose and it can be clearly seen that the amount of traffic coming in from the state highway is very less. Peak traffic at the gravel road is seen at twice a day at both the locations, 8:00 to 10:00 AM and 4:30 – 6:30 PM. This can be attributed due the movement of community, trucks carrying materials or construction trucks like pile driving machine, JCB etc. Figure 4-19 to 4-22 gives us an idea as to what specific kind of traffic composition is observed. Traffic volume count observed indicates that out of the total traffic at the Village Road at Nagpur and state highway at Bhadgaon, maximum influx and outflux was observed for light vehicles (Two wheelers and three wheelers) 47% to 5-% of the traffic at the road followed by light commercial vehicles of the traffic. This is followed by Six Wheelers/Heavy Vehicles such as trucks and Buses etc accounting for 25% and 15% at bhadgaon and Nagpur respectively. Further, non-motored vehicles were very few in numbers at the road. Figure 4-21 shows the gravel road used by the vehicles currently and it mostly constitutes the high commercial vehicles, whereas in figure 4-22 as the construction is yet to be started there were no HCV's or LCVs observed.

4.3 Biodiversity Profile

the survey methodology used and describes the project area's existing ecological baseline conditions. This baseline data is further used to predict potential impacts of the project on the ecology of the project area and suggests mitigation measures to reduce the predicted impacts.

4.3.1 Delineation of the Study Area

This sub-section delineates the study area covered by the biodiversity assessment. It also briefly describes the geographical and ecological status of the delineated study area.

The overall area covered by the assessment includes the following constituent areas:

a) Area of Direct Influence: The area coinciding with the footprint of the Project (estimated to contain the potential receptors of any direct Project-related ecological impacts), hereafter referred to as the 'Project Site'; and

a) Area of Indirect Influence: The area extending 5 km outward from the power plant boundary, (estimated to contain the potential receptors of any indirect Project-related ecological impacts), hereafter referred to as the 'Buffer Area'

The Area of Direct Influence and the Area of Indirect Influence are collectively termed as 'Study Area'.

The Study Area forms part of the northern Deccan Plateau region of the State of Maharashtra.

The overall terrain is flat to gently undulating, interrupted by occasional knolls or small hills. The overall slope of the land is from south to north. The elevation ranges from 375m to 595m amsl. The climate is semi-arid, hot and dry, with low rainfall. The soils are rocky, coarse and largely basaltic.

The Study Area represents a predominantly agricultural landscape, characterized by arable lands, pasturelands, plantations and rural habitations. Fallow or disused arable lands support shrubland and scattered trees. Hill-top plateaus support grasslands, while hill-slopes support near-natural forests.

The terrestrial habitat of the Study Area is fragmented mainly by roads, habitation and solar power plants, while its aerial envelope is interrupted mainly by power lines and transmission pylons.

4.3.2 Methodology

This sub-section describes the methodology used for collecting the primary and secondary data on which the biodiversity baseline of the Study Area is based. The secondary data was collated from suitably authenticated public domain sources, as also, informal consultations with local government officials and members of the local community.

The primary and secondary data collection with respect to species was limited to the higher flora, namely angiosperms, and the higher fauna, namely vertebrates.

4.3.2.1 Primary Data

The primary biodiversity data was collected through qualitative sampling at nineteen (19) sites in the Study Area. The sites were selected through stratified random sampling, governed by considerations of safety and accessibility. At each site, primary observations on species, habitats and ecosystem services were recorded.

The primary data was recorded during 21-24 February 2022. The timings of the primary data collection covered the entire diurnal faunal activity-period, from early morning till late evening, but excluded the nocturnal faunal activity-period. Primary data on both, floristic and faunal species, was recorded through the visual encounter method. Primary data records were based on direct sightings of species, as well as, indirect evidence, such as flowers, pods, calls, nests, burrows, droppings, scats, moults and tracks.

The table below presents the details of the sampling sites along with their location co-ordinates, elevation above the mean sea level (amsl), distance and direction from the Project Site boundary, as well as, the associated habitat type(s).

Table 4-18: Details of the Biodiversity Sampling Sites

Sampling Site ID	Location Co-ordinates	Elevation (amsl)	Distance (m) & Direction from Nearest Point on Project Site Boundary	Habitat Type/s
BD1	21° 2.581'N, 74° 23.609'E	450m	660m, SE (Bhadgaon)	Permanent Inland Wetland
BD2	21° 2.381'N, 74° 24.363'E	451m	1680m, W (Nagpur)	Permanent Inland Wetland
BD3	21° 1.054'N, 74° 23.201'E	494m	3350m, S (Bhadgaon)	Shrubland
BD4	21° 4.301'N, 74° 24.505'E	408m	1650m, NE (Bhadgaon)	Permanent Inland Wetland
BD5	21° 5.099'N, 74° 24.232'E	394m	2813m, NE (Bhadgaon)	Permanent Inland Wetland
BD6	21° 5.212'N, 74° 22.963'E	408m	2509m, N (Bhadgaon)	Permanent Inland Wetland
BD7	21° 5.058'N, 74° 21.659'E	441m	3597m, NW (Bhadgaon)	Shrubland
BD8	21° 5.584'N, 74° 21.114'E	446m	4965m, NW (Bhadgaon)	Shrubland
BD9	21° 2.263'N, 74° 21.032'E	508m	3381m, SW (Bhadgaon)	Shrubland
BD10	21° 1.679'N, 74° 24.698'E	458m	1769m, SW (Nagpur)	Seasonal Inland Wetland
BD11	21° 1.947'N, 74° 25.841'E	438m	1043m, SE (Nagpur)	Seasonal Inland Wetland
BD12	21° 1.186'N, 74° 26.568'E	440m	2995m, SE (Nagpur)	Plantations

BD13	21° 0.764'N, 74° 27.394'E	425m	4459m, SE (Nagpur)	Tropical Dry Forest
BD14	21° 2.765'N, 74° 27.460'E	365m	3066m, E (Nagpur)	Arable Land
BD15	21° 2.666'N, 74° 26.061'E	413m	661m, E (Nagpur)	Seasonal Inland Wetland, Shrubland
BD16	21° 4.990'N, 74° 25.900'E	378m	2975m, NE (Nagpur)	Permanent Inland Wetland
BD17	21° 5.535'N, 74° 25.318'E	381m	3918m, N (Nagpur)	Tropical Dry Forest
BD18	21° 4.865'N, 74° 27.255'E	362m	4146m, NE (Nagpur)	Tropical Dry Forest
BD19	21° 3.805'N, 74° 26.336'E	385m	1690m, NE (Nagpur)	Permanent Inland Wetland, Shrubland

Source: AECOM Primary Survey

Figure 4-23 presents a map indicating the locations of the biodiversity sampling sites vis-à-vis the Study Area.

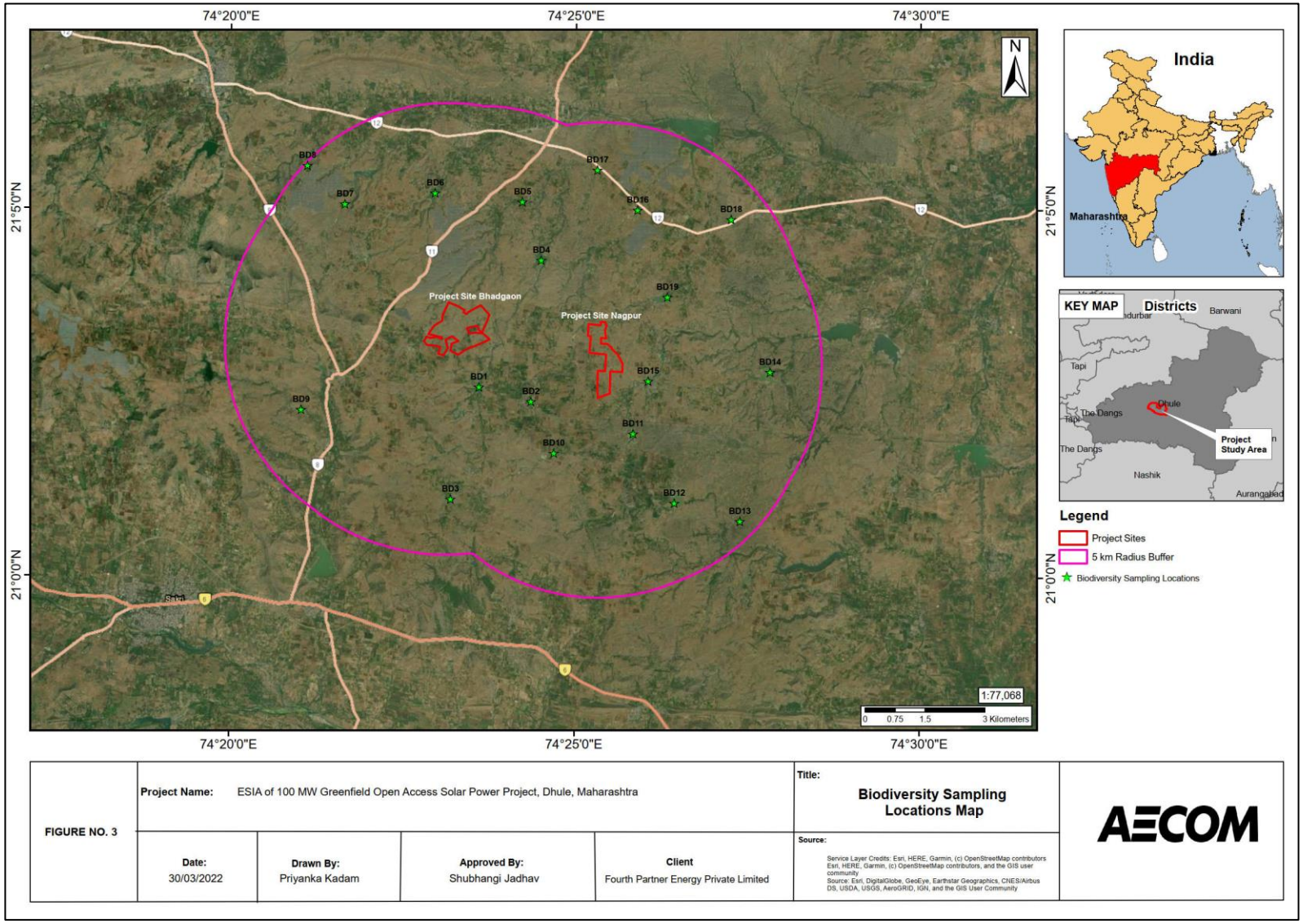


Figure 4-23: Map of the Biodiversity Sampling Locations in the Study Area

4.3.2.2 Secondary Data

Study Area-specific secondary data was collected, as available, from the Divisional Forest Department office, project site-personnel and members of the local community. Additional suitably authenticated secondary data was collated from sources in the public domain, including research journals, standard field guides, scientific reports by research institutions and forest department offices, and websites maintained by internationally recognized conservation organizations, such as International Union for Nature and Natural Resources (IUCN), Alliance for Zero Extinction, World Wide Fund for Nature (WWF-India), Birdlife International and Wetlands International.

The information sources quoted in this report are listed after the corresponding reportage throughout the report.

4.3.3 Species Profile of the Study Area

This sub-section describes the reported and recorded floristic and faunal species of the Study Area.

4.3.3.1 Floristic Species

The floristic species profile is based on the forest-types reported from the Study Area and the floristic species recorded in the Study Area as part of the primary data.

Reported Forest Types

According to the Champion and Seth Classification of Indian Forests, the natural vegetation of the Study Area is classifiable into the following forest-types:

Type 5/DS1 [Subtype DS1 -Dry Deciduous Scrub of Group 5- Tropical Dry Deciduous Forests]

This forest type occurs throughout the dry deciduous forest zone of India. This forest type is usually characterised with a low broken soil cover of shrubby growth 3-6 m high including some tree species reduced to similar conditions, usually many stemmed from the base. Thin grass occurs throughout.

Species characteristic of this forest subtype include:

Tree species: *Acacia nilotica* subsp. *cupressiformis*, *Azadirachta indica, Dalbergia sissoo, Prosopis juliflora, Vachellia catechu, V. leucophloea, V. nilotica* and *Ziziphus jujuba*;

Shrub species:*Calotropis gigantea, C. procera, Capparis decidua, Capparis zeylanica, Commiphora mukul, Crotalaria burhia, Euphorbia* spp., *Grewia tenax, G. villosa, Gymnosporia spinosa, Leptadenia pyrotechnica, Sericostoma pauciflorum, Tephrosia purpurea* and *Ziziphus nummularia*; and

Herb and grass species: *Aerva javanica, Aristida spp., Barleria prionitis, Cenchrus barbatus, Cymbopogon* spp., *Dactyloctenium scindicum, Eleusine compressa, Eragrostis* spp., *Grangea maderaspatana, Heteropogon contortus, Justicia* spp., *Lasiurus hirsutus, Peristrophe bicalyculata, Solanum virginianum* and *Tragia* spp.

Type 6A/DS2 [Subtype DS2 – Southern Euphorbia Scrub of Subgroup 6A – Southern Tropical Thorn Forests]

This is a degradation type of an open forest in which thorny usually hardwooded species predominate, Acacia spp. being particularly characteristic. This type represents a very open formation in which fleshy Euphorbias are the most important constituent. The thorny Acacias and their associates also occur but are more than usually stunted and form widely spaced low rounded bushes. Much of the soil cover is bare but there is usually a thin cover of wiry grasses.

Species characteristic of this forest subtype include:

Tree species: *Prosopis juliflora, Vachellia catechu, V. leucophloea, V. nilotica* and *Ziziphus jujuba*;

Shrub species: *Euphorbia neriifolia, Senna auriculata, Ziziphus nummularia;* and

Grass species: *Aristida* spp., *Eleusine* spp. and *Eragrostis* spp.
As per the IUCN Habitat Classification system, both the said forest types qualify as Tropical Dry Forests.

Recorded Floral Species

A total of 38 floral species were recorded in the Study Area during the primary survey. These include 19 woody species, which would be part of the perennial groundcover of the Study Area, and 19 non-woody species, which would be part of the annual or seasonal groundcover of the Study Area.

Table below presents the details of the floral species, including the scientific and common name, botanical family to which each species is assigned and its conservation status as per the IUCN Red List.

Table 4-19: Floral Species recorded in the Study Area

S. No.	Scientific Name	Common Name	Family	IUCN Status*
Woody Species				
1	*Acacia nilotica*	Gum Arabic Tree	Fabaceae	LC
2	*Acacia nilotica* subsp. *cupressiformis*	-	Fabaceae	NA
3	*Albizia lebbeck*	Indian Siris	Fabaceae	LC
4	*Azadirachta indica*	Neem	Meliaceae	LC
5	*Calotropis gigantea*	Crown Flower	Apocynaceae	NA
6	*Dalbergia sissoo*	Shisam	Fabaceae	LC
7	*Eclipta prostrata*	-	Asteraceae	LC
8	*Euphorbia neriifolia*	Indian Spurge Tree	Euphorbiaceae	LC
9	*Euphorbia tirucalli*	Pencil Tree	Euphorbiaceae	LC
10	*Gliricidia sepium*	Mexican Liliac	Fabaceae	LC
11	*Ipomoea carnea*	Bush Morning Glory	Convolvulaceae	NA
12	*Lantana camara*	Lantana	Verbenaceae	NA
13	*Leucaena leucocephala*	Wild Tamarind	Fabaceae	NA
14	*Prosopis juliflora*	Algaroba	Fabaceae	NA
15	*Senegalia catechu*	Black Cutch Tree	Fabaceae	LC
16	*Senna auriculata*	Tanner's Cassia	Fabaceae	NA
17	*Tectona grandis*	Teak	Lamiaceae	NA
18	*Vachellia leucophloea*	White Bark Acacia	Fabaceae	LC
19	*Ziziphus jujuba*	Chinese Date	Rhamnaceae	LC
Non-Woody Species				
20	*Acmella paniculata*	Aachaara	Asteraceae	LC
21	*Alternanthera sessilis*	Sessile Joyweed	Amaranthaceae	LC
22	*Argemone mexicana*	-	Papaveraceae	NA
23	*Bacopa monnieri*	Water Hyssop	Plantaginaceae	LC
24	*Blumea eriantha*	Wool-Flower Blumea	Asteraceae	NA
25	*Carex* sp.	-	Cyperaceae	-

26	*Centella asiatica*	Centella	Apiaceae	LC
27	*Cyperus pumilus*	Dwarf Sedge	Cyperaceae	LC
28	*Echinops echinatus*	Indian Globe Thistle	Asteraceae	NA
29	*Grangea maderaspatana*	-	Asteraceae	LC
30	*Homonoia riparia*	Willow-Leaved Water Croton	Euphorbiaceae	LC
31	*Ludwigia hyssopifolia*	Seed Box	Onagraceae	LC
32	*Nymphoides indica*	Water Snowflake	Menyanthaceae	LC
33	*Phyla nodiflora*	Turkey Tangle Frogfruit	Verbenaceae	LC
34	*Solanum virginianum*	Thorny Nightshade	Solanaceae	NA
35	*Tridax procumbens*	Mexican Daisy	Asteraceae	NA
36	*Trapa natans*	Water Caltrop	Lythraceae	LC
37	*Typha angustifolia*	Lesser Bulrush	Typhaceae	LC
38	*Wedelia trilobata*	Yellow Dot	Asteraceae	NA

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

Sources: AECOM Primary Survey, AECOM Primary Survey; IUCN (2021). The IUCN Red List of Threatened Species. Version 2021-3; The Plant List - http://www.theplantlist.org/

Figure 4-24 presents a photographic log of some of the floral species recorded in the Study Area.

Euphorbia tirucalli

Prosopis juliflora

Argemone mexicana

Echinops echinatus

Senna auriculata

Solanum virginianum

Figure 4-24: Some Floral Species recorded in the Study Area

Source: AECOM Primary Survey

4.3.3.2 Faunal Species

This section of the report presents the higher faunal species, namely vertebrates, comprising mammals, birds, reptiles, amphibians and fishes, having reported ranges that overlap the Study Area. The detailed species-tables are provided as annexures to this report. Each annexed table gives the scientific and common names of each species, the conservation status assigned to it by the International Union for Nature and Natural Resources (IUCN) and the Schedule of the Wildlife Protection Act, 1972 (WPA) under which it is listed. Names of the species recorded as part of the primary data appear in **bold** font in each table.

Mammals

At least seventy-three (73) species of mammals have reported ranges that fully or partially overlap the Study Area.

Significant species with respect to the IUCN Red List include 1 species designated as Endangered and 5 species as Vulnerable. Significant species with respect to the WPA include 10 species listed in Schedule I.

None of these species was recorded during the primary survey.

Appendix B presents details of the mammal species of the Study Area.

Birds

At least three hundred and thirty-three (333) species of birds, comprising 208 resident species and 125 migratory species, have reported ranges that fully or partially overlap the Study Area.

Significant species with respect to the IUCN Red List include 5 species designated as Critically Endangered,3 species as Endangered and 8 species as Vulnerable. Significant species with respect to the WPA include 12 species listed in Schedule I.

24 species of birds were recorded during the primary survey.

Appendices C and D present details of the resident and migratory bird species respectively of the Study Area.

Reptiles

At least sixty-five (65) species of reptiles have reported ranges that fully or partially overlap the Study Area.

Significant species with respect to the IUCN Red List include 2 species as Vulnerable. Significant species with respect to the WPA include 4 species listed in Schedule I.

None of these species was recorded during the primary survey.

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

Amphibians

At least fifteen (15) species of amphibians have reported ranges that fully or partially overlap the Study Area.

None is significant with respect to the IUCN Red List or the WPA Schedule I.

None of these species was recorded during the primary survey.

Appendix F presents details of the amphibian species of the Study Area.

Fishes

At least forty (40) species of fishes have reported ranges that fully or partially overlap the Study Area.

Significant species with respect to the IUCN Red List include 1 species designated as Vulnerable. None of the recorded species is listed in Schedule I of the WPA.

None of these species was recorded during the primary survey.

Appendix G presents details of the fish species of the Study Area.

4.3.3.3 Invasive Alien Species

At least six (06) species, comprising five (05) floristic species and one (01) faunal species, reported from the Study Area, are designated as invasive alien species with respect to the Study Area.

All the said species were recorded as part of the primary data.

Table below lists the invasive alien species of the Study Area, along with the vernacular name of each species, the conservation status assigned to it by the International Union for Nature and Natural Resources (IUCN) and its native range. The floral and faunal species are listed in separate sections.

Table 4-20: Invasive Alien Species of Study Area

SN	Scientific Name	Vernacular Name	IUCN Status	Native Range
Floristic Species				
1	*Gliricidia sepium*	Undirmari	Least Concern	Mexico and Colombia
2	*Lantana camara*	Ghaneri	Not Evaluated	Central and South America
3	*Leucaena leucocephala*	Subabhul	Not Evaluated	Mexico and Central America
4	*Prosopis juliflora*	Vilayati Shami	Not Evaluated	Central and South America
5	*Wedelia trilobata*	Wedelia	Not Evaluated	South America and West Indies
Faunal Species				
6	*Columba livia*	Kabootar	Least Concern	Europe

Sources: AECOM Primary Survey; IUCN (2021). The IUCN Red List of Threatened Species. Version 2021-3; Global Invasive Species Database, Invasive Species Specialist Group, IUCN; CABI Invasive Species Compendium; Invasive Alien Species of India, National Biodiversity Authority, Ministry of Environment, Forests and Climate Change, Government of India.

4.3.4 Habitat Profile of the Study Area

The habitat-profile of the Study Area represents a mosaic of natural, near-natural and modified habitats. Each of these types include both, terrestrial and aquatic habitats. The habitats of the Study Area are fragmented mainly by metalled roads, dirt roads, foot-trails and canals, while the aerial envelope of the study area is mainly interrupted by power distribution lines, pylons and transmission towers.

Figures 4-25 presents a map depicting the habitat profile of the Study Area.

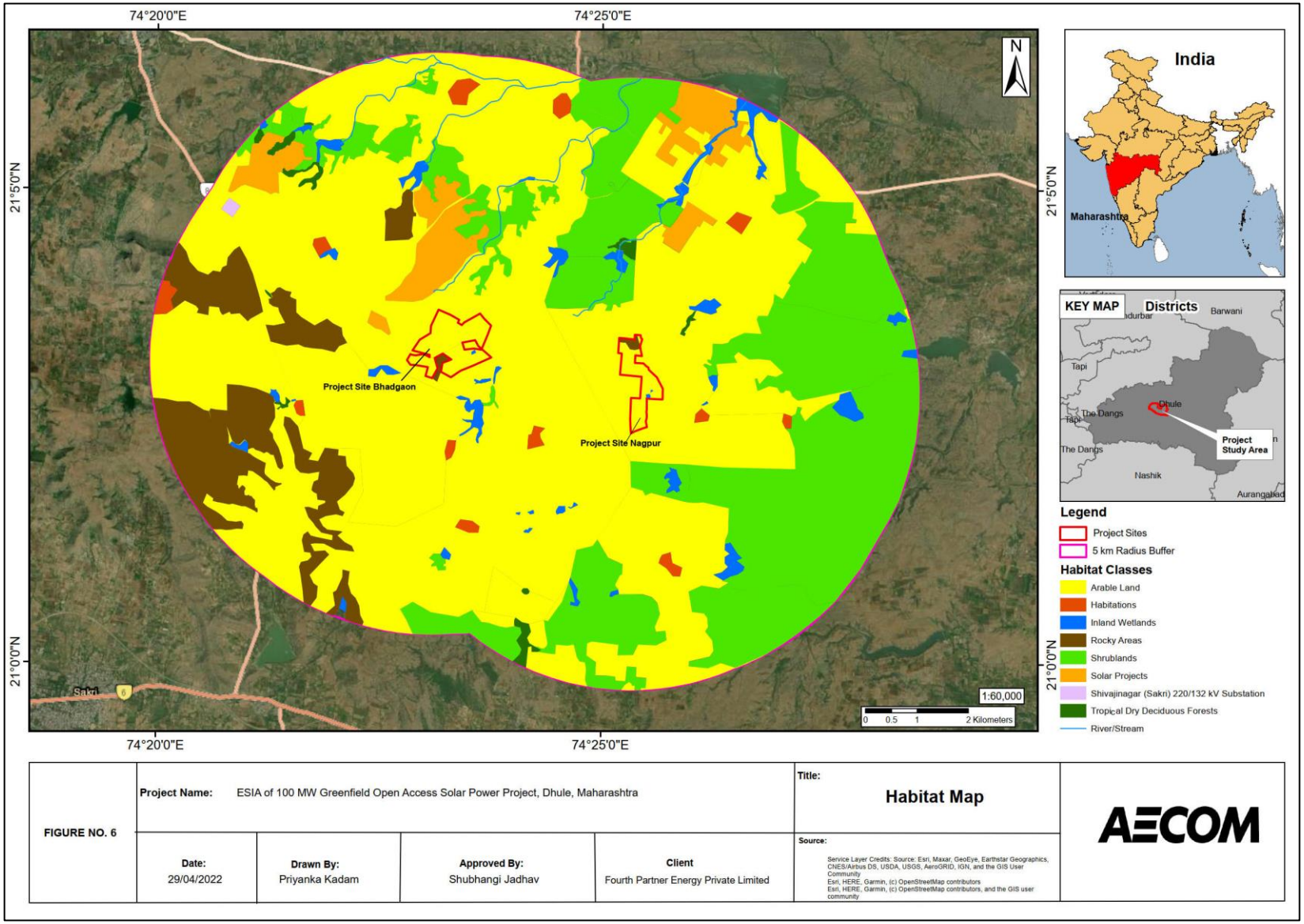


Figure 4-25: Habitat Profile of the Study Area

4.3.4.1 Natural Habitats

As defined by the applicable reference frameworks, natural habitats consist of land and water areas where the biological communities are formed largely by native plant and animal species, and where human activity has not essentially modified the area's primary ecological functions.

Natural and near-natural habitats constitute approximately 36% of the Study Area. These consist of relic patches of forests, shrublands, grasslands, rocky areas and inland wetlands. The inland wetlands consist of seasonal or permanent lakes and seasonal streams. The western portion of the Bhadgaon component of the Project Site overlaps a section of a seasonal stream, while its eastern portion overlaps a seasonal lake. The central portion of the Nagpur component of the Project Site overlaps 2 seasonal lakes. The natural habitats of the Study Area are likely to be supporting habitat specialist species.

Figure 4-2626 presents a photographic log of some of the natural habitats recorded in the Study Area during the primary survey.

Rocky Areas of Rawlya-Javlya Hill in the Study Area

Rocky Area within the Bhadgaon Project Site

Seasonal stream in Bhadgaon component of Project Site

Seasonal Lake in the Study Area

Permanent Lakes in the Study Area

Shrublands in the Study Area

Forest in the Study Area

Grasslands in the Study Area

Figure 4-26: Natural Habitats in the Study Area

Source: AECOM Primary Survey

4.3.4.2 Modified Habitats

As defined by the applicable reference frameworks, modified habitats consist of areas where the natural habitat has apparently been altered, often through the introduction of alien species of plants and animals.

Modified habitats constitute approximately 64% of the Study Area. These consist of arable land, rural habitation, urban areas and inland wetlands. The inland wetlands consist mainly of seasonal ponds. The modified habitats of the Study Area are likely to be supporting generalist species.

Figure 4-2627 presents a photographic log of some of the modified habitats recorded in the Study Area during the primary survey.

Cultivated Arable Land and Power Transmission Line in the Study Area

Solar Power Plant in the Study Area

	
Metalled Road in the Study Area	Dirt Road in the Study Area

Figure 4-27: Modified Habitats in the Study Area

Sources: AECOM Primary Survey

4.3.4.3 Critical Habitats

As per the IFC PS6 Critical Habitat (CH) Criteria 1, 2 and 3, habitats, either natural or modified, that are critical for the survival of IUCN Red List-designated globally threatened species, endemic or restricted range species and migratory and/or congregatory species are potential CH triggers. This section lists species that are potential CH triggers with respect to the Study Area as per CH Criteria 1, 2 or 3.

As per the IFC PS6 CH Criteria 4 and 5, highly threatened or unique ecosystems, as well as, spatial features that support key evolutionary processes, are also potential CH triggers. The data available to this assessment does not indicate presence of any ecosystems or landscapes that may be considered potential CH triggers with respect to the Study Area as per CH Criteria 4 and 5.

CH Screening

The CH Screening presented here is largely based on secondary data collected during the ESIA, as well as the primary survey. The species were screened against CH Criteria 1, 2 and 3, while the Study Area was screened against the Criteria 4 and 5. The geographic range, global population, migratory status, endemicity, and habitat suitability of every species was considered for the screening.

Table 4-2120 presents details of potential CH trigger species along with details such as their IUCN category, extent of occurrence (EOO), habitat, endemicity, global population and migratory or congregatory status.

Table 4-21: Potential CH trigger species

S. No.	Scientific Name	Common Name	IUCN Satus*	Extent of Occurrence (km^2)	Suitable Habitat Type/s**	Endemicity	Global Population (Mature)	Migratory/ Congregatory
Mammals								
1	*Manis crassicaudata*	Indian Pangolin	EN	Not Estimated	F/S/Sh/G/P	-	Not Estimated	-
2	*Lutrogale perspicillata*	Smooth-coated Otter	VU	Not Estimated	F/S/Sh/G/IW/ Mn/Mc/Mi	-	Not Estimated	-
3	*Panthera pardus*	Common Leopard	VU	Not Estimated	F/S/Sh/G/RA/D	-	Not Estimated	-
4	*Rusa unicolor*	Sambar	VU	Not Estimated	F/S/Sh/G/IW/P	-	Not Estimated	-
5	*Semnopithecus hypoleucos achates*	Southern Plains Grey Langur	VU	Not Estimated	F/Sh/RG	-	Not Estimated	-
6	*Tetracerus quadricornis*	Four-horned Antelope	VU	Not Estimated	F/Sh	-	Not Estimated	-
Birds								
7	*Ardeotis nigriceps*	Great Indian Bustard	CR	1,25,00,000	G	-	(50-249)	-
8	*Gyps bengalensis*	White-rumped Vulture	CR	73,70,000	F/S/Sh/G	-	6,000-9,000	C
9	*Gyps indicus*	Indian Vulture	CR	21,50,000	F/S/Sh/G/RA	-	(5,000-15,000)	C
10	*Sarcogyps calvus*	Red-headed Vulture	CR	52,30,000	F/S/Sh/G	-	3,500-15,000	C
11	*Aquila nipalensis*	Steppe Eagle	EN	1,26,00,000	F/S/G/D/RA	-	94,116	M/C
12	*Neophron percnopterus*	Egyptian Vulture	EN	50100000	S/Sh/G/IW/RA/D/AL/PL/U	-	18,600-54,000	C
13	*Sypheotides indicus*	Lesser Florican	EN	5,20,000	G/AL	-	(356-1,228)	-
14	*Amandava formosa*	Green Avadavat	VU	9,34,000	F/Sh/G	-	10,000-19,999	-
15	*Aquila rapax*	Tawny Eagle	VU	5,27,00,000	F/S/Sh/G	-	100,000-999,999	-
16	*Clanga clanga*	Greater Spotted Eagle	VU	1,53,00,000	F/Sh/G/IW/Mi/Mc/AL	-	(3,900-10,000)	M/C
17	*Clanga hastata*	Indian Spotted Eagle	VU	65,60,000	F/IW/PL/AL	-	3,500-15,000	-
18	*Columba eversmanni*	Yellow-eyed Pigeon	VU	3050000	Sh/IW/D/AL	-	10,000-19,999	M
19	*Grus antigone*	Sarus Crane	VU	13800000	G/IW/AL/PL	-	19,000-21,800	C
20	*Marmaronetta angustirostris*	Marbled Teal	VU	14600000	IW/Mc/AL	-	55,000-61,000	M/C
21	*Schoenicola platyurus*	Broad-tailed Grassbird	VU	192000	Sh/G/IW	-	3,500-15,000	-
Reptiles								

22	*Crocodylus palustris*	Mugger	VU	Not Estimated	IW/Mn	-	(5,700-8,700)	-
23	*Lissemys punctata*	Indian Flapshell Turtle	VU	Not Estimated	IW/M	-	Not Estimated	-
Fishes								
24	*Wallago attu*	-	VU	10446620	IW	-	Not Estimated	-

**Status assigned by IUCN where, CR- Critically endangered, EN- Endangered, VU- Vulnerable. **Suitable Habitat Types, where, AL - Arable Land, D-Desert, F-Forest, G-Grassland, IW-Inland Wetland, M-Marine, Mc-Marine Coastal, Mi-Marine Intertidal, Mn-Marine Neritic, P- Plantations, PL-Pasture Land, RA-Rocky Area, RG- Rural Garden, S- Savanna, Sh-Shrubland, U- Urban Area*

Source: IUCN 2021. The IUCN Red List of Threatened Species. Version 2021-3.

CH Criterion 1 – Globally Threatened Species

Globally Threatened Species are defined as species designated by the IUCN Red List as Critically Endangered (CR), Endangered (EN) or Vulnerable (VU). As per CH Criterion 1, an area that supports a globally important concentration of a CR or EN species, as well as an area that supports a globally important concentration of a VU species, the loss of which would lead to the species being designated as EN or CR, both qualify as potential CH.

At least 24 faunal species, including 4 CR species, 4 EN species and 16 VU species, have reported ranges that include the Study Area. None of these was recorded in the Study Area during the primary survey.

Considering the geographic ranges, global populations and suitable habitat types of the concerned globally threatened species as well as inputs received through stakeholder consultations, it is less likely that the habitats of the Study Area support the threshold numbers of any of the said species required to trigger CH Criterion 1 with respect to the Study Area.

Hence, it is less likely that the Study Area contains CH with respect to any potential CH Criterion 1 trigger species reported from the Study Area.

Table below presents details of the globally threatened species of the Study Area, including the scientific and common names of each species and its IUCN Red List status.

Table 4-22: Globally threatened species reported from the Study Area

S. No.	Scientific Name	Common Name	IUCN Category*
Mammals			
1	*Manis crassicaudata*	Indian Pangolin	EN
2	*Lutrogale perspicillata*	Smooth-coated Otter	VU
3	*Panthera pardus*	Common Leopard	VU
4	*Rusa unicolor*	Sambar	VU
5	*Semnopithecus hypoleucos achates*	Southern Plains Grey Langur	VU
6	*Tetracerus quadricornis*	Four-horned Antelope	VU
Birds			
7	*Ardeotis nigriceps*	Great Indian Bustard	CR
8	*Gyps bengalensis*	White-rumped Vulture	CR
9	*Gyps indicus*	Indian Vulture	CR
10	*Sarcogyps calvus*	Red-headed Vulture	CR
11	*Aquila nipalensis*	Steppe Eagle	EN
12	*Neophron percnopterus*	Egyptian Vulture	EN
13	*Sypheotides indicus*	Lesser Florican	EN
14	*Amandava formosa*	Green Avadavat	VU
15	*Aquila rapax*	Tawny Eagle	VU
16	*Clanga clanga*	Greater Spotted Eagle	VU
17	*Clanga hastata*	Indian Spotted Eagle	VU
18	*Columba eversmanni*	Yellow-eyed Pigeon	VU
19	*Grus antigone*	Sarus Crane	VU
20	*Marmaronetta angustirostris*	Marbled Teal	VU
21	*Schoenicola platyurus*	Broad-tailed Grassbird	VU
Reptiles			
22	*Crocodylus palustris*	Mugger	VU

S. No.	Scientific Name	Common Name	IUCN Category*
23	*Lissemys punctata*	Indian Flapshell Turtle	VU
Fishes			
24	*Wallago attu*		VU

**Status assigned by the International Union for Conservation of Nature and Natural Resources, where – CR – Critically Endangered, EN- Endangered and VU-Vulnerable.*
Sources: IUCN (2021) The IUCN Red List of Threatened Species. Version 2021-3.

CH Criterion 2 - Endemic or Restricted Range Species

Species which occur in a limited area are referred to as Endemic or Restricted Range species.

As per the IUCN definition, for terrestrial vertebrates and plants, a restricted-range species is defined as those species that have an extent of occurrence (EOO) less than 50,000 km^2 is considered Endemic or Restricted Range Species. For coastal, riverine, and other aquatic species in habitats that do not exceed 200 km width at any point (e.g., rivers), restricted range is defined as having a global range less than or equal to 500 km linear geographic span (i.e., the distance between occupied locations farthest apart).

None of the species reported from the Study Area meet any of the said definitions. Thus, none of the said species qualify as potential CH trigger species with respect to the Study Area as per CH Criterion 2.

Hence, it is less likely that the Study Area contains CH with respect to any potential CH Criterion 2 trigger species reported from the Study Area.

CH Criterion 3 - Migratory and/or Congregatory Species

Migratory Species

Migratory Species are defined as species of which a significant proportion of its members cyclically and predictably move from one geographical area to another, including within the same ecosystem. The Study Area is located within the Central Asian Flyway. Thus, the Study Area is likely to contain habitats that serve as wintering/summering destination, staging site or flightpaths for the migratory avian species using the said flyways.

At least 125 migratory species, all birds, have reported ranges that include the Study Area. Of these, 4 species were recorded in the Study Area during the primary survey.

Appendix D lists the migratory species of the Study Area. The names of the species recorded during the primary study appear in **bold** font in the annexed table.

Source: http://datazone.birdlife.org/userfiles/file/sowb/flyways/5_Mediterranean_Black_Sea_Factsheet.pdf

Congregatory Species

Congregatory species include species that gather in globally significant numbers at a particular site and at a particular time in their life cycle for feeding, breeding or mid-migration resting. The Study Area contains significantly large extents of shrubland, grassland and desert habitats. Thus, the Study Area is likely to contain habitats of congregatory species associated with the said habitat types.

At least 76 congregatory species have reported ranges that include the Study Area. Of these, 9 species was recorded in the Study Area during the primary survey.

The table below presents details of the congregatory species of the Study Area, including the scientific and common names of each species, its IUCN Red List status and the Schedule of the Wildlife Protection Act, 1972 (WPA) under which it is listed. The names of the species recorded during the primary survey appear in **bold** font.

Table 4-23: Congregatory species reported from the Study Area

S. No.	Scientific Name	Common Name	IUCN Status*	Migratory Status**	WPA Schedule***
1	*Actitis hypoleucos*	Common Sandpiper	LC	W	IV
2	*Amaurornis phoenicurus*	White-breasted Waterhen	LC	R	-
3	*Anas acuta*	Northern Pintail	LC	W	IV
4	*Anas crecca*	Common Teal	LC	W	IV
5	*Anas platyrhynchos*	Mallard	LC	W	IV
6	***Anas poecilorhyncha***	**Indian Spot-billed Duck**	**LC**	**R**	**IV**
7	*Anastomus oscitans*	Asian Openbill	LC	W	IV
8	*Anhinga melanogaster*	Darter	NT	W	IV
9	*Anser indicus*	Bar-headed Goose	LC	W	IV
10	*Anthropoides virgo*	Demoiselle Crane	LC	W	IV
11	***Ardeola grayii***	**Indian Pond Heron**	**LC**	**R**	**IV**
12	*Aythya ferina*	Common Pochard	LC	W	IV
13	*Aythya fuligula*	Tufted Duck	LC	W	IV
14	*Botaurus stellaris*	Eurasian Bittern	LC	W	IV
15	***Bubulcus ibis***	**Cattle Egret**	**LC**	**W**	**IV**
16	*Burhinus indicus*	Indian Thick-knee	LC	R	IV
17	*Butorides striata*	Striated Heron	LC	R	IV
18	*Calidris minuta*	Little Stint	LC	W	-
19	*Calidris temminckii*	Temminck's Stint	LC	W	-
20	*Carpodacus erythrinus*	Common Rosefinch	LC	W	IV
21	*Chlidonias hybrida*	Whiskered Tern	LC	W	-
22	*Ciconia ciconia*	White Stork	LC	W	IV
23	*Ciconia episcopus*	Woolly-necked Stork	NT	R	IV
24	*Ciconia nigra*	Black Stork	LC	W	IV
25	*Circus aeruginosus*	Eurasian Marsh Harrier	LC	W	-
26	*Circus macrourus*	Pallid Harrier	LC	W	-
27	*Circus melanoleucos*	Pied Harrier	LC	W	-
28	*Circus pygargus*	Montagu's Harrier	LC	W	-
29	*Clanga clanga*	Greater Spotted Eagle	VU	W	-
30	*Clanga hastata*	Indian Spotted Eagle	VU	R	-
31	*Dendrocygna bicolor*	Fulvous Whistling-duck	LC	P	IV
32	*Dendrocygna javanica*	Lesser Whistling Duck	LC	R	IV
33	***Egretta garzetta***	**Little Egret**	**LC**	**R**	**IV**
34	***Fulica atra***	**Eurasian Coot**	**LC**	**R**	**IV**
35	*Gallicrex cinerea*	Watercock	LC	R	-
36	*Gallinago gallinago*	Common Snipe	LC	W	IV

S. No.	Scientific Name	Common Name	IUCN Status*	Migratory Status**	WPA Schedule***
37	*Gallinago stenura*	Pintail Snipe	LC	W	IV
38	*Gallinula chloropus*	Common Moorhen	LC	R	-
39	*Gelochelidon nilotica*	Gull-billed Tern	LC	W	-
40	*Grus antigone*	Sarus Crane	VU	R	IV
41	*Gyps bengalensis*	White-rumped Vulture	CR	R	I
42	*Gyps indicus*	Indian Vulture	CR	R	I
43	***Himantopus himantopus***	**Black-winged Stilt**	**LC**	**W**	**IV**
44	*Limosa limosa*	Black-tailed Godwit	NT	W	-
45	*Mareca penelope*	Eurasian Wigeon	LC	W	IV
46	*Merops philippinus*	Blue-tailed Bee-eater	LC	S	-
47	***Microcarbo niger***	**Little Cormorant**	**LC**	**W**	**IV**
48	*Mycteria leucocephala*	Painted Stork	NT	R	IV
49	*Netta rufina*	Red-crested Pochard	LC	W	IV
50	*Nettapus coromandelianus*	Cotton Pygmy-goose	LC	R	IV
51	*Nycticorax nycticorax*	Black-crowned Night Heron	LC	R	IV
52	*Pastor roseus*	Rosy Starling	LC	W	IV
53	*Phalacrocorax carbo*	Great Cormorant	LC	W	IV
54	*Phoenicopterus roseus*	Greater Flamingo	LC	W	IV
55	*Platalea leucorodia*	Eurasian Spoonbill	LC	R	-
56	*Plegadis falcinellus*	Glossy Ibis	LC	R	IV
57	***Porphyrio porphyrio***	**Purple Swamphen**	**LC**	**R**	**-**
58	*Porzana porzana*	Spotted Crake	LC	W	-
59	*Recurvirostra avosetta*	Pied Avocet	LC	W	IV
60	*Rostratula benghalensis*	Greater Painted-snipe	LC	R	IV
61	*Sarcogyps calvus*	Red-headed Vulture	CR	R	IV
62	*Spatula clypeata*	Northern Shoveler	LC	W	IV
63	*Spatula querquedula*	Garganey	LC	W	IV
64	*Sterna aurantia*	River Tern	NT	R	-
65	*Sturnia malabarica*	Chestnut-tailed Starling	LC	W	IV
66	*Tachybaptus ruficollis*	Little Grebe	LC	R	IV
67	***Tadorna ferruginea***	**Ruddy Shelduck**	**LC**	**W**	**IV**
68	*Threskiornis melanocephalus*	Black-headed Ibis	NT	W	IV
69	*Tringa erythropus*	Spotted Redshank	LC	W	-
70	*Tringa glareola*	Wood Sandpiper	LC	W	IV
71	*Tringa nebularia*	Common Greenshank	LC	W	-
72	*Tringa ochropus*	Green Sandpiper	LC	W	IV
73	*Tringa stagnatilis*	Marsh Sandpiper	LC	W	IV

S. No.	Scientific Name	Common Name	IUCN Status*	Migratory Status**	WPA Schedule***
74	*Tringa totanus*	Common Redshank	LC	W	-
75	*Vanellus indicus*	Red-wattled Lapwing	LC	R	-
76	*Vanellus malabaricus*	Yellow-wattled Lapwing	LC	R	-

Status assigned by the International Union for Conservation of Nature and Natural Resources, where – CR – Critically Endangered, VU- Vulnerable, NT-Near Threatened, LC-Least Concern. **Migratory Status of Birds, where W – Winter visitor, R – Resident, S- Summer visitor, P-Passage Migrant. * Status assigned by the Wildlife (Protection) Act, 1972, where I – V are the schedules.*

Sources: IUCN (2021) The IUCN Red List of Threatened Species. Version 2021-3; R. Grimmett, C. Inskipp & T. Inskipp (2011). Birds of the Indian Subcontinent. Oxford University Press, pp 1-528.

Appendix D lists the migratory species of the Study Area. ***Figure 4-26*** depicts the Central Asian Flyway vis-à-vis the Indian subcontinent.

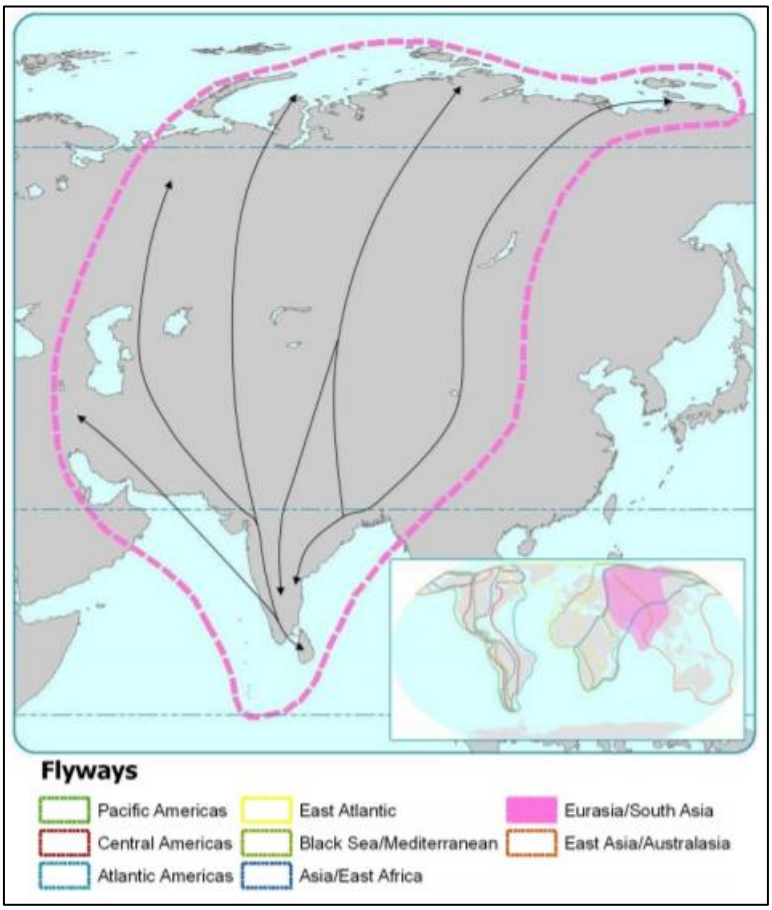


Figure 4-26: The Central Asian Flyway

Source: http://datazone.birdlife.org/userfiles/file/sowb/flyways/7_Central_Asia_Factsheet.pdf

Considering the geographic ranges, global populations and suitable habitat types of the concerned migratory and/or congregatory species, it is less likely that the habitats of the Study Area support the threshold numbers of the species required to trigger CH Criterion 3.

Hence, it is less likely that the Study Area contains CH with respect to any potential CH Criterion 3 trigger species reported from the Study Area.

Thus, it is less likely that the habitats of the Study Area could support the numbers of individuals of the said species, that would trigger the applicable CH Criteria.

However, in case of 1 CR species, *Sypheotides indicus* (Lesser Florican or LF), approximately 70% of the Study Area contains habitat types deemed suitable for, though not of major importance to, the species.

The trigger threshold for the applicable CH criterion, namely CH Criterion 1, consists of 2 components. The first component is regular or cyclical occurrence of 0.5% of the global population of the species within the Study Area. For the said species, 0.5 % of the global population is technically equivalent to only 1 individual. As per available data, it is not unlikely for 1 LF individual to occur cyclically in the Study Area. The second component is regular or cyclical occurrence of at least 5 reproductive units of the species within the Study Area. As per available data, it is unlikely that the minimum numbers of individuals of the said species, required to meet the second component of the applicable CH trigger threshold, would occur in the Study Area. Hence, the species is less likely to fully qualify as a CH trigger with respect to the Study Area, as defined by PS6 guidance. Nevertheless, considering its highly globally threatened status, it is important to take the necessary steps to adequately mitigate any foreseeable Project-related impacts or risks with respect to the species.

As recommended by PS6 guidance, a Subject Matter Expert (SME), Dr. Sujit Narwade, Bustard Scientist, Bombay Natural History Society (BNHS) and member of the IUCN SSC Bustard Specialist Group (BSG), was consulted on the matter. As per inputs received from the said SME, there are no recent records of either species from the Study Area. However, the said area is considered under-observed with respect to the 2 species, hence focused surveys are necessary to confirm presence or absence of the species therein.

Recent satellite telemetry-based evidence indicates that the said species traverses vast distances annually, ranging to over a thousand kilometres. Given the significantly small known population and significantly large apparent home-range of the species, monitoring in the Study Area is less likely to generate any conclusive evidence regarding presence or absence of the species therein.

Hence, it is deemed advisable to adopt a precautionary approach and presume that the Project Site is situated within CH for the said species

4.3.5 Designated Areas

Designated areas include legally protected areas, such as National Parks, Wildlife Sanctuaries, Reserve Forests, Protected Forests, Community Forests and Conservation Areas notified by the Government of India, as well as, internationally recognized areas, such as Ramsar Wetlands, Important Bird Areas, Key Biodiversity Areas or UNESCO World Heritage Sites.

Legally protected and internationally recognized areas located in the nearest proximity to the Project Site are as follow:

4.3.5.1 Legally Protected Area

Reserve Forests

The legally protected areas nearest to the Project Site consist of 3 Reserve Forests, the names of which could not be ascertained. Each of these is a nationally designated minor legally protected area qualifying as a Category VI IUCN Protected Area. One is located adjacent to the northern boundary of the Bhadgaon component of the Project Site. The other two are located 550m and 2km south respectively of the Nagpur component of the Project Site. None of these are overlapped by the Project Site.

Purna Wildlife Sanctuary

This is the nearest major legally protected area with respect to the Project Site. It covers an area of approximately 160 km^2. It is nationally designated as a Wildlife Sanctuary and qualifies as a Category II IUCN Protected Area. It is situated ~ 53 km southwest of the nearest point on the Project Site boundary.

4.3.5.2 Internationally Recognised Area

Ozar and adjoining grassland- Important Bird Area (IBA No. IN166)

This is the nearest internationally recognized area. It covers an area of approximately 200 km^2. It is designated as an Important Bird & Biodiversity Area (IBA). It is situated ~108 km southwest of the nearest point of the Study Area. The IBA trigger species are *Ardeotis nigriceps* (Great Indian Bustard) and *Sypheotides indicus* (Lesser Florican or LF).

Nandur Madhmeshwar Wildlife Sanctuary -Key Biodiversity Area

This is the next nearest internationally recognized area. It covers an area of approximately 6 km^2. It is designated as a Key Biodiversity Area (KBA) and Important Bird & Biodiversity Area (IBA). It is situated ~112 km southwest of the nearest point of the Study Area. The KBA trigger species are Waterbirds as a species group, as well as vulture species.

Sources: The Gazette of India, ESZ (Purna Wildlife Sanctuary) Notification No. 1043 dated 31st May 2012 BirdLife International (2022) Important Bird Areas factsheet: Ozar and adjoining grassland. Downloaded from http://www.birdlife.org on 17/05/2022; Key Biodiversity Areas Partnership (2022) Key Biodiversity Areas factsheet: Nandur Madhmeshwar Wildlife Sanctuary. Extracted from the World Database of Key Biodiversity Areas. Developed by the Key Biodiversity Areas Partnership: BirdLife International, IUCN, American Bird Conservancy, Amphibian Survival Alliance, Conservation International, Critical Ecosystem Partnership Fund, Global Environment Facility, Global Wildlife Conservation, NatureServe, Rainforest Trust, Royal Society for the Protection of Birds, World Wildlife Fund and Wildlife Conservation Society. Downloaded from http://www.keybiodiversityareas.org/ on 17/05/2022.

The figure below presents a map indicating the locations of the designated areas nearest to the Project Site.

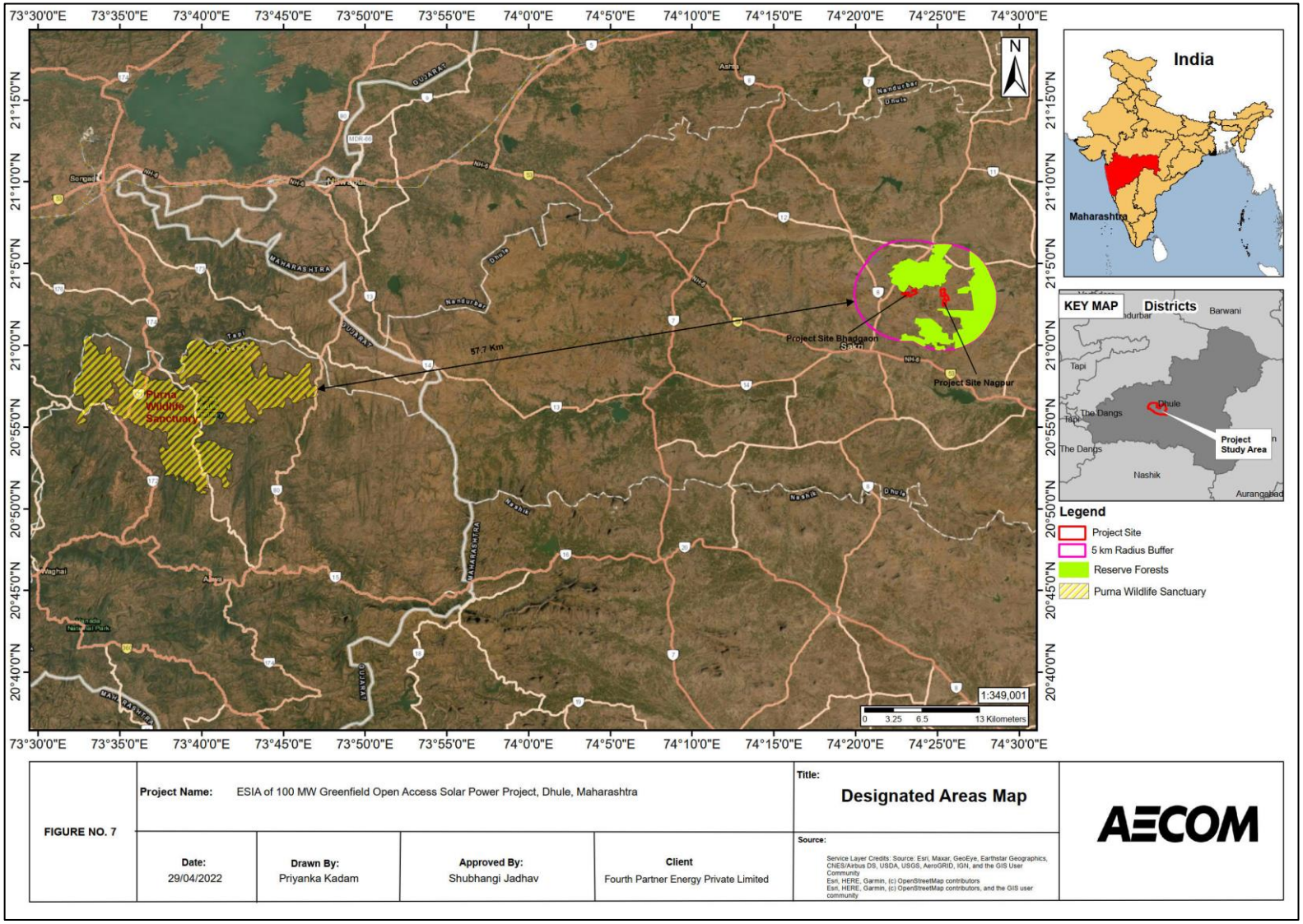


Figure 4-27: Designated Areas near the Project Site

4.3.6 Ecosystem Services

This sub-section presents an overview of the significant ecosystem services provided by the Study Area to the local community.

4.3.6.1 Provisioning Services

The provisioning ecosystem services provided by the Study Area include priority provisioning services, such as water, as well as, wild or cultivated species that provide food, fodder, fuel, fibre and timber to the local community.

Water: The groundwater and surface water bodies of the Study Area are the main sources of drinking, domestic and irrigation water. Groundwater is accessed through dug-wells and bore-wells. Almost all the natural as well as artificial surface waterbodies are regularly accessed to collect water for drinking and domestic purposes and to water livestock. A few large lakes in the Study Area are used for capture fishery.

Cultivated Foods: The soils of the Study Area are used by the local community to cultivate the following cereal, millet, oil seed, vegetable and fibre crops: *Triticum aestivum* (Gahu), *Sorghum bicolor* (Jwari), *Arachis hypogaea* (Shengdana), *Gossypium* sp. (Kapus), *Zea mays* (Maka) and *Allium cepa* (Kanda).

Fodder: Natural vegetation, as well as crop residue is utilized as fodder for livestock.

Timber: *Azadirachta indica* (Neem) and *Tectona grandis (Teak)* are the most important timber species.

Figure 4-28 presents photographs of some of the priority provisioning services provided by the Study Area

	
Capture fishery in the Study Area	Livestock grazing in the Study Area

Source: AECOM Primary Survey

Figure 4-28: Priority Provisioning Ecosystem Services of the Study Area

4.4 Socio-economic Profile

4.4.1 Socio-Economic Environment

The section endeavours to represent the socio-economic characteristics of the project area and identify the direct and indirect project impacts with the help of collection and analysis of primary and secondary data. Relevant information and statistical data used in the section have been drawn from secondary sources such as the Primary Census Abstract, 2011 - Census of India, 2011, Agriculture Census 2015-16-Ministry of Agriculture & Farmers Welfare, .

4.4.2 Approach and Methodology

Methodology adopted:

- Identification of project impacted area (direct and indirect project impact area) in accordance with the project site location; and
- A radius of five (05) kilometres from the project area was earmarked as the indirect project impact area for the ESIA. Identification of villages falling within the specified five (05) kilometres radii was undertaken.

  – ***Primary data collection:***
    - Interaction with relevant government stakeholders were undertaken;
    - Interaction with Village Panchayat Members of the directly impacted project villages was undertaken;
    - Consultations with opinion leaders (leader, principal/teacher of Government School, Bhadgaon and Nagpur villages) were undertaken;
    - Focus Group Discussions with the community members of Bhadgaon and Nagpur villages was undertaken; and
    - Consultations with members involved in animal grazing was undertaken.

Socio-Economic Baseline from the macro (district) level to micro (village) level was developed through consultations with community members/ village heads/opinion leaders. It is supplemented through secondary data base available in the public domain. They are as below:

– ***Secondary data collection:***

The following government publications (secondary database) were referred to while developing the socio-economic baseline for the study.

- Primary Census Abstract, 2011; Office of the Registrar General & Census Commissioner, India; Ministry of Home Affairs.
- Village Directory Abstract 2011, Office of the Registrar General & Census Commissioner, India; Ministry of Home Affairs; and
- District Census Handbook, Directorate of Census Operations, Maharashtra.

4.4.3 Administrative Profile

4.4.3.1 State profile: Maharashtra

The state is located between 16º N and 22º N latitudes and 72º E and 80º E longitudes and falls in the western part of India, along the Arabian Sea. The state of Gujarat and the Union Territories of Daman, Dadra and Nagar Haveli are to the North-West; Madhya Pradesh is to the North; Chhattisgarh to the East; Andhra Pradesh to the South-East and Karnataka and Goa lie to the South of Maharashtra. A 720 km long coastline stretches from Daman in the North to Goa in the South, which falls in the resource development zone called the Western Plateau and Hill Regions of India. Maharashtra has been divided into six divisions for administrative purposes viz. Amravati, Aurangabad, Konkan, Nagpur, Nashik, Pune. The state consists of 35 districts, 33 Zilla Parishads, 353 Tehsils, 27,946 Gram Panchayats, 349 Panchayat Samitis, 222 Municipal Councils, 22 Municipal Corporations, 3 Nagar Panchayats, 7 Cantonment Boards, 41,095 inhabited villages, 2616 un-inhabited villages and 378 towns. With respect to climate of the districts in Maharashtra, Ratnagiri records the highest average annual rainfall followed by the other districts in the Konkan region. Amravati, Akola and Nandurbar are regions with dry climate and have recorded lower average annual rainfall.

As per details from Census 2011, Maharashtra has population of 11.24 Crores, an increase from figure of 9.69 Crore in 2001 census. Total population of Maharashtra as per 2011 census is 112,374,333 of which male and female are 58,243,056 and 54,131,277 respectively. In 2001, total population was 96,878,627 in which males were 50,400,596 while females were 46,478,031. The total population growth in this decade was 15.99 percent

while in previous decade it was 22.57 percent. The population of Maharashtra forms 9.28 percent of India in 2011. In 2001, the figure was 9.42 percent.
Demographic profile of the state of Maharashtra has been provided in Table below.

Table 4-24 Demographic Profile of State of Maharashtra

Description	2011	2001
Population	11,23,74,333	9,68,78,627
Male	5,82,43,056	5,04,00,596
Female	5,41,31,277	4,64,78,031
Population Growth	15.99%	22.57%
Percentage of total Population	9.28%	9.42%
Sex Ratio	929	922
Child Sex Ratio	894	913
Density/km2	365	315
Density/mi2	946	815
Area (Km^2)	3,07,713	3,07,713
Area mi2	1,18,809	1,18,809
Total Child Population (0-6 Age)	1,33,26,517	1,36,71,126
Male Population (0-6 Age)	70,35,391	71,46,432
Female Population (0-6 Age)	62,91,126	65,24,694
Literacy	82.34%	76.88%
Male Literacy	88.38%	85.97%
Female Literacy	75.87%	67.03%
Total Literate	8,15,54,290	6,39,65,943
Male Literate	4,52,57,584	3,71,84,963
Female Literate	3,62,96,706	2,67,80,980

'Source: https://www.census2011.co.in/census/state/maharashtra.html

4.4.3.2 District profile: Dhule

Dhule District lies between 20° 35' and 21° 42' north latitudes and 73° 45' to 75° 15' east longitudes. The District is surrounded by Jalgaon District to its east, Nashik District to its south, Nandurbar District to its western side and Mewed District of Madhya Pradesh State on its Northern side. The headquarters of Dhule District is located at Dhule, a city with population of 3,75,559 as per Census, 2011. The District has an area of 7,195 sq. km., and a population of 20,50,862 as per Census 2011. The density of the population is 285 persons per sq.km. Most of the people of this District are engaged in agricultural activities. As per 2011 census, 25.54 percent of the total workers are engaged as cultivators and 45.87 percent of the total workers are engaged as agricultural labourers, together constitute 71.41 percent of the total workers of the District. Cloth, Vanaspati ghee, Starch, Chilli powder, Groundnut oil, Food grains, Cotton, Oilseeds, Pulses, Groundnut etc., are the important items of export from this District. These are mainly exported to Mumbai and Gujarat.[14].

4.4.3.3 Project Area

The proposed solar power project is proposed to be developed in Nagpur and Bhadgaon Villages of Sakri Taluk, Dhule District. The total land requirement for the proposed project would be around 450 acres. The project site comprises of two (2) land parcel each at Nagpur and Bhadgaon Villages, measuring 60.7028 hectares (150 acres) and 121.4 hectares (300 acres) respectively

[14] DCHB, Dhule District, Directorate of Census Operations, Maharashtra

4.4.3.4 Study Area

The villages under direct project impact are Bhadgaon and Nagpur villages. The study area has been divided into core zone a direct impact area (the area where the project will be located) and the buffer zone i.e., indirect impact area (within 05 km of the project area). Bhamer, Hatti Bk, Kalambhir, Mhasale, Rojgaon, Tembhe Pr.bhamer, Ubhand, Vardharne, Vehergaon villages falls within the 5-kilometre radii of the project site. Being a solar power project, it is expected that the area of influence of the project will be five (05) kilometre and the socio-economic impacts of the project is anticipated to be minimal, since the solar power projects in general do not have any significant impacts on community health and safety and the current project is not envisaged to have any physical resettlement or major economic impacts. Risks pertaining to community health and safety would be restricted primarily during the construction phase due to increased traffic movement and influx of labour migrants

Table 4-25 Revenue Villages falling within five (05) kilometre radii.

District	Tehsil	Revenue Villages
Core Zone : Project Villages		
Dhule	Sakri	Bhadgaon (u)
		Nagpur (v)
Buffer Zone : Study Area Villages (05km Radius		
Dhule	Sakri	Bhamer
		Hatti Bk.
		Kalambhir
		Mhasale
		Rojgaon
		Tembhe Pr.bhamer
		Ubhand
		Vardharne
		Vehergaon

4.4.4 Demographic profile of the Study Area

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

4.4.4.1 Population level

Table 4-18 represents the population level of the study area.

Table 4-26 Population Level

Administrative Unit	Households 2011	Total Population 2011	Male Population 2011	Female Population 2011	Sex Ratio 2011
District					
Dhule	**408874**	**2050862**	**1054031**	**996831**	**946**
Tehsil					
Sakri	**94950 (23.2%)**	**464913 (22.7%)**	**235997 (22.4%)**	**228916 (23%)**	**970**
Core Zone	**506 (0.5%)**	**2607 (0.6%)**	**1341 (0.6%)**	**1266 (0.6%)**	**944**
Bhadgaon	136	750	397	353	889
Nagpur	370	1857	944	913	967
Buffer Zone	**3005**	**14936 (3.2%)**	**7738 (3.3%)**	**7198 (3.1%)**	**930**

Administrative Unit	Households 2011	Total Population 2011	Male Population 2011	Female Population 2011	Sex Ratio 2011
Bhamer	756	3425	1822	1603	880
Hatti Bk.	119	636	336	300	893
Kalambhir	308	1356	689	667	968
Mhasale	296	1468	773	695	899
Rojgaon	137	872	456	416	912
Tembhe Pr.bhamer	129	543	268	275	1026
Ubhand	287	1419	715	704	985
Vardharne	315	1467	730	737	1010
Vehergaon	658	3750	1949	1801	924

Source: PCA 2011

It can be noted from the table above that Sakri tehsil comprises of 22.7% of the total population of Dhule district. The core zone villages i.e. the direct impact villages comprises of 0.6% (2607) and Buffer Zone villages i.e. the indirect impact villages comprises of 3.2% (14936) of the total population Sakri Tehsil. The sex ratio in the core zone villages are 944 females for 1000 males and buffer zone villages it was 930 which is less than the Tehsil (970) and District rate (946).

4.4.4.2 Social stratification: Vulnerable groups, SCs and STs

Vulnerable groups are those groups of people who may find it difficult to lead a comfortable life and lack developmental opportunities due to their disadvantageous positions. Further, due to adverse socio-economical, cultural and other practices present in each society, they find it difficult many a times to exercise their human rights fully[15].

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

The section below aims to define the status of these socially excluded categories/ groups within the study area. ***Table 4-19*** represents the presence of vulnerable sections of the community in the study area.

Table 4-27 Presence of Vulnerable Sections of Community within the study area

Administrative Unit	Total Population (2011)	SC Population (2011)	SC % (2011)	ST Population (2011)	ST % (2011)
District					
Dhule	**2050862**	**127571**	**6.2%**	**647315**	**31.6%**
Tehsil					
Sakri	**464913**	**16867**	**3.6%**	**247970**	**53.3%**
Core Zone	**2607**	**69**	**2.6%**	**765**	**29.3%**
Bhadgaon	750	20	2.7%	237	31.6%
Nagpur	1857	49	2.6%	528	28.4%

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

Administrative Unit	Total Population (2011)	SC Population (2011)	SC % (2011)	ST Population (2011)	ST % (2011)
Buffer Zone	**14936**	**937**	**6.3%**	**4285**	**28.7%**
Bhamer	3425	435	12.7%	725	21.2%
Hatti Bk.	636	3	0.5%	538	84.6%
Kalambhir	1356	140	10.3%	414	30.5%
Mhasale	1468	161	11.0%	572	39.0%
Rojgaon	872	0	0.0%	257	29.5%
Tembhe Pr.bhamer	543	0	0.0%	361	66.5%
Ubhand	1419	53	3.7%	625	44.0%
Vardharne	1467	40	2.7%	160	10.9%
Vehergaon	3750	105	2.8%	633	16.9%

Source: PCA 2011

Table 4-19 above denotes that there is presence considerable number of Scheduled Tribe (ST) population and Scheduled Caste Population in the study area.

Nomadic Tribes " means tribes wandering from the place to place in search of their livelihood as declared by Government from time to time and Nomads are commonly known as “Bhatake” in Maharashtra and are seen in various parts of Maharashtra. The nomadic tribes in Maharashtra also wander by loading their belongings on small horses, donkeys etc., and keep shifting their bases, looking for places where they can sustain themselves. Dombari-s, magicians, fortune-telling, dispensing herbal medicines are some of the professions that they undertake while on the move. Apart from following a season-based trail, these people have their permanent base, with their home and agricultural land. They take on the nomadic mantle after the harvesting season is over, spend the in-between period by wandering to sustain themselves by doing some agricultural activity and return to their base to prepare themselves for the next harvesting season.[16]

The Indian Constitution does not classify or mention about the De-notified or Nomadic Tribes and confines to the classification as Scheduled Castes, the Scheduled Tribes and the Backward Classes. It was observed that even though many these Tribes and Communities are listed in SCs, STs and BCs/OBCs category, they have not been able to take advantage of the affirmative action programmes launched by the Union and the States from time to time due to illiteracy and ignorance. As a result, these Communities continue to be the most disadvantaged and the most vulnerable section of the Indian society.[17] At the district level, SC and ST population comprises of 6.2% and 31.6% respectively. And in tehsil level SC and ST population was at 3.6% and 53.3% respectively. With respect to the study area villages highest number of SC population were reported in Bhamer village (12.7%) and ST population in Hatti Bk. Village (84.6%).

Based on the field observations and outcome of the stakeholder consultation there are presence of Nomadic tribes in the region. It was reported that 60% of the households from Nagpur village and 20% of from Bhadgaon village are Nomadic tribes and Bhilla, Pardhi, Vanjari, Rathod, Thilari and Kokini are the major reported Nomadic tribes in the villages. It was also reported that various socioeconomic development programs sponsored by state and central government are implemented effectively in the region. Also it was revealed during the consultation that most of the nomadic tribe and ST population are having land and due to lack of irrigation facilities people move to neighbouring villages in search of agriculture labour work and main source of livelihood of the nomadic tribe population is dependent on agriculture labour activity.

4.4.4.3 Gender Profile

The ***Table 4-20*** below represents the gender profile of the study area.

[16] The Maharashtra Scheduled Castes, Scheduled Tribes, Denotified Tribes (Vimukta Jatis), Nomadic Tribes, Other Backward Classes and Special Backward Category (Regulation of Issuance and Verification of) Caste Certificate Act, 2000
[17] National Commission for De-notified, Nomadic and Semi-Nomadic Tribes, Ministry of Social Justice & Empowerment, 2008

Administrative Unit	Total Population	Female Population	Sex Ratio	Child Sex Ratio	Female Litercy Rate	Women Workers Participation
District						
Dhule	**2050862**	**996831**	**946**	**897**	**570528 (65.7%)**	**365922 (39.1%)**
Tehsil						
Sakri	**464913**	**228916**	**970**	**940**	**110620 (55.8%)**	**110454 (44.8%)**
Core Zone	**2607**	**1266**	**944**	**876**	**543 (50.8%)**	**785 (49.3%)**
Bhadgaon (u)	750	353	889	833	178 (58.7%)	203 (45.4%)
Nagpur (v)	1857	913	967	891	365 (47.7%)	582 (50.8%)
Buffer Zone	**14936**	**7198**	**930**	**821**	**2961 (48.5%)**	**3647 (45.7%)**
Bhamer	3425	1603	880	772	746 (53.6%)	967 (47%)
Hatti Bk.	636	300	893	790	44 (17.5%)	169 (47.9%)
Kalambhir	1356	667	968	850	310 (55.5%)	283 (41.9%)
Mhasale	1468	695	899	800	332 (54.7%)	265 (37.6%)
Rojgaon	872	416	912	939	140 (41.4%)	245 (47.7%)
Tembhe Pr.bhamer	543	275	1026	1017	60 (27.8%)	137 (50%)
Ubhand	1419	704	985	1058	307 (51.5%)	426 (49%)
Vardharne	1467	737	1010	815	385 (59%)	352 (46%)
Vehergaon	3750	1801	924	748	637 (42.8%)	803 (45.5%)

Source: PCA 2011

The gender profile of the study area is presented in the table above. The sex ratio of the study area i.e., the core and buffer zone are at 944 and 930 females per 1000 males respectively, which is less than that of the Tehsil (970) and District ratio (946). The sex ratio among the children below six years in core and buffer zone villages were 876 and 821 respectively.

Literacy level amongst the women in the core and buffer zone of the study area was 50.8% and 48.5% respectively, however Hatti Bk. village in the buffer zone seems to have lowest women literacy rate of 17.5. Hatti Bk. village is Scheduled Tribe majority village having 84.6% of ST population. There are various schemes being undertaken by the State government in order to improve and promote inclusive education. The schemes are Ashram Schools for VJNT students is government funded scheme, which encourages residential schools for the Vimukta Jatis and Nomadic dominated region, Beti Bachao Beti Padao (BBBP) Scheme programmes which have been launched with the primary objective to empower the girl chid and ensure her education, essentially addressing the pre and post birth discrimination against the girl child, is implemented in the State of Maharashtra.

Participation in the workforce population amongst the women in the study area also is below 50 percent. Dhule district has 39.1% Sakri tehsil had 44.8% and at the village level 49.3% for the core zone villages and 45.7% for the buffer zone villages.

During consultations with the sarpanches of Bhadgaon and Nagpur, a government funded residential school named Nomadic Tribe Ashram school is being run in Nagpur village, In this school students were given free accommodation and food to encourage children belonging to nomadic tribes to enrol in formal education.

4.4.5 Education level

For measurement of literacy level in the census, any person aged seven years or above, who can both read and write any Indian language with understanding, is considered to be a literate person. The literacy level of the study area has been represented in this section.

The literacy level of the study area is presented in the ***Table 4-21*** below:

Table 4-28 Literacy profile of Study Area

Administrative Unit	Total Population	Literate Population	Literate Male Population	Literate Female Population
District				
Dhule	**2050862**	**1293916 (72.8%)**	**723388 (79.5%)**	**570528 (65.8%)**
Tehsil				
Sakri	**464913**	**255770 (63.7%)**	**145150 (71.4%)**	**110620 (55.8%)**
Core Zone	**2607**	**1409 (64.5%)**	**866 (77.7%)**	**543 (50.8%)**
Bhadgaon	750	457 (71.4%)	279 (82.8%)	178 (58.7%)
Nagpur	1857	952 (61.7%)	587 (75.4%)	365 (47.7%)
Buffer Zone	**14936**	**7371 (58.9%)**	**4410 (68.9%)**	**2961 (48.5%)**
Bhamer	3425	1896 (64.4%)	1150 (74.2%)	746 (53.6%)
Hatti Bk.	636	130 (24.8%)	86 (31.4%)	44 (17.5%)
Kalambhir	1356	730 (65.1%)	420 (74.7%)	310 (55.5%)
Mhasale	1468	862 (67.9%)	530 (79.9%)	332 (54.7%)
Rojgaon	872	354 (49.8%)	214 (57.4%)	140 (41.4%)
Tembhe Pr.bhamer	543	191 (44.8%)	131 (62.4%)	60 (27.8%)
Ubhand	1419	737 (61%)	430 (70.1%)	307 (51.5%)
Vardharne	1467	890 (69.5%)	505 (80.5%)	385 (59%)
Vehergaon	3750	1581 (52.4%)	944 (61.7%)	637 (42.8%)

Source: PCA 2011

Table 4-21 above represents the literacy level in the study area. It can be noted that the literacy level in the core and buffer zone was 64.5% and 58.9% respectively, which is less than the district literacy rate. In all administrative units, the female literacy rate is less than that of male literacy rate. The literacy level at Dhule District was at 72.8% and at Sakri Tehsil the literacy rate was 63.7%.

At the village level, the lowest literacy rate (24.8%) was at Hatti Bk and highest literacy rate (71.4%) was at Bhadgaon Village. During consultations with the sarpanches of Bhadgaon and Nagpur villages, it was stated that the reason for a very low female literacy rate is due to presence of nomadic tribe population. As discussed in detail in the earlier sub-sections, Nomadic Tribes " means tribes wandering from the place to place in search of their livelihood, since these tribes do not reside at any permanent place their children are not encourage to attend any schools. Government of India had taken initiatives such as Residential schools as Ashram schools for the Nomadic tribes in the region. In Nagpur village, a Ashram school run by Government of Maharashtra which is residential school especially for the Nomadic Tribe children. About 800 students are currently being enrolled in the Ashram school where free food and accommodation is provided for the students.

With respect to the educational facilities in the core zone villages, primary school is present in Bhadgaon village and Higher Secondary School up to class 12 is present in Nagpur village. For higher education facilities like Higher secondary school are accessed from the nearest town Sakri Town and for College, ITI, etc. are accessed from Dhule City. It was also reported that about 50% of the youths in the villages are educated and migrated to the nearby metro cities in search of decent jobs.

4.4.6 Occupation and Livelihood

Occupational pattern distribution of a population in an area indicates the development and diversification of an economy. The trend suggests that developed countries have higher distribution of population in the services and secondary sectors and the developing or underdeveloped countries have higher concentration of population in the primary (i.e. the agricultural) sector. For the Census Survey, the occupations are classified into Cultivators, Agricultural Labourers, Household (HH) Industries and Others[18].

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

Table 4-29 Occupational pattern in the Study Area

Administrative Unit	Workers			Main Workers	Cultivators			Agriculture Labours			HH Workers			Other Workers		
	Total	Male	Female		Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female
Dhule	**936370**	570448	365922	**825875**	**239139**	155285	83854	**429536**	205983	223553	**20646**	11897	8749	**247049**	197283	49766
%	**45.7%**	(60.9%)	(39.1%)	**88.2%**	**25.5%**	(64.9%)	(35.1%)	**45.9%**	(48%)	(52%)	**2.2%**	(57.6%)	(42.4%)	**26.4%**	(79.9%)	(20.1%)
Sakri	**246442**	135988	110454	**222151**	**100599**	60584	40015	**110028**	50637	59391	**4238**	2384	1854	**31577**	22383	9194
%	**53%**	(55.2%)	(44.8%)	**90.1%**	**40.8%**	(60.2%)	(39.8%)	**44.6%**	(46%)	(54%)	**1.7%**	(56.3%)	(43.7%)	**12.8%**	(70.9%)	(29.1%)
Core Zone	**1593**	808	785	**934**	**459**	244	215	**873**	435	438	**27**	10	17	**234**	119	115
%	**61.1%**	(50.7%)	(49.3%)	**58.6%**	**28.8%**	(53.2%)	(46.8%)	**54.8%**	(49.8%)	(50.2%)	**1.7%**	(37%)	(63%)	**14.7%**	(50.9%)	(49.1%)
Bhadgaon	**447**	244	203	**382**	**256**	136	120	**172**	92	80	**0**	0	0	**19**	16	3
%	**59.6%**	(54.6%)	(45.4%)	**85.5%**	**57.3%**	(53.1%)	(46.9%)	**38.5%**	(53.5%)	(46.5%)	**0%**	(0%)	(0%)	**4.3%**	(84.2%)	(15.8%)
Nagpur	**1146**	564	582	**552**	**203**	108	95	**701**	343	358	**27**	10	17	**215**	103	112
%	**61.7%**	(49.2%)	(50.8%)	**48.2%**	**17.7%**	(53.2%)	(46.8%)	**61.2%**	(48.9%)	(51.1%)	**2.4%**	(37%)	(63%)	**18.8%**	(47.9%)	(52.1%)
Buffer Zone	**7975**	4328	3647	**7035**	**2640**	1656	984	**4176**	1946	2230	**158**	88	70	**1001**	638	363
%	**53.4%**	(54.3%)	(45.7%)	**88.2%**	**33.1%**	(62.7%)	(37.3%)	**52.4%**	(46.6%)	(53.4%)	**2%**	(55.7%)	(44.3%)	**12.6%**	(63.7%)	(36.3%)
Bhamer	**2056**	1089	967	**1570**	**322**	251	71	**1468**	704	764	**97**	46	51	**169**	88	81
%	**60%**	(53%)	(47%)	**76.4%**	**15.7%**	(78%)	(22%)	**71.4%**	(48%)	(52%)	**4.7%**	(47.4%)	(52.6%)	**8.2%**	(52.1%)	(47.9%)
Hatti Bk.	**353**	184	169	**202**	**149**	83	66	**197**	97	100	**0**	0	0	**7**	4	3
%	**55.5%**	(52.1%)	(47.9%)	**57.2%**	**42.2%**	(55.7%)	(44.3%)	**55.8%**	(49.2%)	(50.8%)	**0%**	(0%)	(0%)	**2%**	(57.1%)	(42.9%)
Kalambhir	**675**	392	283	**624**	**293**	191	102	**296**	131	165	**2**	2	0	**84**	68	16
%	**49.8%**	(58.1%)	(41.9%)	**92.4%**	**43.4%**	(65.2%)	(34.8%)	**43.9%**	(44.3%)	(55.7%)	**0.3%**	(100%)	(0%)	**12.4%**	(81%)	(19%)

Administrative Unit	Workers			Main Workers	Cultivators			Agriculture Labours			HH Workers			Other Workers		
	Total	Male	Female		Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female
Mhasale	**704**	439	265	**627**	**376**	262	114	**248**	125	123	**10**	7	3	**70**	45	25
%	**48%**	(62.4%)	(37.6%)	**89.1%**	**53.4%**	(69.7%)	(30.3%)	**35.2%**	(50.4%)	(49.6%)	**1.4%**	(70%)	(30%)	**9.9%**	(64.3%)	(35.7%)
Rojgaon	**514**	269	245	**513**	**189**	108	81	**242**	112	130	**3**	3	0	**80**	46	34
%	**58.9%**	(52.3%)	(47.7%)	**99.8%**	**36.8%**	(57.1%)	(42.9%)	**47.1%**	(46.3%)	(53.7%)	**0.6%**	(100%)	(0%)	**15.6%**	(57.5%)	(42.5%)
Tembhe Pr.bhamer	**274**	137	137	**274**	**5**	3	2	**263**	132	131	**0**	0	0	**6**	2	4
%	**50.5%**	(50%)	(50%)	**100%**	**1.8%**	(60%)	(40%)	**96%**	(50.2%)	(49.8%)	**0%**	(0%)	(0%)	**2.2%**	(33.3%)	(66.7%)
Ubhand	**870**	444	426	**746**	**304**	159	145	**510**	244	266	**2**	0	2	**54**	41	13
%	**61.3%**	(51%)	(49%)	**85.7%**	**34.9%**	(52.3%)	(47.7%)	**58.6%**	(47.8%)	(52.2%)	**0.2%**	(0%)	(100%)	**6.2%**	(75.9%)	(24.1%)
Vardharne	**766**	414	352	**738**	**544**	310	234	**177**	77	100	**7**	6	1	**38**	21	17
%	**52.2%**	(54%)	(46%)	**96.3%**	**71%**	(57%)	(43%)	**23.1%**	(43.5%)	(56.5%)	**0.9%**	(85.7%)	(14.3%)	**5%**	(55.3%)	(44.7%)
Vehergaon	**1763**	960	803	**1741**	**458**	289	169	**775**	324	451	**37**	24	13	**493**	323	170
%	**47%**	(54.5%)	(45.5%)	**98.8%**	**26%**	(63.1%)	(36.9%)	**44%**	(41.8%)	(58.2%)	**2.1%**	(64.9%)	(35.1%)	**28%**	(65.5%)	(34.5%)

Source: PCA 2011

Table 4-22 above denotes that majority of the population in all administrative units are engaged in agricultural activities as their main occupation. Dhule district has 71.4 % of workforce population engaged in agricultural activities. With respect to the Sakri Tehsil about 85.4% workers were engaged in agricultural activities.

With respect to the study area, 83.6% (28.8% Cultivators and 54.8% Agriculture Labours) of the workers from core zone villages and 85.5% (33.1% Cultivators and 52.4% Agriculture Labours) of the buffer zone villages were involved in agriculture activities. Though the overall figure shows that the major source of livelihood is related to agriculture and allied activities, breakup shows that majority of the workers were involved only as agriculture labour and the same was confirmed during the stakeholder consultation with the village representatives and landowners. Due to lack of irrigation facility, undulating terrain land and soil being gravel in texture the project villages do not support for extensive cultivation. The local agriculture labour was also reported to be involved as an unskilled labour from the nearby solar plants in the region, there are about 5 solar plants (cumulatively 460 MW) operational in the region. The educated youths from the villages have mostly migrated to the nearby metro cities like Mumbai, Pune, Surat in search of decent jobs.

In addition to the agriculture activities about 5-10% of the households are involved in cattle rearing mostly sheep/goat and cows. As reported during the consultation among few shepherds, they expressed that there would not be any adverse impact or loss of livelihood due to the proposed project, as there are designated grazing areas in the region.

4.4.6.1 Agriculture and Irrigation Sources

Agriculture and allied activities being the major source of livelihood in the region, the land holding size among the farmers reported to be small. With respect to the land holding size in Sakri Tehsil, 33.2% of the landowners are classified as marginal landholders with holding less than 1.0 Ha., 35.8% of them were small with holding 1.0 ha. to 2.00 ha and only 0.6% of them were classified as large holding land more than 10.00 ha. The average landholding size in Sakri Tehsil was 1.75 ha. whereas in the Dhule district the average landholding size was 1.67 ha.[19]. Based on the outcome of the consultation, it was reported that the project villages are of mostly undulating terrain, rocky/gravel in texture and does not have any perennial source of irrigation. Mostly meagre cultivation activities are done in the project site area and only during the monsoon. The common crops cultivated in the study area villages are Cotton, Onion, Channa, Thuvar Dall, Wheat, Groundnut, Millets, Chilli, Vegetables, etc. Mostly seasonal single crops are being cultivated and the cropping season are mostly between June to April. As reported, majority of the land is rainfed and does not have any irrigation sources, however during the site visit could be able to observe few farmers with resources pump water from the nearby check dams.

4.4.7 Physical Infrastructure and Civic Amenities

4.4.7.1 Health Profile and Infrastructure

During consultations with the Bhadgaon and Nagpur Village Panchayat representatives it was stated that there is no Primary Health Centre within these villages, the nearest Government hospital is Sakri Primary Health Centre, however there is a private clinic serving in Nagpur Village. As reported, mostly people prefer to go to Government hospital in case of ailment.

The nearest Government Primary Health Centre (PHC) is located at Sakri Town which is at a distance of about 17km from the project villages. The PHC is having maternity care centre and is of 50 bed capacity. The study area is covered by 108 Ambulance services and under National Health Mission (NHM). Anganwadi centres are located in both the project villages. For major ailments the patients are referred to District General Hospital located at Dhule and further private multi-speciality hospitals as Mumbai and Nashik. As reported, there are no existing common illness or disease endemic to the region.

4.4.7.2 Drinking Water

Drinking Water supply is primarily through panchayat supplied water pipes connecting all the houses. As per Dhule District CGWA report, the ground water quality is good and suitable for drinking and irrigation purpose, however localized nitrate and fluoride contamination is observed. The drought area has been observed in western and southern parts of the district occupying parts of Sakri and Dhule talukas. The moderate to deeper water levels of 5 to 10 m bgl is observed in almost all parts of Dhule, Shirpur and Sakri.

[19] Agricultural Census, 2015-16

4.4.7.3 Sanitation

Swachh Bharat Abhiyan scheme was stated to be implemented in both the villages. Consultations with Bhadgaon and Nagpur Sarpanches indicated that though physical structures are in place, the practice of open defecation is still prevailing.

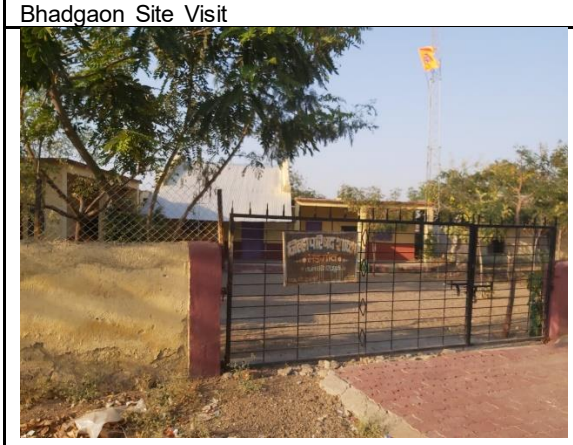
4.4.7.4 Religious and Archaeological Important Sites

The proposed project site is to be developed within private land, there are no presence of any religious or cultural important places within the project site. However, there is a small sacred place being worshiped by the neighbouring farmers. This sacred place is not a major religious facility and being worshiped by locals nearby. The project will have no bearing/ impact on the said scared place.

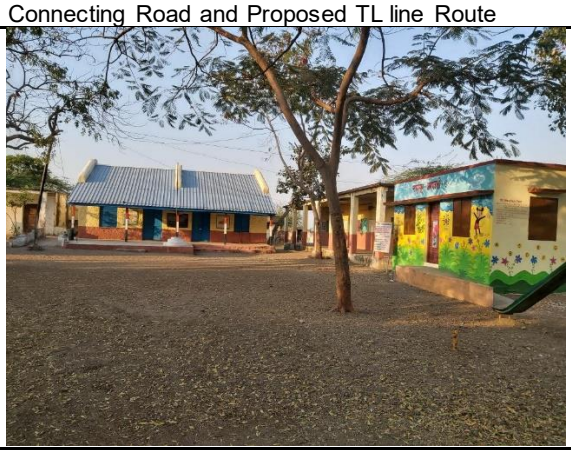
Photo Documentation

Bhadgaon Site Visit

Connecting Road and Proposed TL line Route

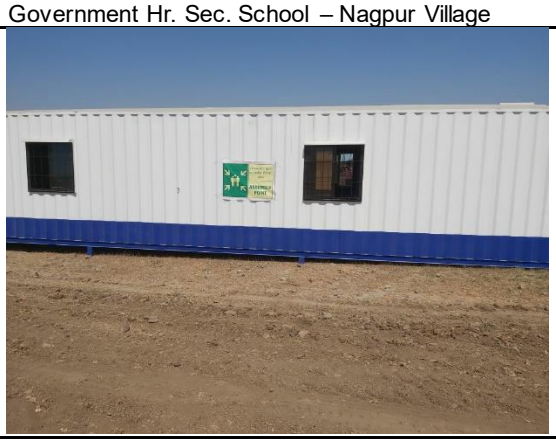


Government Primary School- Bhadgaon Village



Government Hr. Sec. School – Nagpur Village

Existing road 30 feet upgradation 1.5 km



Site office – Bhadgaon Village Site

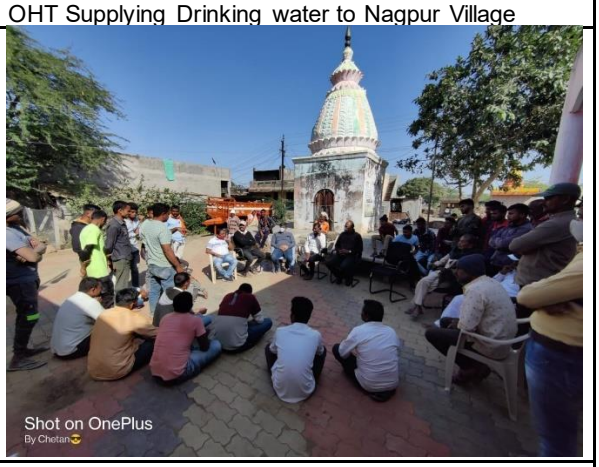
Small Temple Locted adjacent to the Bhadgaon Plot

Checkdam adjacent to the Nagpur Plot

Farmsheds adjacent to the proposed project sites used for storing farm produce and agriculture equipments

Fencing construction in progress- Bhadgaon Plot

OHT Supplying Drinking water to Nagpur Village



Gramsabha Meeting Conducted by FPEPL for negotiationg the Land compensation value

5. Stakeholder Engagement and Consultation

5.1 Introduction

Stakeholder mapping refers to the process of identifying individuals or groups having influence over a project and assessing the effects of their actions on the project. Stakeholder mapping helps in identifying the different stakeholders as primary or secondary based on the degree of influence on a project and by analysing the stakes or interest each of them has in the project and the way both the stakeholder group as well as the project can benefit from each other.

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.

The AECOM team visited the project site from 22nd- 24th February 2022. The team was able to conduct consultations with stakeholders in Bhadgaon and Nagpur villages. 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.

5.2 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 in ***Table 5-1.***

Table 5-1 Overview of Disclosure and stakeholder consultation requirement

Institution/ Regulatory Body	Reference Regulation/ Standard	Requirements
IFC	PS-1	• 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 will allow 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.

5.3 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"[1]. 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 below.

Table 5-2 Stakeholder Group Categorisation

Stakeholder Groups	Primary Stakeholders	Secondary Stakeholders
Community	• Local Laborers • Landowners • Agricultural Laborers	• Local community • Vulnerable Communities • Grazing lad users
Institutional Stakeholders	• Developers and Contractors • Gram Panchayats	• Civil Society/ Local NGOs
Government Bodies	• Regulatory Authorities • District Administration	
Other Groups	• Migrant Workforce	

5.4 Approach and Methodology of 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 a 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[2] and proximity[3] 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 in a scale of low, medium and high. The overall significance of the stakeholder group is assessed as per the matrix provided below (***Table 5-3***):

Table 5-3: Stakeholder Significance and Engagement Requirement

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

5.5 Stakeholder Analysis

Table 5.4 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:

1. Freeman, R. and Reed, D. (1983). Stockholders and Stakeholders: A new perspective on Corporate Governance. *California Management Review.* pp. 88 – 106.
2. Power/Responsibility: Those stakeholders to whom the organisation has, or in the future may have, legal, financial, and operational responsibilities in the form of regulations, contracts, policies or codes of practice.
3. Proximity: indicates stakeholders that the organisation interacts with most, including internal stakeholders, those with long-standing relationships and those the organisation depends on its day-to-day operations.

- ***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 5-4: 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	Landowners / MAHATRANSCO	• The entire project is to be developed on private land. The required land is to be proposed to be procured by executing sale deeds on willing buyer and willing seller basis. • As observed during the site visit and reported by the landowners and village representatives the project site land is mostly rocky, undulating terrain, rainfed land which are scarcely cultivated based on the monsoon. • There are no standing structures within the project site and the compensation paid for the land is more than the market and government circle rate and the rate per acre is fixed through negotiations done by Gram Sabha meetings. Hence as reported, Physical or economic displacement is not envisaged due the proposed project. • MAHATRANSCO is responsible for providing clearances and permits for erection of the power project and commissioning of the project including evacuation of power.	• Constituting the most critical stakeholder group, landowners from whom the land is being sourced; • The level of impact of loss of land is envisaged to be negligible most of the land is scarcely cultivated due to unfavourable conditions for cultivation and the compensation to be paid for the land is at the replacement cost which is higher than the market rate and government circle rate .	The impact associated with the landowners are related to grievances associated to compensation payment, loss of common property resources adjacent to the project. And with respect to the MAHATRANSCO it mostly on the compliance by the players operating the power plant.	• The major concern of the stakeholder group is that of compliance and Job / business opportunities and economic development of the region..	High
	Contractors and Sub-contractors	As indicated earlier, FPEPL is the developer for the 100 MW solar power project proposed to be set up on 2 land plots located in Nagpur and Bhadgaon Villages. The required land is to be procured through willing buyer and willing seller basis. The EPC contract for the project is in the process of being finalised.	• Hassle-free procurement of the identified plots of land for the project; and • 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; and • Leaving behind a legacy of conflict-ridden relationship with local communities.	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

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
	Local Labourers	• A considerable section of the working population of the local area are agriculture labourers. • Due to the lack of industries in the region, the availability of employment in the unskilled category is limited; and • Skilled laborers and educated youths are reported to be migrated to the nearby metropolitan cities in search of decent jobs.	The local wage earners have developed high expectations for employment in the project.	• Any labour unrest and protests will cause delays in construction schedule and create a non-congenial social atmosphere; and • The delay in construction activities will have financial implications on the project.	The major concerns of this stakeholder group include: - • Regular payment of wages for the work rendered; • Continued employment even beyond the completion of construction work; • Health and Safety issues at work; and • Holidays and leaves as per labour laws applicable etc.	Medium
	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 73rd Amendment to the Constitution of India; and Sarpanch and other members of the Gram Panchayat 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.	The project will create collective benefit for the local community.	• GPs play an important role in overall mobilization and shaping the perception and opinions of the people in the project area. They also serve as the official forum for consent and approval required for the project.	The expectations/ concerns of the GPs include; • Employment Opportunities for the Local Youth; • CSR activities for development of local area; and • Nature of impact that the project would have on the livelihoods of communities.	Medium
	Regulatory Authorities	• The office of District Industries Commissioner (DIC) regulates Industrialization at the District Level; • Maharashtra State Electricity Transmission Company Limited (MAHATRANSCO) for power evacuation/ grid connectivity etc.	The project will comply with the applicable regulatory framework comprising of the guidelines and policies of the State Government such as State Renewable Energy Policy 2020. Permission and coordination with the District	-	The main expectation of the Regulatory Authorities from the project Proponents is 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
			Industries Centre, Dhule is mandatory for creation of local infrastructure and smooth operation of the industry.			
	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 Tehsildar, District Magistrate Collectors, and Revenue officer etc.; and The sub-registrar of the revenue department is responsible for registration of sale of land, land mutation, updating of records of transfer of land.	The process of land sale deed registration for the 2 land parcels was in progress at the time of the site visit.	• There are several permissions and regulatory approvals that are required prior to as well as after the construction of the project from the District Administration. Delay in issuance of the relevant permits can adversely impact the timely execution of the project. Similarly, unresolved matters relating to land such as litigation, non-payment of compensation and encroachment might create complications, drag the firm into legal disputes thereby delaying project execution.	The key concerns of the District Administration authorities might include. • Matters concerning local employment. • Preference to local youths in matters of vehicle hire and issuance of contract job etc.; and Local area development through CSR interventions.	Low
	Migrant Workforce	• Project-related construction activities are yet to be allotted to any contractors. As on date only construction of boundary wall is in progress. An estimated workforce comprising of 200-300 workers will be employed for a duration of 6 months which are expected to be mostly migrant workers and will be engaged in the project-specific construction activities, especially in the skilled and highly skilled categories.	• Migrant workers may see this as a better economic and livelihood opportunity for them; and • The fluctuation of the supply of local labour in harvest and other agricultural peak seasons can be met by deployment of migrant workers.	• Retaining the migrant workforce, especially during the construction phase of the project is extremely critical.	The major concerns of this stakeholder group may include. • Regular payment of wages for the work rendered. • Continued employment even beyond the completion of construction work. • Health and Safety issues at work. • Holidays and leaves as per labour laws applicable etc.; and	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
					• Issues relating to conflicts with the local labour and host community.	
Secondary Stakeholders	Local Community	• The stakeholder group comprising of local communities around a radius of 5 kms inhabit 11 villages • The community in the study area is dependent on agriculture and allied activities. • The study area inhabits Nomadic Tribes	• the CSR activities focused on education and health, among others should also target at the neighbouring villages and the immediate local community which will lead to improvement in livelihood.	• The broad support of the local community will create a hindrance or risk-free business process.	• Expectations of getting employment benefits from the project; and • Growing community demands for implementing welfare interventions in the region by the project Proponent.	• Low
	Vulnerable Communities	• This stakeholder group comprises of SC and ST Communities in the study area Which constitutes 2.64% of Scheduled Caste Population and 29.34% of Schedule Tribe population. Based on the field observations and outcome of the stakeholder consultation there are presence of Nomadic tribes in the region. The Indian Constitution does not classify or mention about the De-notified or Nomadic Tribes and confines to the classification as Scheduled Castes, the Scheduled Tribes and the Backward Classes.	• In view of the poor social and economic conditions of the Vulnerable Communities, the project Proponent may have to provide engagement avenues to its members.	• The stakeholder group will have a negligible impact on the project as no land belonging to the SC/ST or nomadic tribes been sourced for the project. • No dependency of Nomadic tribes was established during consultations.	▪ Key concerns of this stakeholder group will primarily revolve around targeted support being extended for availing the benefits of community interventions by the project Proponent.	Low
	Agricultural Laborers	• Based on the Census data also as confirmed during the consultation, the majority of the working population is dependent on agriculture labour. The average landholding size in Sakri Tehsil was 1.75 ha. Mostly meagre cultivation activities are done in the project site area during the monsoon. Since the project site villages are not suitable	• The project villages are of mostly undulating terrain, rocky/gravel in texture and does not have any perennial source of irrigation and • The local community will be benefitted by means of the local employment	• The stakeholder group will have a negligible impact on the project.	Expectations of getting employment benefits from 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
		for cultivation, mostly move to neighbouring villages in search of agriculture labour work. • The agricultural census of India defines farmers on the basis of the following; o Marginal – Farmers having less than one hectare of land; o Small – Farmers having between one and two hectares of land; o Semi-medium – Farmers having between two and four hectares of land; o Medium – Farmers having between four and ten hectares of land; and o Large – Farmers having more than 10 hectares of land	opportunities that will be generated.			
	Civil Society/Local NGOs	• The local NGOs, mostly based out of the Cities of Dhule, are acting as a social watchdog in matters relating to securing the livelihoods of rural communities along with their related socio-cultural facets; and • However, the number of such NGOs active in the study area is highly limited.	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 NGOs and CBOs after obtaining prior approval from competent authorities.	• 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 implementing CSR initiatives.	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 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.	Low

Note: *It is significant to note that the stakeholder analysis is based on the situation during site visit for this ESIA report. The stakeholder influence on the project is dynamic and may change during the project life. Consequently, the stakeholder analysis needs periodical reassessment and updated by client.*

Summary of overall stakeholder influence is presented in the ***Table 5-5-5***.

Table 5-5 Summary of overall stakeholder influence

Stakeholder Category	Relevant Stakeholders	Magnitude of Influence/Impact	Likelihood of Influence on/by Stakeholder	Overall Rating of Stakeholder Influence
Primary stakeholder	FPEL	High	High	High
	Developers and Contractors	Medium	Medium	Medium
	Local Labourers	Negligible	Medium	Medium
	Gram Panchayats	Medium	Negligible	Medium
	Regulatory Authorities	Negligible	Negligible	Low
	District/ Tehsil Administration	Negligible	Negligible	Low
	Migrant Workforce	Negligible	Negligible	Low
Secondary Stakeholders	Local Community	Negligible	Negligible	Low
	Vulnerable Communities	Negligible	Negligible	Low
	Agricultural Labourers	Negligible	Negligible	Low
	Civil Society/Local NGOs	Negligible	Negligible	Low

5.6 Stakeholder Consultations and Engagement

The section provides a summary of the consultations undertaken with the Stakeholders of the project. Participant list for the stakeholder consultations undertaken have been provided as **Appendix A**

5.6.1 Consultations with Sarpanch (Village Head),opinion leaders and Landowners of Nagpur village Panchayat

Summary of consultations undertaken with the Sarpanch and Panchayat members of Nagpur village on 23rd February 2022 has been presented in the table below.

Basic details	
Location: Nagpur Village, Sakri Tehsil	District: Dhule
Project Title: ESIA of 100 MW solar power project of FPEPL	Date: 23rd February 2022
Stakeholder Group Title: Sarpanch (Village Head) and Panchayat members of Nagpur village	
Objective of the Interview/Consultation	
To understand the socio-economic baseline of Nagpur village and an assessment of the perception of the upcoming project amongst the community members.	
Key discussion points	
1	**What is the demographic of the village?** Nagpur village has approximately 1800 population residing from 470 houses. Based on the consultation it was reported that 60% of the population belongs to nomadic tribe. The sex ratio in the village seems to be equal to the male.
2	**Communities present in the village and their primary occupational activity.** Among the 470 houses, 19 houses belong to ST community, 23 houses belongs to SC community and rest of the houses belongs to General community and Nomadic tribe community. Bhila, Pardhi and Kokini are the major nomadic tribe community from the Nagpur village. • The primary occupation of the village community is agriculture labour and allied activities. The nomadic tribes are in move in search of job opportunities to the neighbouring villages. • No land belonging to vulnerable population such as SC/ST and Nomadic tribes were sourced for the proposed project development.
3	**Occupational Pattern and Livelihood Activities.** • Primary occupational activity comprises of cultivators and agricultural labourers. The agricultural activity was largely dependent on rainfall in the area. Women are also engaged as agricultural labourers in the village. • About 7 families engaged in cattle rearing and there are no designated grazing area within or adjacent to the proposed project site.

	• 50% of the educated youths have migrated to the neighbouring metro cities such as Mumbai, Pune, Dhule in search of decent jobs.
4	**Agricultural Crops Grown in the area** • The primary agricultural crops grown in the village is Cotton, Onion, Millets, Chilli, Vegetables, Maize. Most of the crops harvested are sold to the local market and to the nearest market at Sakri. Cultivation is carried out mostly during monsoon season i.e., June to April. There is no permanent source of irrigation and most of the cultivations are rainfed. **Livestock Population** • It was stated that all households in the village possess cow and sheep. Majority of the milk produced are self-consumed or sold locally. Sheep / Goat reared are sold to the local market and through the local traders. About 7 houses do cattle rearing
5	**Migration Trend in the Village** • Majority of the population in the study area belong to nomadic tribe population, these nomadic tribes are in move from one place to another in search of job opportunities. • It was stated that 50% of the educated youth population of the village have migrated to nearby towns in search of skilled and decent jobs.
6	**Educational Profile** • Within the Nagpur village, a school up to class 12 is there. The higher education facilities like other technical studies such as ITI, Diploma, colleges etc., are located from the nearby towns Sakri and Dhule. • Majority of the population being nomads there was higher number of school dropouts, or reported to have lesser enrolment, Government of India had introduced various development schemes for the betterment of the nomad tribes such as residential Ashram schools to promote literacy level among nomadic tribes. About 800 students from 6 neighbouring villages are studying in the Ashram school in Nagpur.
7	**Health Profile** • Within Nagpur village there are no allopathic hospital, the nearest hospital is located at Sakri Tehsil which is located at a distance of 18km. • The village is covered by 108 Ambulance service under National health Mission. • In case of ailment people mostly prefer to visit government PHC at Sakri Tehsil. • The PHC maintain Anti-venom and Anti-rabis stocks and Covid-19 screening is done and has 50 beds for in-patient care.
8	**Women Profile** • All girl children of Nagpur village were enrolled in school however dropouts were observed among the girls in the region . Now the dropout rate among the nomadic women children had come down due to the government intervention and ashram schools. As per the earlier census data, the literacy rate among the women is less compared to national and state averages. • Women of the village are primarily engaged as agricultural labours during major agricultural activities such as cropping and harvesting seasons.
9	**Youth Profile** The youth of Napur village were primarily engaged as agricultural labourers and 50% of the educated youths have migrated to the nearby metro cities in search of job opportunities.
10	**Social Perception of Project:** There are number of solar power projects in the region, however they do not benefit the Nagpur village as those solar plants are located far from their village and moreover only the villages adjacent to the solar plants are given job opportunities. The proposed project in their village may create number of economic and employment opportunities.
11	**Perception among the Landowners** • In total 13 landowners belonging from both Bhadgaon and Nagpur villages were consulted. • Unanimously all the farmers expressed their willingness to give their land for the project, as they are paid higher than the market price • Most of the farmers consulted have invested on buying another land from the compensation money. • They do not have any grievance related to the land procurement and disbursement of compensation.

12	**Benefits/ Expectations from the Project** • Induced Development benefits due to project development such as improved road connectivity, • Increased employment opportunities, the region is mostly dependent on agriculture and allied activities and job opportunities are mostly seasonal. The project should hire local workforce to create regular income opportunities to the local. • Small trade and business opportunities to be given to the local traders and community. • Infrastructure and facilities improvement under CSR fund i.e., Library, Gym/Recreation centre, Village level RO plant (Water ATM), etc.
13	**Concerns regarding the Project** No reported grievance.

Photo Documentation

5.6.2 Focused group discussion with Sarpanch (Village Head), opinion leaders and landowners of Bhadgaon Village Panchayat

Summary of consultations undertaken with the Sarpanch and Panchayat members of Nagpur village on 23rd February 2022 has been presented in the table below.

Basic details	
Location: Bhadgaon Village, Sakri Tehsil	District: Dhule
Project Title: ESIA of 100 MW solar power project of FPEPL	Date: 23rd February 2020
Stakeholder Group Title: Sarpanch (Village Head) and other opinion leaders	
Objective of the Interview/Consultation	
To understand the socio-economic baseline of Bhadgaon village and an assessment of the perception of the upcoming project amongst the community members.	
Key discussion points	
1	**What is the demographic of the village?** Bhadgaon village has approximately 1050 population residing from 129 houses. 20% of the population belongs to nomadic tribe. The sex ratio in the village seems to be equal to the male.
2	**Communities present in the village and their primary occupational activity.** Among the 129 houses, 35 houses belong to ST community, 4 houses belong to SC community, 20 houses belong to Nomadic tribe population and rest of the houses belongs to General community and Nomadic tribe community. Vanjari, Rathod, Thilari, etc., are the major nomadic tribe community from the Bhadgaon village. • The primary occupation of the village community is agriculture labour and allied activities. The nomadic tribes are in move in search of job opportunities to the neighbouring villages. • No land belonging to vulnerable population such as SC/ST and Nomadic tribes were sourced for the proposed project development.

3	**Occupational Pattern and Livelihood Activities.** • Primary occupational activity comprises of cultivators and agricultural labourers. The agricultural activity was largely dependent on rainfall in the area. Women are also engaged as agricultural labourers in the village. • About 6 families engaged in cattle rearing and there are no designated grazing area within or adjacent to the proposed project site. • 50% of the educated youths have migrated to the neighbouring metro cities such as Mumbai, Pune, Dhule in search of decent jobs.
4	**Agricultural Crops Grown in the area** • The primary agricultural crops grown in the village is Onion, Bajra, Wheat, Cotton, etc.. Most of the crops harvested are sold to the local market and to the nearest market at Sakri. Cultivation is carried out mostly during monsoon season i.e., June to April. There is no permanent source of irrigation and most of the cultivations are rainfed. **Livestock Population** • It was stated that all households in the village possess cow and sheep. Majority of the milk produced are self-consumed or sold locally. Sheep / Goat reared are sold to the local market and through the local traders. About 6 houses do cattle rearing
5	**Migration Trend in the Village** • Majority of the population in the study area belong to nomadic tribe population, these nomadic tribes are in move from one place to another in search of job opportunities. These nomadic tribes do not have a permanent place to live. • It was stated that 50% of the educated youth population of the village have migrated to nearby towns in search of skilled and decent jobs.
6	**Educational Profile** • Within the Bhadgaon village, a school up to class 5 is there. The higher education facilities like higher secondary school, technical studies such as ITI, Diploma, colleges etc., are located from the nearby towns Sakri and Dhule. • Majority of the population being nomads there was higher number of school dropouts, or reported to have lesser enrolment, Government of India had introduced various development schemes for the betterment of the nomad tribes such as residential Ashram schools to promote literacy level among nomadic tribes. About 800 students from 6 neighbouring villages are studying in the Ashram school in Nagpur.
7	**Health Profile** • Within Bhadgaon village there are no allopathic hospital, the nearest hospital is located at Sakri Tehsil which is located at a distance of 18km. • The village is covered by 108 Ambulance service under National health Mission. • In case of ailment people mostly prefer to visit government PHC at Sakri Tehsil. • The PHC maintain Anti-venom and Anti-rabis stocks and Covid-19 screening is done and has 50 beds for in-patient care.
8	**Women Profile** • All girl children of Bhadgaon village were enrolled in school. Now the dropout rate among the nomadic women children had come down due to the government intervention and ashram schools. As per the earlier census data, the literacy rate among the women is less compared to national and state averages. • Women of the village are primarily engaged as agricultural labours during major agricultural activities such as cropping and harvesting seasons.
9	**Youth Profile** The youth of Bhadgaon village were primarily engaged as agricultural labourers and 50% of the educated youths have migrated to the nearby metro cities in search of job opportunities.
10	**Social Perception of Project:** There are number of solar power projects in the region, however they do not benefit the Bhadgaon village as those solar plants are located far from their village and moreover only the villages adjacent to the solar plants are given job opportunities. The proposed project in their village may create number of economic and employment opportunities.
11	**Perception among the Landowners** • In total 13 landowners belonging from both Bhadgaon and Nagpur villages were consulted.

	• Unanimously all the farmers expressed their willingness to give their land for the project, as they are paid higher than the market price • Most of the farmers consulted have invested on buying another land from the compensation money. • They do not have any grievance related to the land procurement and disbursement of compensation.
12	**Benefits/ Expectations from the Project** • Induced Development benefits due to project development such as improved road connectivity, • Increased employment opportunities, the region is mostly dependent on agriculture and allied activities and job opportunities are mostly seasonal. The project should hire local workforce to create regular income opportunities to the local. • Small trade and business opportunities to be given to the local traders and community. • Infrastructure and facilities improvement under CSR fund i.e., Community Hall, Toilet facility at Primary school, Water ATM, etc. • The village youths are practicing and taking training for cracking CRPF, ARMY exams, requesting to provide a dedicated GYM or practice grounds.
13	**Concerns regarding the Project** No reported grievance.

Photo Documentation

5.6.3 Consultations with Land Aggregator

Summary of consultations undertaken with the Land aggregator who involved in land procurement on 23rd February 2022 has been presented in the table below

Basic details	
Location: Nagpur Village, Sakri Tehsil	District: Dhule
Project Title: ESIA of 100 MW solar power project of FPEPL	Date: 23rd January 2020
Stakeholder Group Title: Land Aggregator involved in Land Procurement	
Objective of the Interview/Consultation	
To understand the land procurement process, determination of compensation value and perception about the landowners in regard to selling land for the project, etc.	
Key discussion points	
1	**Extent and Type of Land** • The total land required for the proposed solar power project is about 450 Acres, of which 150 acres have been identified from Nagpur village and 300 acres from Bhadgaon village. • 100% of the land identified are private agriculture land and no government land is being involved in the project.

2	**Mode of Land Sourcing** • The required land is sourced through Land Agregator appointed by FPEPL i.e. Atlanta Power, Land is being procured based on the willing buyer and willing seller basis.
3	**Determination of Compensation Value** • The compensation value for the land is being determined through consultation with the landowners and the compensation value is fixed which is two times the government circle rate and higher than the prevailing market value of the region. The land procurement process is initiated after obtaining 100% consent from the landowners.
4	**Involvement of SC/ST/Nomadic Tribe Land** • No land belonging to SC/ST / Nomadic tribe population is procured for the proposed project development.
5	**Current Status of Land Procurement** • As on the date of site visit (22nd Feb 2022), sale deeds were executed for 285 acres (105 acres of total 150 acres from Nagpur Village and 180 acres of 300 acres from Bhadgaon village) and land was transferred in the name of the project developer.
6	**Grievance related to Land Procurement** • As on date there are no reported grievance among the landowners.

5.6.4 Consultations with Chairman of Nomadic Tribe School, Nagpur, Sakri

Basic details	
Location: Nagpur Village, Sakri Tehsil	District: Dhule
Project Title: ESIA of 100 MW solar power project of FPEPL	Date: 23rd February 2022
Stakeholder Group Title: Chairmen Nomadic Tribe School, Nagpur village, Sakri Tehsil	
Objective of the Interview/Consultation	
To understand the educational profile of the village as well as to get an understanding on perception of the upcoming project amongst the community members. Additionally, to understand the needs of the village.	
Key discussion points	
1	**Literacy Level of the Area** • The literacy level at the project site villages are around 60% only. And the women literacy less when compared to the men. This is due to the presence of large number nomadic tribe population.
2	**Education Amenities** • Within Bhadgaon village there is only a primary school upto Class-V and in the Nagpur village a Hr. Sec. School up to class-12. Usually, the children from Bhadgaon village reach to Sakri Tehsil for Hr. Secondary school and for technical and college studies.
3	**Reasons for lower literacy level** The reason for a very low female literacy rate is due to presence of nomadic tribe population. As discussed in detail in the earlier sub-sections, Nomadic Tribes " means tribes wandering from the place to place in search of their livelihood, since these tribes do not reside at any permanent place their children are not encourage to attend any schools.
4	**Government Intervention** • In Nagpur village, a Ashram school run by Government of Maharashtra which is residential school especially for the Nomadic Tribe children. About 800 students are currently being enrolled in the Ashram school where free food and accommodation is provided for the students
5	**Community attitude towards girl child education** • Earlier people were not willing to enrol their kids in schools considering their way of living but based on the current government intervention and various schemes implemented students including girl children are being enrolled for schools and even for higher education.
6	**Felt Needs in regard improving the education level** • Some of the felt needs with regards to education infrastructure are Construction / improvement of compound wall for the Nomadic tribe Ashram school, RO Drinking Water facility, Improvement of sanitation facility at school, etc.

Nomadic Tribe Ashram School, Nagpur Village

5.6.5 Consultations with Shepherds involved in grazing at project site, Bhadgaon village

Basic details	
Location: Bhadgaon Village, Sakri Tehsil	District: Dhule
Project Title: ESIA of 100 MW solar power project of FPEPL	Date: 23rd February 2022
Stakeholder Group Title: Shepherds involved in cattle rearing in the vicinity of the project site, Bhadgaon village, Sakri Tehsil	
Objective of the Interview/Consultation	
To understand livelihood dependency of the shepherds on the proposed project and their perception about the proposed solar power project.	
Key discussion points	
1	**Major Source of Livelihood** • The shepherds are from Raipur village which is located at 8 km from the project, the major source of livelihood for the Raipur village people is cattle rearing. Most of the people work in the farms of the large farmers. The person involved in cattle rearing are paid Rs. 20,000 / year with food, shelter, and clothing.
2	**Does the Proposed project site is a dedicated Grazing land?** • No, dedicated grazing fields are far from the project site i.e. near to the hillock at a distance of 1-2 km from the project site.
3	**Perception about the project and will there be any hindrance to grazing?** • They welcome the project as it may create new employment opportunities as the area is dry and not feasible for doing extensive cultivation. The project development may create sustainable income source among the locals. • The proposed project will not be a hindrance to the people involved in grazing as the proposed project site is not a dedicated grazing land or not obstructing the traditional path to reach the grazing fields.

Consultation with the Shepherds	
	

5.6.6 Consultations with Allopathic Medical Practitioner, Sakri Tehsil

Basic details	
Location: Nagpur Village	District: Dhule
Project Title: ESIA of 100 MW solar power project of 4PEL	Date: 23rd February 2022
Stakeholder Group Title: Private Medical Practitioner, Nagpur Village, Sakri Tehsil	

Objective of the Interview/Consultation	
To understand the existing health facilities in the project vicinity, health status and common illness if any among the local community and the perception about proposed solar power project.	
Key discussion Points	
1	**Nearest Health Facility** It was stated that there is no Primary Health Centre functional within the project villages, the nearest Government hospital is Sakri Primary Health Centre
2	**People - availing medical facilities** People are availing medical aids mostly from the Sakri PHC, including maternity care. For major ailments the patients are referred to District General Hospital located at Dhule and further private multi-speciality hospitals as Mumbai and Nashik.
3	**Existing Medical Facility** It was stated that there is no Primary Health Centre within these villages, the nearest Government hospital is Sakri Primary Health Centre, however there is a private clinic serving in Nagpur Village. The nearest health facility Primary Health Centre (PHC) located at Sakri Town which at the distance of about 17km from the project villages. The PHC is having maternity care centre and is of 50 bed capacity. The study area is covered by 108 Ambulance services and under National Health Mission (NHM). Anganwadi centres are located in both the project villages.
4	**Is there a common illness endemic to the region?** As reported, there are no existing common illness or disease endemic to the region.

6. Analysis of Alternatives

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

- No Project Scenario;
- Alternate Location for the Proposed Project;
- Alternate Methods of Power Generation;
- Alternate Technology for Proposed Project; and
- Alternate Routes for Transmission Lines.

6.1 No Project Scenario

India being a tropical country is blessed with good sunshine over most parts, and the number of clear sunny days in a year are also quite high. The country receives solar energy equivalent to about 5,000 trillion kWh per year, with most parts receiving over 4-7 kWh per sq. m per day. India's equivalent solar energy potential is about 6,000 million GWh of energy per year. The State of Maharashtra is blessed with about 250-300 sunny days per year.[23]

According to a survey conducted by the World Energy Council, as the population increases and as the growing rate of electrification places huge requirements on energy supplies, the total primary energy demand of India is expected to increase by almost 150% by 2035. The anticipated power supply position of Maharashtra in terms of energy requirement and demand for the year 2021-2022 is given in ***Table 6-1.***

Table 6-1: Anticipated Power Supply position of Maharashtra in 2022-2023

State	Requirement (Million Units)	Availability (Million Units)	Surplus (+)	
			Million Units	%
Maharashtra	178,257	190,247	11,990	6.7

Source: Load Generation Balance Report, 2022-2023, Central Electricity Authority, Ministry of Power[24]

Maharashtra's total Installed Solar power capacity was reported to be nearly 2290 MW as per the Ministry of New and renewable energy.

The Maharashtra Electricity Regulatory Commission (MERC) as per their draft policy announced its renewable purchase obligation (RPO) from 2020 to 2025. The solar RPO targets mentioned in the policy draft will start at 4.5%, going up to 13.5% over the next five years. Thus to meet the target requirements, increase in the solar power potential is emphasized

Among the renewable sources of energy, solar energy has a huge potential for power generation in Maharashtra. There are 250-300 days of clear sun with an available average radiation of 4 to 6 kWh/sq.metre over a day. There is a capacity to generate 1.5 million units/MW/year through solar photovoltaic systems & up to 2.5 million units/MW/ year through solar thermal systems. Maharashtra is already in process to boost this enormous source and interested solar project developers can submit their proposals to MEDA[25].

The proposed project is an opportunity to utilize the solar potential of the area for power generation. A "No Project Scenario" assumes that the project will not be carried out. A "No Project Scenario" will not solve the issue of progressive deficit at National level. An alternative without the project is undesirable, as it would worsen the power supply-demand scenario, which would be a constraint on economic growth. Additionally, continued use of traditional fossil fuel sources for power generation will have adverse effect on the environment.

[23] Solar Power | Maharashtra Energy Development Agency (Govt. of Maharashtra Institution), India (mahaurja.com)
[24] L.G.B.R. Report - Central Electricity Authority (cea.nic.in)
[25] Solar Power | Maharashtra Energy Development Agency (Govt. of Maharashtra Institution), India (mahaurja.com)

6.2 Alternate Location for Project

Solar power projects are non-polluting energy generation projects and are dependent on the availability of sufficient solar irradiation. The state of Maharashtra receives good amount of solar irradiation. Due to its geographical and environmental advantages, Maharashtra has huge potential for solar power generation. Among the renewable sources of energy, solar energy has a huge potential for power generation in Maharashtra. There are 250-300 days of clear sun with an available average radiation of 4 to 6 kWh/sq.metre over a day. There is a capacity to generate 1.5 million units/MW/year through solar photovoltaic systems & up to 2.5 million units/MW/ year through solar thermal systems. Maharashtra is already in process to boost this enormous source and interested solar project developers can submit their proposals to MEDA.[26]

The following additional criteria have been considered for site selection:

- The proposed site is located away from major settlements;
- The site does not fall under any reserved or protected forests;
- The land procured for the site mainly comprises of barren land in nature and practically unusable for any other purpose; and
- No environmentally sensitive features such as water bodies, forests, archaeological sites are located in the immediate site surroundings. There is one temple located at about 1 km from the Bhadgaon land parcel but the same is not affected by the site.

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

6.3 Alternate Source of Power Generation

As of October 2021, India's renewable energy capacity stood at 1.49 GW representing ~38.27% of the overall installed power capacity and providing a great opportunity for the expansion of green data centres. In October 2021, India's renewable energy capacity increased by 1,522.35 MW (megawatt).

As of September 2021, India had 101.53 GW of renewable energy capacity and represents ~38% of the overall installed power capacity. The country is targeting about 450 Gigawatt (GW) of installed renewable energy capacity by 2030 – about 280 GW (over 60%) is expected from solar. By December 2019, 15,100 megawatts (MW) of wind power projects were issued, of which, projects of 12,162.50 MW capacity have already been awarded. Power generation from renewable energy sources in India reached 127.01 billion units (BU) in FY20 and installed renewable power generation capacity has gained pace over the past few years, posting a CAGR of 17.33% between FY 2016-2020. Solar power installed capacity has increased by more than 18 times from 2.63 GW in March 2014 to 49.3 GW in at the end of 2021. In FY22, till December 2021, India has added 7.4GW of solar power capacity, up 335% from 1.73 GW in the previous year. Off-grid solar power is growing at a fast pace in India, with sales of 329,000 off-grid solar products in the first half of 2021.

With a potential capacity of 363 GW and with policies focused on the renewable energy sector, Northern India is expected to become the hub for renewable energy in India.[27]

Coal fired power plants have the highest Greenhouse Gas (GHG) emission intensities on a lifecycle basis. Although natural gas, and to some degree oil, have noticeably lower GHG emissions. Biomass, nuclear, hydroelectric, wind, and solar photovoltaic all have lifecycle GHG emission intensities that are significantly lower than fossil fuel-based generation. UNEP's report estimates that the lifecycle GHG emission intensity of solar power generation is consistent with renewable energy sources including biomass, hydroelectric and nuclear.

As per the estimation of International Atomic Energy Agency (IAEA) the grams of carbon equivalent (including CO_2, CH_4, N_2O etc.) per kilowatt-hour of electricity (g Ceq/ kWh) for Solar energy project are low and scores better when compared with other forms of conventional and non-conventional sources of energy.

[26] Solar Power | Maharashtra Energy Development Agency (Govt. of Maharashtra Institution), India (mahaurja.com)
[27] Renewable Energy Industry in India: Overview, Market Size & Growth | IBEF

Various power generation options can be evaluated on the levelled cost of power generation which includes the capital and O&M costs and reliability of power generation in terms of plant load factor. The comparative analysis of various power generation options based on these factors has been presented in ***Table 6-3***.

Table 6-2 Comparative analysis of Various Power Generation Options

S. No.	Power Generation Method	Cost (Rs/kWh) *	Plant Load Factor**	Average Life Cycle of GHG Emission (tonnes CO_2e/ GWh) ***
1.	Coal	2.5	65-85%	888
2.	Natural Gas	3.9	70-85%	500
3.	Hydro	3.8	30-50%	26
4.	Nuclear Power	2.5-5.7	65-85%	28
5.	Wind Energy	4.2	25-40%	26
6.	Solar	15.3-17.1	10-15%	85

*Source: *LBNL, CERC, CSTEP & NPCIL; ** Renewable UK; *** World Nuclear Association Report*

Although power generation options using conventional sources offer advantages such as lower levelled costs of power generation and higher plant load factors, the operation and maintenance of solar power projects does not involve air emissions or effluent discharges. Other environmental pollution (stack emissions, ash management etc.) issues are also insignificant. Also, there are no significant social issues associated with solar power projects as the land was government owned and did not have any habitations.

Considering all the above-mentioned favourable scenarios existing nationally and locally for solar power generation, there is no requirement of an alternative method. Low GHG emissions during the entire project life cycle; availability of appropriate lands, solar power generation is the most appropriate alternative in the project area.

6.4 Alternate Project Technology

There are different types of solar panels available for accumulation of solar energy, the proposed project intends to utilize Crystalline Silicon Photovoltaic Technology based on general comparisons of various parameters such as temperature & efficiency, cost effectiveness, durability, and bankability of modules. The production of polycrystalline cells is more cost-efficient which are manufactured by cooling a graphite mould filled with molten silicon. These cells have module efficiency of around 17.01%.

The energy accumulated from the solar panels is converted from DC to suitable AC power for feeding to the grid. This process is environmentally advanced than creating battery bank for storage of energy, which minimizes the hazards related to handling and disposal of batteries. A comparison of the characteristics of the most popular cell technologies have been presented in ***Table 6-4***.

Table 6-3: Characteristics of some PV Technology Classes

Parameter	Crystalline	Thin Film	Thin Film	CPV
Types of Materials	Polycrystalline	Amorphous Silicon, CdS, CdTe etc.	Micro Amorphous	Triple Junction GaAs Cell & lens, tracker
Handling	Better protection against breakage	Not Guaranteed	Guaranteed but not proven	Installation would be at site. Not Guaranteed
Power Efficiency	13-16%	6-8%	9-11 %	20-25%
Technology	Well Developed	Stable for Proven Performance	Under development	Under development
Module Weight	Light weight modules	Heavier modules	Heavy modules	Heaviest System
Area utilization	Higher power generated per unit area due to high efficiency	Less power per unit area	Less power per unit area	Highest power per unit area

Parameter	Crystalline	Thin Film	Thin Film	CPV
Temperature Effects	Temperature variations affect output	Least impact of Temperature variations	Lesser impact of Temperature variations	High variation
Irradiance	Used particularly for Normal radiations	Better performance with Diffuse radiations	Better performance with Direct and Diffuse radiations	Works only for Normal radiations
Module quantity	Lesser no. required due to high efficiency	More modules required	Moderate number of modules required	Lowest nos. of modules required
Output per MW installed	High	Highest Output in Indian Conditions	Varies as per sunlight condition and various locations	Very High(due to tracking)
Transportation Cost	Lower Transportation cost	Higher cost	Lesser cost compared to amorphous	High cost
Mounting Structure	Fewer Mounting structure required per KW power	More Mounting structures required	More Mounting structures required	Sophisticated mounting required
Land Requirement	Lesser space required per MW	Largest space requirement	Larger space required per MW	Lowest space required
Inverter	High inverter flexibility	Limited inverter flexibility	Limited inverter flexibility	Limited inverter flexibility
Cost	High cost per Watt	Lower cost per Watt	Higher Cost per watt	Highest cost per Watt
Stabilization	Stable power output at initial stages	Stability achieved after 4-6 months	Stability achieved after 4-6 months	Unknown
Power Degradation	Less Degradation	Lower Degradation	Lower Degradation	High Degradation
Plant Maintenance	Less maintenance required after installation so lower cost	Highest maintenance required, so highest maintenance cost	Less maintenance required after installation so lower cost	High maintenance required, so high maintenance cost
Cooling Requirement	Not required	Not required	Not required	Requires active or passive cooling which could increase cost
Cabling	Well known, and lower cabling losses	Well Understood but yet difficult due to higher number of arrays	Well Understood but yet difficult due to higher number of arrays	Complex and under development. Cabling losses expected to be high

The calculation of the performance ratio for a given solar power installation needs to take into account several key losses. These typically fall into three broad categories:

- Irradiation Losses
- PV Module Losses
- System Losses

As per the PV-Syst report, all these losses have been analysed and taken into consideration before selection of the technology.

6.5 Alternate Transmission Line Route

As per information provided by FPEPL, a 33kV line is passing between Nagpur and Bhadgaon land which is approximately 1.5kms. This gets connected to 132/33kV switch yard in Bhadgaon which gets further connected to 1.32 kms away LILO point where an existing 132kV Sakri-Dhule Transmission line. The power will be further evacuated through a substation which is 6 kms away from the project land. The RoW of the transmission line is finalized and is mostly passing through agricultural land parcels. The final route for the transmission line would be selected based on the following factors.

- To avoid any habitations along the route;
- No house or community structures are located under the transmission line;

- Areas requiring extensive clearing of vegetation have been avoided; and
- Selection of the transmission route avoids any environmental sensitive site, if identified.

Hence, with multiple benefits of clean energy production, employment generation and attempt to elevating the standards of rural economies, the project would prove advantageous to all realms of the society and nation. The transmission line details were not available, however, as per the discussions with the Site representative, the project with all the chosen options such as site selection, mode of power generation, selections of technology, transmissions lines etc., is appropriate alternative causing minimal disturbance to the surrounding regions.

7. Impact Assessment

This chapter describes the environmental and social impacts identified by accessing the primary and secondary information gathered. Impacts have been identified based on review of available project information, discussions with representatives of the project and the local community, as well as sector-specific professionals and subject experts. Impacts anticipated during the operation phase have also been included and classified.

Additionally, this chapter evaluates the significance of each identified impact based on the collective severity of its spread, duration, intensity, and nature. Mitigation measures have been suggested for each identified impact evaluated as significant.

7.1 Impact Assessment Criteria

Identified impacts have been appraised along the criteria of spread, duration, intensity and nature. As presented in ***Table 7-1***, each appraisal criterion is further classified based on the level or type of its spread, duration, intensity, or nature, while stating the defining limit of each level or type.

Table 7-1: Impact Assessment Criteria

Criteria	Sub-Classification	Defining Limit	Remarks
Spread: Refers to area of direct influence from the impact of a particular project activity.	Local spread	impact is restricted within the footprints of the Project boundary	In case of biodiversity, the farthest directly impacted habitat or ecosystem service would be considered
	Medium Spread	impact is spread up to 2 km around the project area	In case of biodiversity, the farthest directly impacted habitat or ecosystem service would be considered
	High spread	impact is spread beyond 2 km from footprint boundary of the Project	In case of biodiversity, the farthest directly impacted habitat or ecosystem service would be considered
Duration: Based on duration of impact and time taken by an environmental aspect to recover to its original state	Short Duration	when impact is likely to be restricted for a duration less than 2 years	In case of biodiversity, the anticipated recovery time of impacted habitats or ecosystem services would be considered
	Medium Duration	when impact extends up to five years	In case of biodiversity, the anticipated recovery time of the impacted habitats or ecosystem services would be considered
	Long Duration	when impact extends beyond five years	In case of biodiversity, the anticipated recovery time of the impacted habitats or ecosystem services would be considered
Intensity: Defines the magnitude of impact	Low intensity	when changes in the prevailing (baseline) environmental conditions does not exceed 20%	In case of biodiversity, percentage of loss or degradation of habitats and/or ecosystem services would be considered
	Moderate intensity	when changes in the prevailing (baseline) environmental conditions does not exceed 30%	In case of biodiversity, percentage of loss or degradation of habitats and/or ecosystem services would be considered
	High intensity	when changes in the prevailing (baseline) environmental conditions exceeds 30%	In case of biodiversity, percentage of loss or degradation of habitats and/or ecosystem services would be considered

Nature: Refers to whether the effect is considered beneficial or adverse	Beneficial	-	Useful to Environment and Community
	Adverse	-	Harmful to Environment and Community

Table 7-2 presents the Impact Significance Matrix applied in order to assess the overall significance of the impacts appraised as per the Impact Assessment Criteria outlined in Table 7-1.

Table 7-2: Impact Significance Matrix

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

7.2 Impact Identification

Table 7-3 below presents the Activity-Impact Interaction matrix for pre-construction, construction, operation and decommissioning phases of the project, based on environmental and occupational health and safety variables. Each of the impacts identified has been further discussed and corresponding mitigation measures have been proposed.

Table 7-3: Activity- Impact Interaction Matrix – Pre-Construction, Construction, Operation & Decommissioning Phase

Project Activities	Receptors/Resources										
	Aesthetics and Visual impacts	Ambient Air and Noise Quality	Soil Quality	Surface and Ground water Quality	Water resources	Land Use	Traffic & Transport	Ecological Impact	Social-Economic Impact	Community Health and Safety	Occupational Health and Safety Hazards
Pre-Construction and Construction Phase											
Land Procurement											
Site Clearance, Site Levelling and Grading											
Sourcing and Transportation of Construction Materials and equipment											
Storage and Handling of Raw Materials and Debris											
Establishment and Use of Labour Camp											
Civil Works (PV Module foundations, access road construction etc.)											
Operation of DG sets											
Erection of Solar Modules and Laying of Transmission Lines											
Transformer yard construction											
Handling and Disposal of Wastes											
Operation Phase											
Solar Panel Operation											
Maintenance of ancillary facilities such as store, yard, site office											
Site Maintenance and Security											
Handling and Disposal of Waste											
Material Handling and Storage											
Water Requirements for employees											
Repair and Maintenance of Solar Panels											
Inspection and maintenance of transmission lines											
Decommissioning Phase											
Removal of Solar Panels											
Removal of Foundations											
Site Restoration											
Waste Management											

Project Activities	Receptors/Resources										
	Aesthetics and Visual impacts	Ambient Air and Noise Quality	Soil Quality	Surface and Ground water Quality	Water resources	Land Use	Traffic & Transport	Ecological Impact	Social-Economic Impact	Community Health and Safety	Occupational Health and Safety Hazards
Material Handling and Storage											
Water Requirement for Employees											
Loss of Employment											

7.3 Environmental Impacts and Mitigation Measures

7.3.1 Impacts during the Pre-construction and Construction Phase

During the construction phase, the following activities may have impacts on environment:

- Site Preparation;
- Excavation and levelling;
- Hauling of earth materials and wastes;
- Cutting and filling;
- Erection of concrete and steel structures;
- Painting and finishing;
- Clean up operations; and
- Landscaping

7.3.1.1 Ambient Air Quality

Anticipated Impacts

The impact on ambient air quality is anticipated due to the various Project activities. Project components such as site preparation, transmission cable laying, switchgear, internal road network, transportation of raw materials and porta cabins, along with land clearing, levelling, excavation, grading activities, vehicle movement and Diesel Generator (DG) sets operation. The main impacts associated with construction activities will be:

- **Dust Generation:** resulting from earthworks such as levelling, grading, excavation works, piling and movement of vehicles across dirt/unpaved roads, especially during windy conditions.
- **Exhaust Emissions:** Exhaust emissions of SO_2, NO_X, CO, CO_2 and PM_{10} will be attributed predominantly to the construction of the plant, road activities such as movement of trucks and vehicles during construction works and point source emissions from the batching plant to be installed during construction phase. These emissions will be restricted to the project area and are anticipated to be generated in medium concentration. However, it will be dispersed rapidly within the area leading to an impact of low significance. This implies the effects to be of localized nature and temporary which indicates that any deterioration in air quality at project location is unlikely to be significant and is expected to be transient.

Mitigation Measures

- The FPEPL and contractors shall ensure the reduction and control of air emissions from construction activities by minimizing dust from material handling sources.

- Loading and unloading of raw materials should be carried out in the most optimum way to avoid fugitive emissions.
- Sprinkling of water to be carried out by the respective contractors to suppress dust from construction activities.
- Best practices such as halting of activity during sustained strong winds should be opted for. It shall be ensured that all stockpiles are covered, and storage areas provided with enclosures to minimize dust from open area source.
- Stock piling and storage of construction material will be oriented after considering the predominant wind direction.
- Vehicles engaged for the project will be required to obtain "Pollution under Control" (PUC) certificates.
- Sufficient stack height needs to be provided to D.G. sets as per the Central Pollution Control Board (CPCB) norms.
- Speed of vehicles on the village road and on the internal roads shall be limited to 10-15 km/hr in order to reduce fugitive dust emissions.
- Cease or phase down work if excess fugitive dust is observed, or there are any community grievance related to dust. Investigate the source of dust and ensure proper dust suppression.

Significance of Impact

The impact on ambient air quality will have moderate intensity with medium spread for a short duration which will result in an overall moderate impact without mitigation. With mitigation, after control of intensity the significance of the impact will reduce to minor owing to the short duration of construction.

Table 7-4: Impact Significance – Ambient Air Quality

Aspect	Scenario	Spread	Duration	Intensity	Overall
Ambient Air Quality	Without Mitigation	Medium	Short	High	Moderate
	With Mitigation	Local	Short	Medium	Minor

7.3.1.2 Soil Quality

Anticipated Impacts

The project location has a solid textured soil. Loose topsoil will be generated due to excavation on project site during site levelling for erection of module structures and internal roads preparation. The impact anticipated here is loss of topsoil, which can be due to inappropriate storage. However, these activities and associated impacts are limited to be within the project boundary and during construction phase only. The intensity of the impact can be considered as medium as the site was observed to be relatively flat and levelling would be required only at a few places. Soil contamination may result due to accidental spillage and inappropriate storage of PV panel components, diesel or transformer oil during construction phase.

Mitigation Measures

- Provide appropriate storage of top soil in an isolated and covered area to prevent its loss in high solar and runoff.
- Allow only covered transportation of top soil within the project site.
- Use top soil at the time of plantation and it can be given to nearby agricultural field after taking consent with the landowners/farmers.
- Low height native plantation /grass cultivation activities will be undertaken to appease the chances of soil erosion by client and its contractors.
- Store hazardous material like diesel and used oil in isolated room and on impervious surface to prevent seepage into project site soil.

- Storage and disposal of hazardous waste in line with Hazardous Waste (Management, Handling & Transboundary Movement) Rules, 2016. Hazardous waste will be disposed to State Pollution Control Board authorised vendor only.
- Filling and transfer of oil to and from the container shall be on impervious surface.
- Provision of mobile toilets and septic tanks for usage of project team / workers
- Broken solar panels should be stored on paved surface and be handed back to manufacturers/ authorised recycler.
- Provision of mobile toilets and septic tanks for usage of project team / workers
- Disposal of recyclable solid waste through local vendors with appropriate permission from concern authorities. Recyclable waste to be disposed to recycler.
- Storage and disposal of hazardous waste in line with Hazardous Waste (Management, Handling & Transboundary Movement) Rules, 2016. Hazardous waste will be disposed to State Pollution Control Board authorised vendor only.

Significance of Impact

Considering the distribution of impact within the project boundary and short duration of construction phase with low intensity makes impact of low significance and can be controlled with the recommended mitigation measures.

Table 7-5: Impact Significance – Soil Quality

Aspect	Scenario	Spread	Duration	Intensity	Overall
Soil Quality	Without Mitigation	Medium	Short	High	Moderate
	With Mitigation	Local	Short	Moderate	Minor

7.3.1.3 Impact on Surface and Ground Water Quality

Anticipated Impacts

Surface Water:

The surface topography of the project site can be characterized as mix (flat and mild undulations). Alteration of soil structure during construction could lead to erosion and subsequent siltation in the surface water bodies at the nearby areas. Changes in surface hydrology can in turn adversely affect conditions that maintain healthy biological resources especially the avifauna. Accidental spillage of hazardous materials, improper disposal of solid, liquid and hazardous wastes and contaminated surface runoffs from the Site.

During the construction works, there is a possibility of contaminated runoff from the site as the activities involve the installation of solar modules, underground cables, soil compaction, increased run off and sedimentation of surface waters. Any spillage of chemicals or disposal of waste in or near surface seasonal streams can cause water pollution issues in nearby areas.

Ground Water:

As per ground water resource estimation all the talukas in Dhule have been categorised as “Safe” and hence none of the taluka has been notified either by CGWA or SGWA[28]. During the construction phase, labour camp and portable cabins will be set up at the project site and hence generation of domestic wastewater from the labour camp and portable cabins is anticipated. Improper disposal of sewage and wastewater from worksite and construction debris can contaminate the groundwater resources in the area since groundwater depth is very shallow.

Mitigation Measures

- Construction of dedicated storm water drains for reduction any contamination to runoff due to project activities. Storm water drains shall be designed considering natural topography to avoid any obstruction

[28] http://cgwb.gov.in/District_Profile/Maharashtra/Dhule.pdf

to natural flow and final outlet shall be connected to propose storm water drains by Solar Power Park Developer;

- Proper drainage to be provided for wastewater generated from the Porta Cabins and labour camps and shall be treated on Site septic tanks and soak pits as per the specifications in IS 2470:1995 (Part I and Part II);
- Periodic monitoring shall be carried out to ensure that the waste water is not finding its way into surface and groundwater;
- All solid wastes such as construction debris, used or waste oil, paint cans, etc. will be stored on impervious surface in secure location to avoid soil and groundwater contamination;
- Paved impervious surface and secondary containment to be used for fuel storage tanks;
- Loading and unloading protocols should be prepared and followed for diesel oil and used oil;
- Drip paned provided to vehicles with leaks to prevent water contamination;
- Leak proof holding tanks for sanitary waste water to protect the shallow ground water level.

Considering the distribution of impact within project boundary and short duration which will result in an overall moderate impact without mitigation. However, with proper implementation of suggested mitigation the overall impact will be negligible.

Table 7-6 Impact Significance – Impact on Surface and Ground Water Quality

Aspect	Scenario	Spread	Duration	Intensity	Overall
Impact on Surface and Ground Water Quality	Without Mitigation	Local	Short	High	Moderate
	With Mitigation	Local	Short	Low	Insignificant

7.3.1.4 Impact on Water Availability

Anticipated Impacts

In the construction phase, water will be required for civil work during the preparation of concrete, construction of the foundation and building structure of all facilities, as well as for worker needs water for their daily use. The Project's water use has the potential to result in decreased water available for other users, particularly in the Project area where known water resource challenges. As per the information provided by the Site personnel, the main water supply will be provided by the local suppliers in the form of water tankers. Domestic water requirement will be only for drinking, which will be met by packaged drinking water.

Mitigation Measures

Water for construction activities, flushing and washing purpose will be met through water supplied from tankers. It is to be ensured that pre-treatment is provided to ground water, in case ground water is utilized for drinking. It is also suggested that the quality of water from the bore wells is monitored regularly to check for contamination, if any. The other mitigation measures to be implemented are:

- The water for construction should only be sourced from authorized sources through tankers.
- The drainage will be designed in such way that natural storm water flow is maintained.
- It shall also be ensured that levelling of project site will not cause accumulation of surface runoff in adjacent surrounding areas.
- Conserve water at all project locations and ancillary facilities and if possible recycle and reuse water utilising every opportunity.
- Sourcing of water tanker from area where ground water is reported to be under "Safe" category should be considered by the EPC contractor.
- No chemicals / oils to be stored near any water body.

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

Significance of Impact

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

Table 7-7: Impact Significance – Impact on Water Availability

Aspect	Scenario	Spread	Duration	Intensity	Overall
Impact on Water Availability	Without Mitigation	Medium	Short	High	Moderate
	With Mitigation	Local	Short	Moderate	Minor

7.3.1.5 Ambient Noise Quality

Anticipated Impacts

Construction will cause increased noise levels due to activities such as grading, excavating and drilling for foundations, concrete batching, construction of ancillary structures, and operation of diesel generators, material movement and site clean-up, and construction equipment like dozer, scrapers, concrete mixers, generators, pump, rock drills etc. There is potential for disturbance to habitations in proximity of construction site. Movement of traffic during night hours can also disturb the local community. Approximately 90 – 92 dB (A) of noise is expected to be generated from construction activities which will attenuate to less than 45 dB(A) i.e. night time prescribed noise level at about 80 m. The nearest habitations from the proposed Project site include Vardhane Village which is approximately 2 kms away from both the land parcel, and is south to bhadgaon whereas west to Nagpur.

Additionally, the baseline noise levels measured at South west, north and eastern boundary indicated that the baseline noise is below the Industrial Zone Standards specified in Noise Pollution (Regulation and Control) Rules, 2000 however observed to be above the Residential Zone standard limits.

Mitigation Measures

- Use DG set with acoustic enclosure
- Restrict major noise generating activities during night time 10:00 pm to 6:00 am
- Provide personal protective equipment (e.g. ear muffs) to all workers wherever noise is generated due to machinery operation.
- Regular maintenance of project vehicles.
- Special acoustic enclosures should be provided for individual noise generating equipment's, wherever possible.
- Low noise equipment shall be used as far as practicable

- The number of equipment operating simultaneously shall be reduced as far as practicable
- Workers should be prevented from continuous exposure to noise.
- Provision of personal protective equipment (PPE) to workers, wherever noise is generated due to machinery operation.
- During material movement, honking should be done cautiously to avoid disturbance to locals.
- In case of complaints of higher noise levels and uncomforting received from the inhabitants of nearby settlements possibility of putting noise barriers near to the receptor need to be considered.
- All nearby community will be informed about the GRM and the grievance would be addressed on priority bases.

Significance of Impact

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

Table 7-8: Impact Significance – Ambient Noise Quality

Aspect	Scenario	Spread	Duration	Intensity	Overall
Ambient Noise Quality	Without Mitigation	Mitigation	Short	High	Moderate
	With Mitigation	Local	Short	Moderate	Minor

7.3.1.6 Solid and Hazardous Waste Management

Anticipated Impacts

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

- Domestic solid waste and sewage from labour accommodations;
- Used oil, oil lined containers, oil-soaked rags from generator and other construction machinery;
- Packaging waste such as gunny bags, plastics, etc.;
- Empty paint containers, metal scrap, chemical lined containers etc.;
- Broken or damaged solar panel(s); and
- Construction debris.

The construction debris generated due to the construction activities will have the potential for spread to areas outside the project boundary during construction phase. The dust particles from debris generated during construction activities can be carried along with the wind into nearby areas, thereby increasing the particulate matter in the area. However, this will happen only for a temporary period as the construction activities will be for small duration only. Improper disposal of solid waste from the labour camps and lack of proper sanitation facility for labour can lead to unhygienic conditions due to open defecation and spread of diseases in the area. It can also lead to discontent of local community and result in conflicts with the labour engaged at site.

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

Mitigation Measures

- The quantity of domestic waste generated daily from the labour accommodations will be small and limited as most of the workers will be hired locally. Also, one labour camp will be set up wherein migrant workers will be accommodated. The EPC Contractor shall ensure that the labour camp has adequate waste disposal facilities. Arrangements for collection of garbage in dustbins and daily disposal to the nearest dumpsite/local waste disposal agency shall be made.
- Provision of segregated toilets for male and female workers (if any) in the ratio of 1:15 and 1:10 (toilet to workers) respectively shall be made at the project site in order to maintain hygienic and clean surroundings. Washing and bathing areas should be provided with proper drainage system so that wastewater is not accumulated in the project site. Disposal of sewage shall be made through a septic tank – soak pit arrangement.
- Waste/used oil generated from generators and construction machinery and equipment, oil lined containers, oil-soaked rags etc. should be stored on paved surface in a secure location at the project site. Appropriate secondary containment capable of containing 110 percent of the content of the largest storage tank should be provided. The used oil and oil lined containers, which are characterized as hazardous wastes according to the Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016, should be sold to Maharashtra Pollution Control Board (MPCB) approved vendors at frequent intervals.
- The excavated material generated will be reused for site filling and levelling to the maximum extent possible.
- Ensure contractual obligation that necessitates broken solar panels will be accepted by manufacturer.
- Waste oil from transformer will be collected and stored in paved and enclosed area and subsequently sold to SPCB authorised recyclers.
- All packaging material should also be collected at the storage area and sold to authorized scrap dealers. Storage of oil/chemicals shall be undertaken on paved impervious surface and secondary containment shall be provided for fuel storage tanks.
- Construction debris and excavated material to be stored in a confined area to prevent spread by wind or water. The construction debris to be used for backfilling of excavated areas and for foundation works at site.
- Recyclables viz. paper, plastic, glass, scrap metal waste etc. will be properly segregated and stored in designated waste bins/containers and periodically sold to local recyclers. Any recyclable waste should be encouraged to be recycled at the site. Any waste/damaged part of solar panel(s), broken solar panels will be sent back to panel vendor for disposal.

Significance of Impact

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

Table 7-9: Impact Significance – Waste Storage and Disposal

Aspect	Scenario	Spread	Duration	Intensity	Overall
Waste Storage and Disposal	Without Mitigation	Medium	Short	High	Moderate
	With Mitigation	Local	Short	Moderate	Minor

7.3.1.7 Traffic and Transport

Anticipated Impacts

The construction phase shall involve transportation of construction materials, solar modules and mounting structures. The project site can be accessed through SH 11 which starts from the Raipur village which will be 2.88kms away from the 132kV station to be constructed and 1.64 kms from the existing Lilo point. This road can be accessed via NH 753B from Sakri taluka. The nearest Airport from Dhule is Chikkalthana Airport, located at

Aurangabad, roughly 156 Kms from Dhule. This road network will be utilized for transportation of machines and solar modules. The Project construction activities will lead to additional traffic and increased risk of traffic related accidents and industries to community and to workers.

The traffic density along the State Highway is low and has adequate carrying capacity to accommodate the additional traffic due to the construction activities. However, the village road at are narrow (~3-5 m wide) and hence increased vehicular movements in the Project area, through the village roads may have adverse impacts in the community due to increased risk of traffic related accidents and injustices and increased pollution.

Mitigation Measures

A Traffic Management Plan is required for the management of traffic due to movement of vehicles for transport of equipment and material. Additional traffic on the village road connecting to Project site can be managed by following mitigation measures:

- Only trained drivers with valid license shall be recruited by the EPC Contractor for transfer of material;
- Training program for all the drivers, regarding awareness about road safety and adopting best transport and traffic safety procedures shall be provided before initiation of the decommissioning activities;
- Mitigation measures such as emphasizing on safety amongst drivers, adopting limits for trip duration and arranging driver roster to avoid overtiredness and avoiding dangerous routes and times of day to reduce risk of accident shall also be implemented;
- Regular maintenance of vehicles and use of manufacturer approved parts should be adopted to minimize potentially serious accidents caused by equipment malfunction or premature failure;
- The villagers shall be made aware about the schedule prior to the movement of trucks and transportation in the Project area.

Significance of Impact

Table 7-10 Impact Significance – Impact on Traffic and Transport

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

7.3.1.8 Occupational Health and Safety

Anticipated Impacts

Occupational Health and Safety (OHS) of workers is important during construction and operation phases where local and migrant workers are involved. The activities included in the construction phase that have potential impact to OHS of workers are land clearance for establishment of temporary structures, batching plant, access road, mobilisation of equipment and solar PV installation.

There are likely to be potential impacts on worker's health and safety due to exposure to risk through the project development activities. The following occupational health and safety risks are frequently present, in particular during the construction phase:

- Mobile vehicles and heavy equipment accidents;
- Heat stress when working in humid and high temperatures;
- Manual handling and musculoskeletal disorders;
- Hand are vibration impacts from concrete breakers, grinders, hammer drills, chipping hammers, chainsaws, scrabbles and needle guns;
- Temporary or permanent hearing loss from noise generated machinery used for excavation or piling work;

- Dermatitis that can rise from contact with small substances such as wet cement and asphalt;
- Tripping due to uneven surfaces and obstacles;
- Falling during working at height;
- Fire due to hot works, smoking and failure in electrical installations; and
- Electrical shocks.

Mitigation Measures

The above identified risks are typical on any construction site of this nature. Therefore, it is anticipated that the sub-contractor will have the necessary management measures in place to manage potential OHS issues under their responsibility. Appropriate OHS programme and procedures are also expected to be in place to align with the local regulations, as well as IFC PS-2. The procedure will include at minimum, the following measures:

- Develop and implement a Health and Safety (H&S) plan to follow throughout the construction phase;
- Provide occupation health and safety orientation training to all employees and workers consisting of basic hazard awareness, site-specific hazards, safe working practices, and emergency procedures;
- The contractors will be committed to ensure all Health and Safety measures are in place to prevent accidents and reduce the consequences of non-conformance events;
- The contractors will provide training, awareness and supervision to ensure all of its construction workers comply with the OHS procedures;
- The contractor will provide appropriate resources i.e. PPE to workers on Site; and
- An emergency response procedure and infrastructure will be available on Site to ensure provision of first aid for personnel in case of emergency.

Heat related Stress

- As the construction work will be carried out in months of extreme summer heat, heat- related illness can have significant impact on health of the workers engaged at the site. Heat-related illness is a spectrum of disorders due to environmental exposure to heat. It includes conditions such as heat cramps, fainting, convulsion, heat fatigue, rashes, and heat exhaustion as well as the more severe condition known as heat stroke. The heat stress can be due to many factors such as air temperature, humidity, radiant heat, wind speed, workload, physical fitness of the worker, hydration status of the workers and clothing (including PPE that may restrict air flow across the skin and hinder evaporation of sweat).
- Additionally, Ultraviolet (UV) radiation burns occurs when the skin is exposed to UV radiation from been out in the sun or from activities such as welding. The symptoms include reddening and inflammation of the skin and blistering and peeling of the skin in severe cases.

Mitigation Measures

The above identified risks are typical on any construction site of this nature. Therefore, it is anticipated that the EPC contractor will have the necessary management measures in place to manage potential issues under their responsibility. The procedure will include at minimum the following measures:

- Increase air velocity for indoor workers by using natural cross-ventilation from windows and doors or mobile or ceiling fans. This increases both evaporation of sweat and convective heat loss, and may significantly improve thermal comfort at air temperatures as high as 40°C;
- Operate effective general and local exhaust ventilation and air conditioning;
- Avoid non-essential sources of hot ventilation (e.g. air conditioner outlets adjacent to working areas);
- Install a shield between employees and a source of radiant heat such as curtains on windows or other insulating barrier, enclose the heat source, or move the heat source away from employees;
- Provide cooled drinking water as close as possible to the work site;
- Arrange shade for outdoor workers where practicable;

- Provide a cool rest area in which workers can take their meal breaks and tea breaks;
- Modify the work schedule or shift times so that outdoor and physiologically demanding work is done in the early morning or late afternoon, when it is generally cooler, and the sun's radiation is less intense than during the middle of the day;
- Allow workers to self-regulate their pace of work. This may involve working continuously at less than full capacity, and/ or working for short periods followed by rest pauses in a cool area;
- Workers should be encouraged to present to work in a well hydrated state, and take frequent small drinks throughout each shift to replace fluid lost through sweating;
- Diuretic Fluids such as tea, coffee, alcohol and some soft drinks should not be used to replenish fluid lost due to heat;
- Use PPE that reduces exposure to ultra violet radiation and heat (such as reflective masks or aprons, large brimmed hat, sunscreen); and
- Workers returning from periods away from hot environments should be given the opportunity to acclimatise before being expected to undertake work in very hot conditions at full capacity.

Significance of Impact

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

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

Aspect	Scenario	Spread	Duration	Intensity	Overall
Impact to Occupational Health and Safety of Workers	Without Mitigation	Medium	Short	High	Moderate
	With Mitigation	Local	Short	Moderate	Minor

7.3.2 Impacts during Operation Phase

7.3.2.1 Visual Impacts and Aesthetics

Anticipated Impacts

Visual impacts are assed with reference to the presence of PV panels, reduced vegetation, erection of ancillary facilities and transmission lines/towers. The visual effects are evaluated with reference to passing motorists and fixed settlement, primarily the villages in close proximity to the site.

The Project site is located on flat to undulated land and is visible from considerable distance along the village roads present within the study area. There will be a significant change to visual quality of the area resulting from the development and change in land use that will alter the landscape.

Presence of a large area of PV panels is not expected to constitute a risk for glare since it is situated far from airport, and residential dwellings.

Also, no visual impacts are anticipated due to the PV system design, which is specifically designed to include dark, light-absorbing materials and covered with an anti-reflective coating (ARC) for glass surfaces, which reduces the reflectance from PV panels to 2.5%-2.6% while at the same time improving their efficiency. However, there will be a change of landscape due to installation of solar panels and related structures.

Mitigation Measures

The solar panels to be installed at a low height and to be kept closer to the ground so that it does not pop out of the general landscape of the area. The panels to be arranged in a systematic manner which will give an aesthetic sense to it.

Significance of Impact

The impact on aesthetics and visual aspects will have low intensity with a local spread for a long duration which will result in an overall minor impact without mitigation. The residual minor impact, even after control of intensity and spread, will remain minor owing to the duration of project.

Table 7-12: Impact Significance – Aesthetic and Visual Impacts

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

7.3.2.2 Impact on Soil and Water Quality

Anticipated Impacts Due to Contamination

Operation of solar photovoltaic panels for power generation will not have any direct impact on soil. However, compaction of soils from increased levelling and grading of areas within the site will result in lower permeability and therefore, decreased infiltration and increased runoff. Water, as will be used for the washing activities may contaminate the soil if chemical is used for washing. Without appropriate measures, runoff from PV panels, compacted areas and hard standing areas in addition to erosion by wind may increase erosion and increase the sediment load in run-off.

In operation phase water is used for cleaning of solar panels, where in the use of chemicals cannot be ruled out. Hence, run-off from the plant site with leaked solar washed wastewater, waste oil, and seepages from hazardous waste stored without secondary containment may affect the ground water quality. Portable cabins will be set up for site officials, equipped with urinals and toilets during the construction phase. Proper septic tanks will be constructed for discharge of wastewater, hence the risk of wastewater runoff into the surface water would be reduced.

Anticipated Impacts Due to Improper Waste Handling

Once the plant is commissioned there will be limited disturbance to soil. With reference to Section 2, solid wastes generated during operation will include domestic solid waste; lubricant, used oil/waste oil and oil contaminated rags and limited quantities of broken solar panels. Domestic waste will be collected be local waste collectors. Since the PV panels have a lifespan of 20-25 years, limited quantities of solar panels will be generated during operation (only faulty broken panels).

Mitigation Measures

- Disturbance to soil from repair and maintenance activity will be limited and will ensure proper restoration of soil wherever excavation is undertaken.
- Options of buyback agreements for defunct panels and for replacement and disposal of transformer oil by the supplier are to be explored, otherwise arrangements for disposal of defunct panels and waste oil to authorized recyclers are to be made.
- Fuel and used oil will be stored in demarcated storage areas with adequate secondary containment and appropriate capacity. Spill control and prevention mechanism will be developed, and all the staff will be trained.
- If the solar panels are washed with chemicals, it should be ensured that the chemicals are non-hazardous and biodegradable;
- Storage of oil/chemicals shall be undertaken on paved impervious surface and secondary containment shall be provided for fuel storage tanks;
- During the washing and maintenance of the solar panels adequate storage area shall be designed to collect the washed water.

Significance of Impact

The impact on land due to improper waste disposal and other operational activities will have high intensity with a local spread for a short duration which will result in an overall moderate impact without mitigation. However, with proper implementation of suggested mitigation measures the overall impact will be negligible.

Table 7-13: Impact Significance – Impacts on Soil Quality

Aspect	Scenario	Spread	Duration	Intensity	Overall
Impacts on Soil Quality	Without Mitigation	Local	Short	Moderate	Moderate
	With Mitigation	Local	Short	Low	Insignificant

The impact on water resources will be of moderate intensity with high spread and long duration for water quality, which will result in an overall major impact without mitigation. However, impact on surface and ground water quality can be moderated by mitigation measures, as discussed above.

Table 7-14 Impact Significance – Surface Water Quality

Aspect	Scenario	Spread	Duration	Intensity	Overall
Impacts on Surface Water Quality	Without Mitigation	High	Long	Moderate	Moderate
	With Mitigation	High	Long	Low	Minor

7.3.2.3 Impact on Water Availability

Anticipated Impacts

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

As informed, water from borewell will be used for panel cleaning and domestic purpose. Water requirement of 2.5 litres per m^2 of modules is anticipated for cleaning of modules and with a cleaning schedule of twice a month, approximately 3400 litres per month (2 cycles) of water consumption is anticipated. Since ground water will be used during operation phase, depletion of ground water resources due to extraction during operation phase of the project is anticipated. It was noted that the FPEPL aims to be water neutral in the next 25 years for which water and wastewater management plan is under planning stage and will be finalized shortly.

Additionally, run-off from the plant site with leaked waste oil, and seepages from hazardous waste stored without secondary containment may affect the ground water quality.

Mitigation Measures

Following mitigation measures are recommended:

- Rooftop rainwater harvesting system will be provided within the plant premises. The water harvested will be stored at the Site and will be used for module cleaning instead of tanker water.
- The site office shall be provided with sewage line and the collected sewage shall be channelized to a septic tank with soak pit arrangement.
- If the solar panels are washed with chemicals, it should be ensured that the chemicals are non-hazardous in nature.
- Fuel and used oil will be stored in demarcated storage areas with adequate secondary containment and appropriate capacity. Spill control and prevention mechanism will be developed, and all the staff will be trained.

Significance of Impact

The impact on water resources will be of moderate intensity with high spread and long duration for water quantity, which will result in an overall major impact without mitigation. However, impact on ground water quantity can be moderated by mitigation measures, as discussed above.

Table 7-15: Impact Significance – Impact on Water Availability

Aspect	Scenario	Spread	Duration	Intensity	Overall
Impacts on Water Availability	Without Mitigation	High	Long	Moderate	Major
	With Mitigation	High	Long	Low	Moderate

7.3.2.4 Occupational Health and Safety of Workers

Anticipated Impacts

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

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

Also, Electromagnetic Fields (EMF) emanate from any wire carrying electricity. Possible effects associated with the electric and magnetic fields from transmission lines (or similar electrical sources) fall into two categories:

- Short-term effects that can be perceived and may represent a nuisance
- Possible long-term health effects.

The issue of whether there are long-term health effects associated with exposure to fields from transmission lines and other sources has been investigated for several decades. There is little evidence that electric fields cause long-term health effects. Estimates of magnetic-field exposures have been associated with certain health effects in studies of residential and occupational populations. Research in this area is continuing to determine whether such associations might reflect a causal relationship

Mitigation Measures

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

Mitigation measures that will be followed include the following:

- Regular electrical safety training to workers with safety procedures and other safety requirements that pertain to their respective job assignments;
- Implement Lock out/ Tag Out (LOTO) system;
- Use work equipment or other methods to prevent a fall from occurring. Collective protection systems, such as edge protection or guardrails, should be implemented before resorting to individual fall arrest equipment. In addition, safety nets or airbags can be used to minimize the consequences of a fall should it occur.
- Loading and unloading operation of equipment should be done under the supervision of a trained professional.

- All material will be arranged in a systematic manner with proper labelling and without protrusion or extension onto the access corridor.
- Personal Protective Equipment (PPEs) e.g., shock resistant rubber gloves, shoes, other protective gear etc. should be provided to workers handling electricity and related components and monitored that they are used by the employees
- The transformer yard should be provided with fire extinguishers and sand buckets at all strategic locations to deal with any incident of fire; and
- There should be arrangement for hygienic and scientific sanitation facilities for all the labourers working in the site.
- An accident reporting, and monitoring record shall be maintained.

Significance of Impact

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

Table 7-16: Impact Significance – Occupational Health and Safety of Workers

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

7.3.3 Impacts during Decommissioning Phase

7.3.3.1 Environment and Occupational Health & Safety

Anticipated Impacts

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

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

- Issue of loss of job when the workers will be asked to leave;
- Improper disposal of demolition waste and obsolete machineries will lead to contamination of soil and discontent of community;
- Demolition activity is anticipated to generate dust and exhaust emissions which can be carried downwind to habitations;
- Risks associated with health and safety issues such as trip and fall, electrical hazard etc.;
- The decommissioning activities of dismantling the solar power plant and removing the ancillary facilities can lead to increased noise levels;
- During the dismantling of the solar power plant, visual intrusions will be likely by removal of ancillary facilities, but their consequence will be negligible due to fact that such impact would be temporary (over a short period);
- Depending on the type used, photovoltaic cells may contain toxic substances such as gallium arsenide, copper-indium-gallium-selenide and cadmium telluride. If any solar panel is damaged during dismantling

of the facility, these toxins are likely to spill and leach into the soil and water of the area, posing threat to environmental and public health;

- If the solar panels are not handled or disposed of appropriately during the decommissioning phase, any toxic substances contained within them are likely to escape into the surrounding air, water or soil, creating serious environmental and public health risks.

Mitigation Measures

Demobilization will require removal of machinery, workers and other structures. The mitigation measures for decommissioning shall include:

- The proponent shall inform the workers and local community about the duration of work;
- The workers shall be clearly informed about the expected schedule and completion of each activity;
- All waste generated from decommissioning phase shall be collected and disposed of at the nearest municipal disposal site;
- Sprinkling of water is being carried out to suppress dust from decommissioning activities and transport movement;
- All necessary PPEs shall be used by the workers during demolition work;
- FPEPL will be committed to ensure all health and safety measures are in place to prevent accidents and/or reduce the consequences of non-conformance events;
- Institution of suitable training modules for project personnel and labour contractors involved in the dismantling process to ensure avoidance or minimization of solar panel damage as far as possible and adherence to appropriate decontamination protocols in the event of any unavoidable damage and adhere to proper safe disposal methods.

In addition to above, it is anticipated that the contractor will have the necessary management measures in place to manage potential OHS issues under their responsibility. Appropriate OHS programme and procedures are also expected to be in place to align with the local regulations, as well as IFC PS-2. The procedure will include, at minimum, the following measures:

- Develop and implement a health and safety plan to follow throughout all phases of a project;
- Provide occupation health and safety orientation training to all employees consisting of basic hazard awareness, site-specific hazards, safe working practices, and emergency procedures;
- The contractors will be committed to ensure that all Health and Safety measures are in place to prevent accidents and reduce the consequences of non-conformance events;
- The contractors will provide training, awareness and supervision to ensure all of its construction workers comply with the OHS procedures;
- The contractor will provide appropriate resources i.e. PPE to workers on Site; and
- An emergency response procedure and infrastructure will be available on Site to ensure provision of first aid for personnel in case of emergency

Significance of Impact

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

Table 7-17: Impact Significance – Environment Occupational Health and Safety Hazards

Aspect	Scenario	Spread	Duration	Intensity	Overall
Environment and Occupational Health and Safety	Without Mitigation	Medium	Short	Moderate	Moderate
	With Mitigation	Medium	Short	Low	Minor

7.3.3.2 Impact on Land Due to Improper Waste Disposal

Anticipated Impacts

The PV modules have a lifespan of 20-25 years. The PV modules contain heavy metals and cannot be disposed in landfills. A PV module is essentially made up of glass, metals, silicon and polymer fractions, and there are few materials like polymers as well as metals (small quantities of zinc, tin, copper and silver), metallic compounds and alloys which are classified as potentially hazardous. PV waste recycling is still at a nascent stage globally, both in terms of technical standards and physical infrastructure. So, at present, PV module recycling is not commercially viable.

The polymer component used in solar modules is difficult to recycle and can only be incinerated which again poses a significant health and environmental risk due to the formation of highly corrosive gases at the incineration stage. If landfilled inappropriately, waste and waste constituents can find ways into soil and water, resulting in a potentially damaging impact on the ecosystem. The scope of the India e-waste rules do not include solar panels and therefore there is no legal responsibility for any party to take back or recycle solar panels.

Inappropriate handling or disposal of solar panel during decommissioning phase, are likely to cause damage to the panels. Any damage or unsafe disposal of solar panels will cause release of toxic substances contained within them. These hazardous chemicals are likely to escape into the surrounding air, water or soil, creating serious environmental and public health risks.

Mitigation Measures

- Project developer to research and be involved in programmes and research for recycling solar panels.
- Project developer h to ensure that solar panels are disposed of in accordance with the law and best practice.
- Project developer to develop protocol/procedure for dismantling and handling panels.
- Project-personnel and labour contractors involved in the dismantling process to receive training ensure avoidance or minimization of such damage as far as possible and adherence to appropriate decontamination protocols in the event of any unavoidable damage.

Significance of Impact

Table 7-18 Impact Significance – Impact on Land due to Improper Disposal of Waste

Aspect	Scenario	Spread	Duration	Intensity	Overall
Impact on Land Due to Improper Waste Disposal	Without Mitigation	High	Medium	High	Major
	With Mitigation	Local	Short	Medium	Moderate

7.4 Ecological Impacts and Mitigation Measures

The main direct biodiversity impact anticipated from the Project is degradation of near-natural habitats at the Project Site, especially grasslands and wetlands, along with the attendant loss of priority provisioning services.

The main indirect biodiversity impact anticipated from the Project is potential loss of habitat and potential increase in collision/electrocution- related mortality risk to CR *Sypheotides indicus* (Lesser Florican or LF), for which the Project Site is precautionarily deemed as being situated within Critical Habitat (CH).

As per PS6 guidance, it is necessary for the Project to not only avoid or reduce foreseeable Project-related impacts or risks with respect to the species to the extent possible, but also take additional measures to offset any residual impacts to ensure Net Gain for the species. The necessary mitigation actions are expected to be instituted and implemented through a PS6-compliant Biodiversity Action Plan (BAP) for the Project.

Available technical good practice guidance suggests reduction of Project-related collision/electrocution risk to the species through Transmission Line (TL) mitigation. Guidance obtained through IUCN SSG BSG publications and

SME consultations suggests offsetting of residual habitat loss impact through community-based conservation of LF habitat. The BAP may, therefore, be structured around adaptive TL-risk mitigation and community engagement for LF habitat conservation/enhancement through the life of the Project.

The following sections present the biodiversity impacts anticipated directly from the Project in a phase-wise manner, along with corresponding mitigation measures based on good international industry practice (GIIP).

7.4.1 Impacts during the Construction Phase

Removal of natural vegetation: The removal of vegetation to clear the Project Site for construction will cause loss of near-natural habitat, amounting to approximately 0.035 square km of natural seasonal wetland and 0.22 square km of grassland at Bhadgaon Project Site, whereas, at Nagpur Project Site, near-natural habitats amounting to approximately 0.03 square km of seasonal wetlands and approximately 0.1 square km of rocky area are likely to be degraded. The habitat loss at the Project Site will directly cause loss of habitat for cultivated plains, seasonal wetlands and grassland fauna and loss of provisioning ecosystem services, mainly cultivated foods and fodder. The removal of natural vegetation would also indirectly cause exposure of soil to desiccation by wind and sunlight, loss of soil anchorage and increased vulnerability of soil to erosion by wind and water, leading to changes in the soil regime and the corresponding loss or degradation of the related ecosystem services.

The loss of the natural grassland habitat of the Project Site is of relatively major significance owing to the Project Site being precautionarily assumed as situated within CH for the highly threatened CR *Sypheotides indicus* (Lesser Florican or LF). The degradation of the natural seasonal wetland habitat of the Project Site is of relatively minor significance owing to construction solutions considered while designing the project layout. As per the Site representative, the natural stream crossing through Bhadgaon Project Site will be conserved. The overall impact of loss and degradation of natural and near-natural habitats is of additional significance owing to the natural scrubland habitat along the northern and eastern boundaries of Bhadgaon Project Site officially designated as reserved forest area.

Levelling or grading of land: The current topography of the Project Site is moderately undulating. Levelling or grading of land could lead to alteration of the natural topography, and consequently, the natural drainage and the natural habitat distribution. Obstruction of natural drainage channels may also lead to accumulation of salts and increase soil salinity, turning hitherto freshwater habitats into brackish water ones. Excavation and land-filling involved in levelling and grading can also alter the natural soil-profile, change soil properties and disrupt sub-soil habitats. This could affect the natural rainwater percolation into sub-surface layers, thereby impacting the natural groundwater recharge process and degrading the related ecosystem services.

The loss or degradation of the natural wetland and grassland habitats of the Project Site is of moderate significance owing to presence of alternative comparable habitat around the Project Site.

Laying of roads and paving of surfaces: The laying of roads or paving of surfaces within the Project Site will hinder or obstruct the percolation of rainwater into the ground. This will cause reduction of groundwater recharge and increase in surface run-off, leading to loss or degradation of soil and sub-soil habitats, as well as, the related regulating and supporting services.

This impact is of relatively minor significance owing to availability of a large extent of comparable alternative habitats and ecosystem services around the Project Site.

Movement of vehicles and heavy machinery: Movement of vehicles and operation of construction machinery would expose the natural environment to vehicular emissions and unnatural levels of dust, noise, light and vibrations. This would generally lead to pollution of natural resources and possible contamination of food webs. It would cause compaction of soil substrates, leading to injury or death of soil organisms. It would also reduce percolation of rainwater into sub-soil layers and increase surface run-off, impacting the natural groundwater recharge process and destroying or degrading the related ecosystem services.

This impact is of moderate significance owing to the location of the Project Site in proximity to wildlife habitats.

Artificial Illumination: Use of artificial lighting to illuminate the Project Pite and during night-time will lead to unnatural illumination in the area during the natural dark part of the day. Use of vehicles during night may also

lead to artificial illumination. Interruption of the natural night period by light is known to disrupt the natural biological cycles of many floristic and faunal species.

This impact is of moderate significance owing to the location of the Project Site in proximity to wildlife habitats.

Installation of solar panels: The introduction of the large, geometrically arranged, reflective surfaces of solar panels into a natural area would cause visual obstruction or visual irritation to wild fauna, especially aerially moving fauna. The overall visual effect of the solar panelling would also degrade the aesthetic qualities of the natural landscape, thus affecting the cultural services of the area.

This impact is of high significance owing to the location of the Project Site in proximity to human habitations, wildlife habitats, including habitats used by migratory and/or congregatory species, as also, within the Central Asian avian migratory flyway.

Installation of internal transmission cables: Installation of over-head transmission cables would disrupt the aerial habitat space of the area, leading to death or damage to aerially moving organisms such as birds and bats through accidental collision and electrocution. Installation of underground transmission cables would disturb the natural soil-profile and fragment sub-soil habitats. These effects would lead to injury or death of organisms, thereby impacting ecosystems and the related ecosystem services.

This impact is of high significance owing to the location of the Project Site in proximity to wildlife habitats, including habitats used by migratory and/or congregatory species, as also, within the avian migratory flyway.

Mitigation Measures for the Solar Power Plant

- Enable or facilitate the conservation of the approximately 0.035 square km of natural seasonal wetland and 0.22 square km of grassland in the Bhadgaon Project Site.
- Conserve the 0.03 square km of seasonal wetlands and approximately 0.1 square km of rocky area habitat in the Nagpur Project Site to the extent possible.
- Offset the loss of any natural vegetation including the scattered relic trees or shrubs removed from the Project Site by planting ideally the same species, but higher numbers, of trees, shrubs and herbs, as applicable, in or adjacent to the Project Site.
- Opt for diverse but strictly native species in any additional plantation carried out towards the Project. Species typical to the natural forest-types of the Study Area, as reported in the baseline data, may be used in plantations. Alternatively, advice may be sought from the local forest department office, which can also provide saplings of local native species for plantation.
- Conserve the natural topography of the Project Site by integrating the natural topographical features into the project construction plans.
- Minimise the number and the width of all internal roads.
- Maintain the connectivity and integrity of existing natural water-channels while building internal roads or embankments.
- Ensure that vehicles and machinery used in the construction activities comply with the prescribed emission standards.
- Restrict movement of construction-related vehicles, especially heavy vehicles or machinery, strictly to pre-designated routes.
- Restrict construction activities requiring high levels of illumination to daylight hours in order to prevent disruption of the natural night period by artificial lighting.
- Plant relatively tall-growing native vegetation at a suitable distance along the boundary of the project site to visually screen it from wildlife habitats and human habitations in the surrounding area, as also, to help counter the heat island effect created by the solar installations.
- Install the solar panels in as small and discrete clusters as feasible, rather than installing them in continuous swathes.

- Opt for crystalline silicon type solar panels over other currently available technologies, to avoid introduction of toxic chemicals into the local ecosystems.
- Opt for solar panels with anti-reflective coating (ARC), preferably in conjunction with white, non-polarizing gridding, to reduce reflectiveness and light-polarization.
- Opt for low-intensity artificial lighting, such as LED, to prevent insects from being attracted to the solar park. Ensure that lights are provided with downward-facing shades to limit the dispersion of the illumination.

Mitigation Measures for the Transmission Line Corridor

- Monitor for estimating bird collision risk and identifying high bird use sites or critical avian habitats before establishment of the transmission line.
- Consider undergrounding of the transmission line in any critical avian habitats identified, to the extent feasible.
- Re-route the transmission line to avoid any critical avian habitats identified.
- Minimize the span of the transmission line to increase visibility.
- Insulate phase conductors to avoid electrocution risk.
- Install line markers on power lines to increase visibility.
- Opt for horizontal configuration of power lines.
- Minimize vertical configuration of power lines.
- Opt for bundling/clustering of multiconductor transmission lines.
- Increase diameter of shield wires to increase visibility.
- Opt for blinking lights instead of steady-burning lights, if they are required.
- Restrict human activity around the transmission line corridor to avoid sudden avian flights in high bird use areas.

Source - APLIC (Avian Power Line Interaction Committee) (2012) Reducing Avian Collisions with Power Lines: The state of the art in 2012. Edison Electric Institute and APLIC. Washington, D.C.

Aspect	Scenario	Extent	Duration	Intensity	Type	Significance
Degradation of Habitats	Without Mitigation	Medium	Long	High	Adverse	Moderate
	With Mitigation	Local	Medium	Moderate	Adverse	Minor
Fragmentation of Habitats	Without Mitigation	Medium	Long	High	Adverse	Moderate
	With Mitigation	Local	Long	Moderate	Adverse	Minor
Loss of Ecosystem Services	Without Mitigation	Medium	Long	Moderate	Adverse	Moderate
	With Mitigation	Medium	Medium	Low	Adverse	Minor

7.4.2 Impacts during the Operation and Maintenance Phase

Physical Hindrance by On-ground Installations: The physical presence of the solar panelling and related installations would hinder faunal movement within and through the area, affecting their current access to habitats and resources. Aerially moving fauna, such as insects, birds and bats, may accidentally encounter electrical

components of the project installations, leading to injury or death. Certain bird species such as raptors are known to avoid PV sites and surrounding areas due to a loss of hunting/nesting habitat. The regular activity of humans in the solar park also deter raptors, thus changing the bird community structure in the nearby areas. The solar panelling and related installations would also cast a shadow on the soil underneath, cutting off the existing natural insolation available to the soil and ground flora of the shaded area. Altered insolation patterns would also affect the existing soil-moisture conditions. These effects would collectively degrade or alter the existing floristic profile of the affected area, thus impacting its existing primary production and the associated ecosystem services. Owing to the length of solar panel-strings, as also, the large scale of the proposed installations, the physical presence of the solar panelling would lead to fragmentation of existing contiguous faunal habitats and prevent faunal access to habitats and habitat features such as roosts, feeding grounds, nest sites, tools and nesting materials beyond the solar park.

This impact is of high significance owing to the Project Site being located in proximity to wildlife habitats, including habitats used by globally threatened, as also, migratory and/or congregatory species.

Reflectivity of Solar Panels (Albedo Effect): Especially vulnerable to solar panel reflectivity are aerially moving diurnal organisms, mainly birds. Detours taken by migratory birds as an avoidance response to disturbances or irritants in their natural flight path are known to cause an often-fatal increase in the flight energy expenditure of many long-distance migrant species. The unnatural polarization of light caused by solar panels is known to trigger maladaptive behaviours in polarization-sensitive organisms and alter their ecological interactions, including preferential egg-laying on panel surfaces by insects. Such faunal behaviour-alteration could lead to undesirable long-term impacts on food webs in which affected species occupy critical trophic niches. Birds in flight, mistaking the reflective surface of the panels for water, may collide with the panels in an attempt to drink it. Birds that drink water on the wing (such as swallows) are at a greater risk of mortality from this effect than those that drink from a perched position.

Source: Gábor Horváth, György Kriska, Péter Malik and Bruce Robertson (2009). Polarized light pollution: a new kind of ecological photo-pollution. Front Ecol Environ 2009; 7(6): 317–325; Taylor, R., Conway, J., Gabb, O. and Gillespie, J. (2019). Potential ecological impacts of ground-mounted photovoltaic solar panels: An introduction and literature review. Report for BSG Ecology.

This impact is of high significance owing to the Project Site being located in proximity to wildlife habitats, including habitats used by migratory and/or congregatory species.

Heat Generation by Solar Panels (Heat Island Effect): The large-scale solar installation would heat the air in and around the project site, leading to an overall rise in the ambient temperature, thereby degrading the natural environment of the area. This effect is known to significantly affect areas up to approximately 300 m from the perimeter of the solar-panelled area and up to a height of 5-18 m. The latest available research indicates that temperatures over a PV plant were regularly 3–4°C warmer than associated natural habitats at night. The impact of increase in ambient temperature is known to be especially deleterious to organisms of warm tropical regions, where the normal temperatures are likely to be already near the tolerance limits of the organisms.

Sources: Nicolas Barth, Benjamin W. Figgis, Ahmed Ennaoui, Said Ahzi, "Field-scale Computational Fluid Dynamics applied to wind velocity profiles of photovoltaic plant: Case of the QEERI solar test facility Doha Qatar", Renewable and Sustainable Energy Conference (IRSEC) 2016 International, pp. 613-618, 2016; Barron-Gafford, G. A. et al. "The Photovoltaic Heat Island Effect: Larger solar power plants increase local temperatures." Sci. Rep. 6, 35070; doi: 10.1038/srep35070 (2016)

This impact is of high significance owing to the Project Site being located in proximity to wildlife habitats, including habitats used by migratory and/or congregatory species.

Physical Hindrance by Overhead Transmission Lines: The physical presence of overhead transmission lines would disrupt the existing contiguous aerial habitat of the area, leading to death or injury to aerially moving organisms such as birds and bats, through accidental collision with cables.

This impact is of high significance owing to the Project Site being located in proximity to wildlife habitats, including habitats used by migratory and/or congregatory species.

Physical Hindrance by Underground Installations: The physical presence of underground installations, such as the solar panel mounting foundations and underground transmission cables, would occupy a large area of sub-soil habitats. This would lead to loss of habitat area for sub-soil species and hinder their access to resources.

This impact is of relatively minor significance owing to the Project Site representing a relatively insignificant percentage of the overall land surface in the area.

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

This impact is of high significance owing to the Project Site being located in proximity to wildlife habitats.

Project-related Traffic: The movement of project-related vehicles and personnel to, from and around the Project Site would increase the ambient levels of vehicular emissions, dust, noise, vibrations and artificial illumination in and around the project site. This would lead to pollution of the natural environment. Also, disruption of the night-period by illumination is known to disturb natural floral and faunal biological cycles.

This impact is of high significance owing to the Project Site being located in proximity to wildlife habitats.

Use of Herbicides: Herbicidal chemicals, if used to prevent or control the growth of plants which could cut off sunlight from the solar panelling, would be toxic to most organisms and may have a tendency to persist or bio-accumulate, contaminating the soil, surface water, groundwater and food-chains of the area.

This impact is of fairly high significance since the Project Site is connected by ecological flows to local arable lands and wetlands providing provisioning ecosystem services.

Use of Dust Settling Chemicals: Dust-settling chemicals, if used to prevent dust from coating the surface of the solar panels, would be toxic to organisms and may have a tendency to persist or bio-accumulate, contaminating the soil, surface water, groundwater and food-chains of the area.

This impact is of high significance since the Project Site is connected by ecological flows to local arable lands and wetlands providing provisioning ecosystem services.

Spillage of Materials: Heat transfer fluids, belonging to chemical groups such as Glycols, Nitrates, Nitrites, Chromates, Sulphates and Sulphites, if used in the project systems, would be toxic to organisms. Spillage of these chemicals, either as part of routine operations, or accidentally, could lead to their leaching into the local environment, contaminating the natural soil and water resources of the area.

This impact is of high significance since the Project Site is connected by ecological flows to local arable lands and wetlands providing provisioning ecosystem services.

Mitigation Measures for the Solar Power Plant

- Opt for solar panels with anti-reflective coating (ARC), preferably in conjunction with white, non-polarizing gridding, to reduce reflectiveness and light-polarization.
- Ensure that all electrical components are adequately insulated to prevent electrocution of fauna through accidental contact with project-installations.
- Restrict maintenance-related activities to the daytime.
- Avoid use of artificial lighting in and around the project site as far as possible.
- Opt for low-intensity artificial lighting, such as LED, to prevent insects from being attracted to the solar park. Ensure that lights are provided with downward-facing shades to limit the dispersion of the illumination.
- Ensure that vehicles and machinery used in the project site for operation and maintenance activities comply with the prescribed emission standards.

- Restrict movement of vehicles used in the project site strictly to the minimum possible pre-designated routes.
- Restore the soil and natural vegetation of any construction-phase roads which are not necessary for carrying out operation or maintenance activities, and hence, are not required in the operation and maintenance phase.
- Ensure that operation or maintenance activities, that require illumination, are restricted to daylight hours to prevent disruption of the natural night period by artificial lighting.
- Prohibit the use of herbicides in the facility.
- Opt for manual weeding to control or regulate plant growth in the solar panel area.
- Avoid the use of dust-settling chemicals in the facility.
- Opt for manual sprinkling of water to control dust in and around the solar panel area.
- Institute effective training modules and operational systems to ensure prevention of spillages of toxic substances.
- Install effective containment systems to prevent any accidental spillage from leaching into the local environment.

Mitigation Measures for the Transmission Line Corridor

- Monitor for bird collision incidents and identifying any additional/different avian high use areas (HUAs) or critical avian habitats after establishment of the transmission line.
- Install additional or improved line-markers on power lines as required.
- Regulate Project-related activities around the transmission line corridor to address monitoring findings.

Source - APLIC (Avian Power Line Interaction Committee) (2012) Reducing Avian Collisions with Power Lines: The state of the art in 2012. Edison Electric Institute and APLIC. Washington, D.C.

Aspect	Scenario	Extent	Duration	Intensity	Type	Significance
Degradation of Habitats	Without Mitigation	Medium	Long	High	Adverse	Major
	With Mitigation	Local	Medium	Moderate	Adverse	Moderate
Fragmentation of Habitats	Without Mitigation	Medium	Long	High	Adverse	Moderate
	With Mitigation	Local	Long	Moderate	Adverse	Minor
Loss of Ecosystem Services	Without Mitigation	Medium	Long	Moderate	Adverse	Moderate
	With Mitigation	Medium	Medium	Low	Adverse	Minor

7.4.3 Impacts during the Decommissioning Phase

Damage to Solar Panels: If any solar panel is damaged during dismantling of the facility, polluting materials are likely to be introduced into the air, soil and water in and around the project site, thereby degrading its natural resources.

This impact is of fairly high significance since the Project Site is situated in proximity of natural habitats.

Unsafe Disposal of Solar Panels: If the solar panels are not handled or disposed of appropriately during the decommissioning phase, any toxic substances contained within them are likely to be introduced into the air, water or soil of the disposal site, thereby degrading its natural resources.

This impact is of high significance since the Project Site is situated in proximity of natural habitats.

Mitigation Measures

- Institute suitable training modules for project-personnel and labour contractors involved in the dismantling process to ensure avoidance or minimization of solar panel damage and adherence to appropriate decontamination protocols in the event of any unavoidable damage.
- Institute suitable training modules for project-personnel and labour contractors involved in the dismantling process to ensure adherence to appropriate safe disposal protocols.

Aspect	Scenario	Extent	Duration	Intensity	Type	Significance
Degradation of Habitats	Without Mitigation	Medium	Long	High	Adverse	Moderate
	With Mitigation	Local	Medium	Moderate	Adverse	Minor
Fragmentation of Habitats	Without Mitigation	Medium	Long	High	Adverse	Moderate
	With Mitigation	Local	Long	Moderate	Adverse	Minor
Loss of Ecosystem Services	Without Mitigation	Medium	Long	Moderate	Adverse	Moderate
	With Mitigation	Medium	Medium	Low	Adverse	Minor

7.5 Socio- Economic Impacts and Mitigation Measures

7.5.1 Impacts during the pre-construction phase

7.5.1.1 Impact on animal grazing

Consultations were undertaken with cattle rearing group engaged in grazing of animals adjacent to the Bhadgaon project. Discussions with the shepherds engaged in animal rearing/ grazing reveals that the proposed project site is not the designated grazing land and the proposed project site boundary does not obstruct the movement of cattle to the grazing land located 1-2km from project site. Moreover, the both the plots located in Bhadgaon and Nagpur village are not suitable for extensive grazing. Bhadgaon site is of mostly rocky and Nagpur site is mostly a dry agriculture land where few scattered agriculture activities are carried out.

Significance of Impact

Impact on animal grazing is assessed to be Insignificant without any enhancement measures.

Table 7-19: Impact Significance – Animal Grazing

Aspect	Scenario	Spread	Duration	Intensity	Overall
Animal Grazing	Without Enhancement measures	Local	Short	Low	Insignificant
	With Measures	Local	Short	Low	Insignificant

7.5.1.2 Impact on Access Road

Among two land parcels, a Nagpur village land parcel is of dry agricultural land is being cultivated only during the monsoon season. During the site visit, it was observed that the few villagers and the neighbouring farmers are

crossing the Nagpur project site land to access their neighbouring agriculture land. Though there is no designated access road, the site being barren and unfenced, local people started using the project site land as a shortcut by trespassing. Based on the consultation with the panchayat and neighbouring landowners, it was reported that the people using the project site for accessing their agriculture land were only the landowners of the proposed project site and the need for trespassing will not be there post project implementation. However, as part of Stakeholder Engagement Plan (SEP) / Grievance Redressal Mechanism (GRM), FPEPL must take necessary actions to record / resolve any reported grievance related to the restriction of access to their land or village.

Significance of Impact

Impact on restriction of access to the neighbouring agriculture fields is assessed to be Minor without any enhancement measures and insignificant with enhancement measures.

Table 7-20: Impact Significance – Animal Grazing

Aspect	Scenario	Spread	Duration	Intensity	Overall
Animal Grazing	Without Enhancement measures	Local	Medium	High	Moderate
	With Measures	Local	Medium	Medium	Minor

Local Use project site land for accessing their Agriculture land

7.5.2 Impacts during the construction and operation phases

7.5.2.1 Impacts on Local Economy

During the construction and operational phase of the project, the impact the local economy is likely to be positive as the project will lead to increase in local employment opportunities and increased demand for materials and services through local contracting. Efforts should be made to ensure that maximum proportion of the demand for manpower and materials is met locally through contractors and vendors.

Significance of Impact

Impact on local economy is assessed to be minor without any enhancement measures and moderate with enhancement measures.

Table 7-21: Impact Significance – Local Economy

Aspect	Scenario	Spread	Duration	Intensity	Overall
Local Economy	Without Enhancement measures	Medium	Short	Moderate	Moderate
	With Measures	Medium	Short	Low	Minor

7.5.2.2 Employment opportunities

During the peak construction phase, the manpower requirement will be around 300 (contractual workers). Consultations with the project proponent indicated that most of the manpower requirement in the unskilled and semi-skilled categories will be sourced from the local area and will comprise of youth from the neighbouring villages. Employment of local youths in the project-specific construction activities will positively contribute to the livelihood of the local villages. Specific clauses to encourage the employment of local youths should be incorporated into the EPC contract agreement between FPEPL and the EPC contractor.

Significance of Impact

Impact on employment opportunities is assessed to be minor without any enhancement measures and moderate with enhancement measures.

Table 7-22: Impact Significance – Employment Opportunities

Aspect	Scenario	Spread	Duration	Intensity	Overall
Employment Opportunities	Without Enhancement measures	Medium	Short	Moderate	Moderate
	With Measures	Medium	Short	Low	Minor

7.5.2.3 Labour Rights and Welfare

Approximately 300 of labours especially in the skilled and highly skilled categories to be employed during the construction. The site representative of FPEPL during the site visit confirmed that a labour camp will be set up within the site. The migrant workers will be provided accommodation in the labour camp. It was reported by FPEPL that the labour camp will have a capacity to accommodate 300 labourers. adequate numbers of toilets, with adequate drinking water facility, kitchen etc. will be provided as basic amenities in the proposed labour camp. The size of the rooms will be 5 meters in length x 3.5 meters in breadth and 3.5 meters in height. Each room will be provided with electrical power points along with lights and fans in each room. The EPC Contract will be providing the minimum wages to the labourers including overtime wage as per the Building and Others Construction Workers Act. In addition, benefits in terms of Employee State Insurance (ESI) should be provided to each worker engaged on site. The workers should be aware of their rights and benefits due to them so that no issues emerge. Toilet facilities and drinking water should be provided to all workers on site as well. Grievance Redressal Mechanism for workers should be developed and communicated to the workers so that the workers can approach the management if any concerns or issues are faced by them without any fear of retribution or intimidation.

Significance of Impact

Impact on Labour Rights and Welfare is assessed to be minor without any enhancement measures and moderate with enhancement measures.

Table 7-23: Impact Significance – Labour Rights and Welfare

Aspect	Scenario	Spread	Duration	Intensity	Overall
Labour Rights and Welfare	Without Enhancement measures	Medium	Short	Moderate	Moderate
	With Measures	Medium	Short	Low	Minor

7.5.2.4 Labour Influx

It is anticipated that during the construction phase there will be an influx of migrant workers. During the site visit, it was mentioned by the site representative that for specialized work activities, migrant workers are envisaged to be engaged. Engagement of migrant labourers might lead to an increase of issues with the local population if proper orientation is not provided. The basic issues related with migrant labourers may include:

- Conflict amongst workers and between workers and local community members based on behavioural/ cultural practices.
- Discontent amongst local community members on engagement of outsiders as workforce.
- Mild outbreaks of infectious diseases due to interaction between the local population.
- Safety and security issues for local women.
- Use of community facilities such as temples, transport facilities, public spaces may lead to discontent between the local community and the migrant workforce.

7.5.3 Impacts during the decommissioning phase

7.5.3.1 Loss of employment opportunities

The manpower requirement during the O&M phase was reported by the project proponent to be in the range of 15-to 20 workers who will be engaged on daily basis. The workers will be engaged by the O&M contractor. Some of the key activities to be performed by workers engaged in O&M phase such as housekeeping, solar panel cleaning, bush cutting, security fall under the unskilled and semi-skilled categories for the purpose of which local youth from the neighbouring villages can be sourced. However, in an event of decommissioning, there is a high probability that the manpower engaged in O&M activities might lose employment. This will adversely impact the livelihood of the concerned people.

Significance of Impact

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

Table 7-24: Impact Significance – Employment opportunities

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

Mitigation Measures for the identified social risks

- As part of its CSR programme, FPEPL may collaborate with the Bhadgaon and Nagpur Panchayats to improve village level infrastructure, education promotion programs, skill improvement, etc. as part of the CSR budget. Few suggestive CSR programs based on the felt needs expressed during the stakeholder consultation are highlighted below.
  - Setting up of water ATM at village level, at present raw groundwater is supplied by local Panchayat through overhead tanks and pipelines.
  - Nomadic Tribe -Aadhivasi School run in Nagpur village does not have adequate toilet and safe drinking water facility.
  - RO Drinking water facility at primary school at Bhadgaon and Hr.Sec. School at Nagpur village.
  - Skill Development and observing local skill force through various education promotion and skill development programs among the local and Nomadic tribe population encourages the local youth to pursue education.
  - Many educated youths pursue and getting trained for clearing CRPF, ARMY selections. Developing dedicated Vyamshala (GYM) with coaching support will improve the economic status of the people.
- FPEPL must effectively implement Stakeholder Engagement Plan (SEP) / Grievance Redressal Mechanism (GRM) to take necessary actions to record / resolve any reported grievance related to the restriction of access road and other community level grievances if Preference to fulfil the manpower requirement in the unskilled and semi-skilled categories be sourced from the local area and will comprise of youth from the neighbouring villages. Employment of local youths in the project-specific construction/ operation activities will positively contribute to the livelihood of the local villages.

- The project through the contractor agreement shall ensure that the construction contractors commit and adhere to social obligations including community relations, handling complaints and grievances, adherence to labour laws and international commitments etc. Similarly, water usage amongst the labourers shall be monitored and controlled to minimize generation of wastewater.
- The EPC Contractor needs to ensure that all the required amenities – adequate washrooms, adequate lighting and ventilation in the rooms wherein the labourers will be accommodated, adequate quantities of clean and potable drinking water, access to appropriate medical services etc. is provided in the labour camp.
- The project shall ensure that no child or forced labour is engaged by contractors and all wage payments are done without any discriminations or delays by the contractors. Similarly, adequate sanitation and waste disposal facility shall be ensured at the project site.
- The project shall ensure that while engaging contractors and sub-contractors during the operation phase agreements on priority basis shall be made with local contractors and vendors.
- FPEPL should ensure that the rental accommodation proposed to be provided to the migrant workers during the construction phase should comply with the provisions of PS 5 of IFC's Policy on Environment and Social Sustainability relating to worker accommodation.

7.6 Impact of Climate Change on Solar PV Power Plant

Greenhouse gases are the gases generated from natural and anthropogenic activities, which absorb and emit infrared radiation in the wavelength range emitted by Earth eventually contributing to the global warming and broadly result in climate change. Some of the key greenhouse gases are Water vapor (H_2O), Carbon dioxide (CO_2), Methane (CH_4), Nitrous oxide (N_2O), Ozone (O_3) and Chlorofluorocarbons (CFCs). Emission of CO_2 is associated with this project which relates to global warming.

United Nations Framework Convention on Climate Change (UNFCC) defines climate change as the change resulting from long term direct and indirect activities that induces changes in the compared time which are much more than the natural change.

7.6.1 Anticipated Impacts

7.6.1.1 Construction Phase

This ESIA has focused on the following aspects related to the climate change:

- The potential effects of the project on climate, in particular the magnitude of greenhouse gases (GHGs) emissions emitted during both construction and operation
- The impact of climate change on the project over its lifetime;
- The impact of the project on the climate resilience of wider (social, environmental and economic) systems over time.

GHG Emissions from Solar Power Plant

The potential sources of GHG emissions during construction phase will be vehicular movement, DG set exhaust including unburnt hydrocarbon and carbon-monoxide, and exhaust emissions from construction equipment and machinery. Over 90% of the fuel used for transportation is petroleum based which includes primarily gasoline and diesel[29]. The GHG emissions from construction activities cannot be determined at this stage as the design details, construction plan and details of the construction materials are still in the process of getting finalized, but the impact assessment and mitigation measures in this section will consider the likely impact of the project due to climate change during construction phase to ensure minimum impact. Hence the GHG emissions from the proposed solar power plant is not likely to have serious impact on the climate change during construction phase.

[29] Sources of Greenhouse Gas Emissions | US EPA

The impact of climate change on the project:

Some of the key impacts of climate change on the proposed project are:

i. Rise of atmospheric temperature and heat: The rise in atmospheric temperatures will likely reduce air quality with increase in particulate matter and ozone pollution in the atmosphere and impact the ambient air quality during the construction phase.

ii. Increase in rainfall and flood: As per the think hazard portal[30], urban flooding is categorized as Low.[31] As per BMTPC map, site is not in flood prone in area.

Figure 7-1 below shows flood scenario map of India.

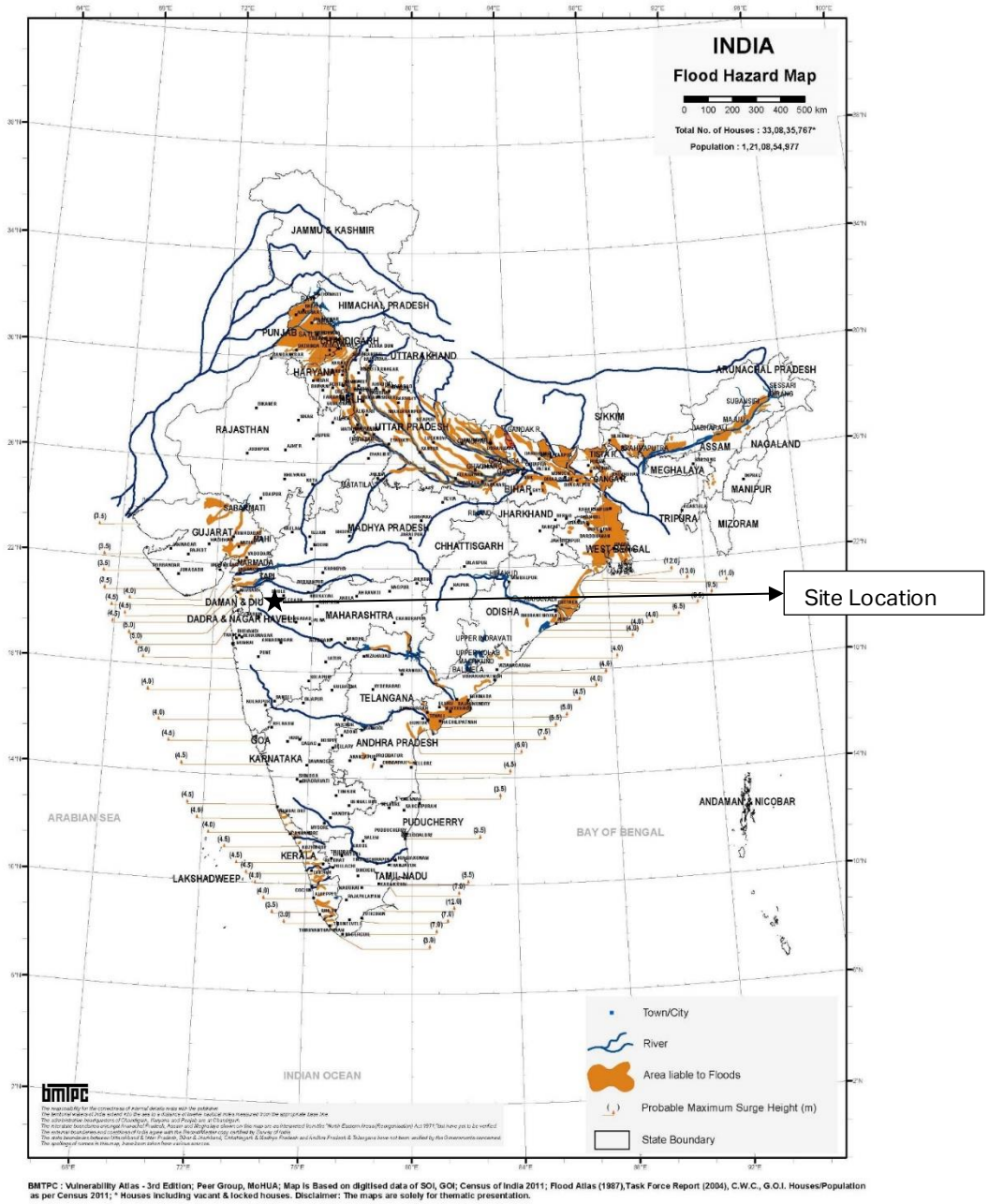


Figure 7-1: Flood Hazard Map Of The Country With Project Location Marked

Source: BMTPC

[30] Information provided is at a district level
[31] Think Hazard - Dhule - Urban flood

i. It is understood that project locations do not witness a heavy rain. So, chances of water getting accumulated in the vicinity is mild. Though, the climate change across the region may aggravate the rainfall scenario through increased rainfall and increase in frequency and intensity of heavy rainfall events, which are likely to increase the water level. This will have potential to impact/hinder the construction activities during construction phase including damage/loss of materials and equipment. The increase in wind speed due to increased storms may also have potential to cause material loss of properties and loss of lives of the workers. Therefore, it is recommended to take into consideration storm water management measures /erosion protection measures during construction phase in view of seasonal streams passing through sites. Flood protection measures will have to be undertake as required. Overall the impact of climate change on project construction activities are not deemed significant.

ii. Exhaust Emissions: There is likely to be significant CO_2 emissions during construction phase arising from vehicular emissions, DG set emissions and exhaust emissions from heavy earth moving equipment and construction machineries. However, the quantum of emissions during the temporary construction phase will be of short duration and impact is not likely to be significant. The technology selected for power generation uses solar energy which is an environmentally friendly source.

Mitigation Measures:

Mitigation measures include:

- Adopt recycling/reuse of water to minimize freshwater consumption. This could be achieved by adopting various initiatives e.g. recycling treated wastewater for toilet flushing, landscaping etc.
- Use of machines, DG, equipment and vehicles only with appropriate pollution fitness certificates. Also carry out periodic maintenance of equipment and vehicles.
- Estimate, maintain and publish carbon footprint (month wise) during construction activities and operational phase and reduce vehicular movement where possible.
- Avoid use of Ozone Depleting Substances during construction phase.

7.6.1.2 Operational Phase

Solar Power Plant is an environmentally friendly power generation technology which has potential to significantly reduce green-house gases (GHG) emissions as it does not use any fossil fuel and thereby reduces the greenhouse gas emissions associated when compared with fossil fuel-based electricity generation system. However, the proposed 100 MW Solar PV Power Plant, like all other Solar Power Plants and their components is vulnerable to fluctuating weather conditions and climate change in broader perspective. The photovoltaic panels of the solar power plant are vulnerable to extreme weather conditions like hail, storm, extreme temperature, cyclones or floods. The climate change factors like extremely high or low temperatures, and high wind could reduce the yield of solar modules. Researches have shown that for each degree of global temperature rise, solar modules could lose around 0.45% of their rated output (Source: "Global warming will hit solar panel performance", *PV-magazine dated 16/08/2019*). However, the design of solar panels will take into consideration the Solar Radiation Assessment Report, which is likely to minimize the impact of climate change on solar panels 'operating efficiency throughout the design life of 25 years. Considering the design of solar panels have taken into account the impact of climate change on the rated outputs, the impact is not likely to be significant.

GHG Emissions from Solar Power Plant

As per the estimation of International Atomic Energy Agency (IAEA) the grams of carbon equivalent (including CO_2, CH_4, N_2O etc.) per kilowatt-hour of electricity (g Ceq/ kWh) for Solar energy project are low and scores better when compared with other forms of conventional and non-conventional sources of energy. The estimated average life cycle of GHG emissions from solar power plant is approximately 85 tonnes CO_2e/ GWh as against 500-880 tonnes CO_2e/ GWh for natural gas and coal respectively. Therefore, as per the DPR received for 70 MW (AC) approximately 83 million units will be generated on an annual basis. Solar Power Plant during operational phase (generating 83 GWh of energy) is estimated to emit approx. 7055 tonnes of CO_2e, which is much lesser as compared to any conventional power plant.

The impact of climate change on the project over its lifetime

Some of the key impacts of climate change on the proposed project are:

- Rise of atmospheric temperature and heat: This climate change will likely increase the ambient temperature of the region and the country resulting in warmer winter and hotter summer. The increased risk of heat waves could impact the solar panels and deformation of Plant & accessories and road surfaces resulting in reduction in service life. Increased temperatures are likely to lead to issues with expansion of joints and cracking of internal plant and concrete pavements/structures exposed directly to atmosphere. Higher summer temperatures will likely reduce air quality with increase in particulate matter and ozone pollution in the atmosphere and impact the ambient air quality.
- Increase in rainfall and flood: The climate change due to increase in rainfall and flood across the region may increase in frequency and intensity of heavy rainfall events. However, it is recommended to take into consideration storm water management measures /erosion protection measures during construction phase in view of seasonal streams passing through sites. Flood protection measures will have to be undertake as required. Hence the impacts of climate change on project production phase are not deemed significant.
- Exhaust Emissions: The technology selected for power generation uses solar energy which is an environmentally friendly source. Although there will be vehicular movement to and from the power plant during operation phase, the incremental increase of GHG emissions in the ambient air quality will be negligible due to very low number of vehicular movements.

Mitigation Measures:

Mitigation measures include:

- Green belt development within near by villages ;
- Adopt recycling/reuse of water to minimize freshwater consumption. This could be achieved by adopting various initiatives e.g. recycling treated wastewater for toilet flushing, landscaping etc.
- Use of machines, DG, equipment and vehicles only with appropriate pollution fitness certificates. Also carry out periodic maintenance of equipment and vehicles.
- Design and construct rainwater harvesting structure to retain the rainwater/stormwater and minimize freshwater consumption.
- Estimate, maintain and publish carbon footprint (month wise) during construction activities and operational phase and reduce vehicular movement where possible.
- Avoid use of Ozone Depleting Substances during operation phase.

7.6.1.3 Climate Transition Risk

Government of India and State Government of Maharashtra's commitment towards building a sustainable and climate resilient future for its people, a Maharashtra state adaption action plan on Climate Change (SAPCC) has been prepared following a consultative process to address any transitional climate risk for the prevailing environmental and socio-economic system. MSAAPC aims in creating a roadmap that leads to the realization of a growing, low-emitting and sustainable economy with a more climate resilient population in Maharashtra and the country.

Risk Rating:

Screening Questions		Score	Remarks
Location and Design of Project	Is siting and/or routing of the project (or its components) likely to be affected by climate conditions including extreme weather-related events such as floods, droughts, storms, landslides	1	likely Solar modules likely to be selected shall be compatible with the climatic condition of the Bhadgaon village. Dhule district is drought prone.

	Would the project design need to consider any hydro-meteorological parameters (e.g., sea-level, peak river flow, reliable water level, peak wind speed etc.)?	0	Note Likely The project area do not have high intensity rainfall
Materials and Maintenance	Would weather, current and likely future climate conditions (e.g. prevailing humidity level, temperature contrast between hot summer days and cold winter days, exposure to wind and humidity hydrometeorological parameters likely affect the selection of project inputs over the life of project outputs (e.g. construction material)?	1	Likely Project can be established within a short time period of 8-10 months (approx..) therefore temporary impact of climate change on material and maintenance may occur.
	Would weather, current and likely future climate conditions, and related extreme events likely affect the maintenance (scheduling and cost) of project output(s)?	1	Likely
Performance of project outputs	Would weather/climate conditions, and related extreme events likely affect the performance (eg. annual power production) of project output(s) (e.g. hydropower generation facilities) throughout their design life time?	1	Likely Although project has been designed after consideration of temperature variation (annually), significant variation in temperature over the period of project life cycle may affect its performance. Dust particles due to the nearby traffic can also affect the production capacity
Total Risk Score:		**4**	

Note:

Options for answers and corresponding score are provided below:

Response	Score
Not Likely	0
Likely	1
Very Likely	2

Responses when added that provide a score of 0 will be considered low risk project. If adding all responses will result to a score of 1-4 and that no score of 2 was given to any single response, the project will be assigned a medium risk category. A total score of 5 or more (which include providing a score of 1 in all responses) or a 2 in any single response, will be categorized as high risk project.

Based on the above risk rating, the project is assessed to have medium risk with respect to impact of climate change.

Table 7-25: Impact Significance – Climate Change

Aspect	Scenario	Overall
Climate Change	Without Mitigation	Moderate
	With Mitigation	Minor

7.7 Cumulative Impact Assessment

Cumulative Impact Assessment (CIA) is the process of (a) analyzing the potential impacts and risks of proposed developments in the context of the potential effects of other human activities and natural environmental and social external drivers on the chosen Valued Environmental and Social Components (VECs) over time, and (b)

proposing concrete measures to avoid, reduce, or mitigate such cumulative impacts and risk to the extent possible.

Cumulative impacts[32] are a result of effects that act together (including those from concurrent or planned future third-party activities) to affect the same resources and/or receptors as project under consideration (e.g. the combined effect of other similar projects in the general area). An effect to a resource in itself may not be considered significant but may become significant when added to the existing and potential effects eventuating from similar or diverse developments in the area.

The other project located in the surrounding area of FPEPL is given in table below:

Table 7-26: Details of proposed solar projects near project site

Name of the Project	FPEPL	Distance from proposed project site
125 MW solar project	Sakri solar plant (Mahagenco)	Shivajinagar (approx. 1 to 2 kms from bhadgaon land parcel)

There is 1 other solar power plant namely Sakri Solar Park, which is operational, located at an aerial distance of approximately 2 km towards North-east of the project boundary. The Sakri Solar Power Park is also developed by the Mahagenco and has capacity of 125 MW located within 10 km radius of the project boundary

In addition to above, there has been a substantial increase in renewable energy developments in India, and legislation is evolving to facilitate the introduction of Independent Power Producers (IPPs). Hence it is anticipated that additional renewable energy power plants will come within 50 km radius of the project area boundary.

Since renewable power projects do not require any resource consumption for its operation, no obstruction to common property resources is anticipated. The potential cumulative impacts identified for the project has been highlighted in the following sub sections.

7.7.1 Environmental Impacts

Air Quality and Soil Characteristics

The baseline ambient air quality measured within 5 km radius of the project was noted to be well within the prescribes standards. No prominent projects are proposed in nearby areas. The construction activity of project will last for 8-10 months, the cumulative impact on ambient air quality can be considered low.

Ambient Noise

The noise from existing surrounding has been captured in the baseline recorded for the project. It was observed that the average day noise (except at one location) and night time levels at all locations were exceeding standards.

It is to be noted that ambient noise levels depend on various factors such as the exact number of vehicles/equipment being used at the construction site, number of hours of operation etc. Since construction activities will be temporary in nature and will be carried out during the daytime and will not last for more than 8-10 months, cumulative noise impact is considered low.

Soil and Water Quality

There will be wastewater generation from cleaning the solar panels. The domestic wastewater may be generated from site office of the operation team. Septic tanks with soak pits should be provided to treat sewage during operation stage. Due to the proposed 100 MW capacity solar park, more wastewater generates during operation phase and there is a potential to impact soil and water quality if wastewater generated is not handled properly.

[32] As per *Good Practice Handbook on Cumulative Impact Assessment and Management: Guidance for the Private Sector in Emerging Markets by IFC (2013),* cumulative impacts are those that result from the successive, incremental, and/or combined effects of an action, project, or activity (collectively referred to as "developments") when added to other existing, planned, and/or reasonably anticipated future ones. For practical reasons, the identification and management of cumulative impacts are limited to those effects generally recognized as important on the basis of scientific concerns and/or concerns of affected communities.

In addition to this, substantial amount of solid and hazardous waste will be generated from the solar park hence cumulative impact on water quality can be considered moderate to high.

7.7.2 Impacts on Biodiversity and Ecosystem Services

The chief Valued Ecological Components (VECs) with respect to the area under consideration include a potentially critical habitat, globally threatened species, specialized habitats, habitat-specialist species and priority provisioning and cultural ecosystem services, as described in the biodiversity baseline.

7.7.2.1 Impact on Biodiversity

The main cumulative impact envisaged is the increased risk of collision and electrocution for migratory birds from the introduction of new transmission lines into the Study Area. Second cumulative impact would result from the generation of a large, reflective, water-mimicking surface by the collective, near-contiguous solar panelling of the Solar Park, which would increase risk of false landings and the resulting injury and entrapment for water-birds.

7.7.2.2 Impact on Ecosystem Services

The natural scrublands and grasslands in and around the Solar Park provide a priority provisioning ecosystem service in the form of fodder for livestock from surrounding villages. The loss of this natural habitat will lead to the a significant reduction in the pasture available to the local livestock, thereby increasing the grazing pressure in comparable alternative habitats around the Solar Park. Another anticipated cumulative impact is that on the soil and water quality in the Study Area. The large-scale change in land-use, through clearing of vegetation and construction of the solar park and shared facilities, will increase the vulnerability of the soil to erosion by wind and water. The largescale land-levelling will impact the natural drainage of the region and may cause influx of saltwater into hitherto freshwater habitats, thus reducing the freshwater resources currently available to the local community. Any changes in the local soil salinity levels, resulting from the salinization of hitherto freshwater ecosystems, is also likely to impact the local agricultural yields.

7.7.3 Socio-economic Impacts

7.7.3.1 Impact on land

The proposed 100MW Solar power project is proposed to be developed in Nagpur and Bhadgaon Villages of Sakri Taluk, Dhule District. The total land requirement for the proposed project would be around 450 acres which includes installation of Solar modules of 100MW capacity along with site office, inverter room, and other associated facilities. Additional land is not required to be procured for transmission line as only RoW from private landowners and NOC from relevant departments for government land parcels will be required. The entire project land was observed to be rocky, undulating terrain and unfit for extensive farming. Moreover, poor soil quality and lack of irrigation facilities for cultivation of the concerned land parcels were reported during community consultations. During site visit, only few patches of land parcels were cultivated which are usually cultivated during the monsoon and it is devoid of any residential dwellings/ archaeological sites. The project of FPEPL will have no economic impacts as no farming activities or other livelihood pursuits are being undertaken on it. The required land is being procured through the land aggregator on a Willing Buyer and Willing Seller basis.

7.7.3.2 Migrant Workers

During the O&M phase, all the projects proposed to be set up in the solar power park will not involve any migrant labor. Only skilled personnel will be hired from outside the project area, who will be accommodated in rented accommodation complying with the relevant provisions of PS 5 of the IFC policy on environmental and social sustainability. Most of the civil works being small in nature should be handled by the local contractors from the nearby regions. This would ensure that the workers are from local area. Only skilled workers for erection of solar modules and operation of cranes should be sources from outside and their numbers should be relatively less.

As a strategic principle, all the proponents should decide to engage local people during construction to avoid migration of labor from far off places. This will not have any stress on the local and moreover provide job opportunities to the local population.

7.7.3.3 Impact on Infrastructure

The road connectivity in the area is good therefore transportation of solar modules and other construction materials/ machineries will not lead to any disturbances to the habitations. There will be no disturbance to habitations as the erection activities will be undertaken at a considerable distance from human settlements.

7.7.4 Conclusion

The Project will have minor as well as short term impact during construction phase. Minor impact due to generation of dust and fugitive emissions are expected during construction phase only. Minor impact is expected to resource utilization like land, water and socio-economic conditions of the Project area villages. Land for the proposed Project is owned by farmers, who are dependent on rain for farming . Impact analysis reveals that minor impact is anticipated on livelihood of local community. The impacts on environment and social parameters is assessed to be minor during operation phase of the proposed project.

The Project would change overall character of the region and would contribute to the conversion of rural dry waste land to landscapes with industrial character. However, no existing highly scenic view or aesthetically unique or distinctive landscape would be forfeited by the introduction of these types of Projects. The Project represents conversion from a natural environment of dry agricultural fields to build environment with an industrial character. The area is unpopulated, and no residents would be subject to alteration of view in association with proposed Projects. The Project would change the landscape pattern of the area and likely to have some impact on biological diversity through habitat loss, degradation and fragmentation.

Therefore, minor cumulative impact may be expected due to the Project and other Projects which may come in future in the area at present.

The Project also has a positive impact in terms of employment generation for the local people during entire Project lifecycle. The impacts identified both during construction and operation phase can be minimized and mitigated by adopting suitable mitigation measures as suggested in the ESIA report. Based on the conclusion drawn from the ESIA study the proposed Project can be categorized as Category B (as per categorization of Projects), which specifies that this Project is expected to have limited adverse environment and social impacts which can be mitigated by adopting suitable mitigating measures.

8. Environment and Social Management Plan

8.1 Introduction

The purpose of an Environmental and Social Management Plan is to ensure that social and environmental impacts, risks, and liabilities identified during the ESIA process are effectively managed during the operation and closure of the proposed project. An Environmental and Social Management Plan (ESMP) is an important component of an ESIA as it provides an important tool that can be used to measure and check, in a continuous mode, the efficacy of the mitigation measures and project commitments incorporated in the ESIA to minimize or eliminate identified negative impacts. The ESMP also aligns the schedule for implementation of management plans.

The key objectives of the ESMP are to:

- Formalize and disclose the program for environmental and social management;
- Provide a framework for the implementation of environmental and social management initiatives;
- Monitor the FPEPL's compliance with all the mitigation measures and commitments in the ESIA report;
- Monitor the FPEPL's compliance with legal standards and limits for waste discharge and emissions;
- Provide early warning signals on potential environmental changes, so that appropriate actions can be taken to prevent or minimize environmental and social impacts;
- Put in place a sound and cost-effective contingency plan that can be activated for prompt response to any accidental occurrence;
- Encourage and achieve the highest environmental and socio-economic performance and response from individual employees and contractors throughout the duration of the project; and
- Routinely check all measures/devices put in place for effective monitoring of project functions and activities.

The ESMP delineates the monitoring and management measures to avoid and/or minimize such impacts by allocating management responsibility and suggesting skill requirement for implementation of these measures. Also, the ESMP shall ensure a continuous communication process between FPEPL, project developer, workers (including sub-contractors), local community and other stakeholders.

In addition, the ESMP may also be used to ensure compliance with statutory requirements, and corporate safety & environmental and social management policies.

An ESMP is, therefore, a tool which ensures continuous assessment of the environmental and social impact of a project operation as well as proactive response to the impacts to reduce their overall effect on the identified environmental and social parameters. It makes an organization to do the right thing at the right time rather than responding to situations borne out of statutory or legal compulsion.

In this section, an ESMP is presented to be used throughout the life span of the proposed project. This ESMP will facilitate environmental and social management of the proposed project and procedures are provided to help prevent, avoid, or minimize negative environmental impacts that may occur during project operations and decommissioning phase.

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

The enforcement and implementation of the project specific ESMP requires a robust manpower network working towards the common goal of ensuring compliance to the commitments towards ESHS standards for the project. Organization structure of FPEPL with project level responsibilities is given in ***Figure 8-1.***

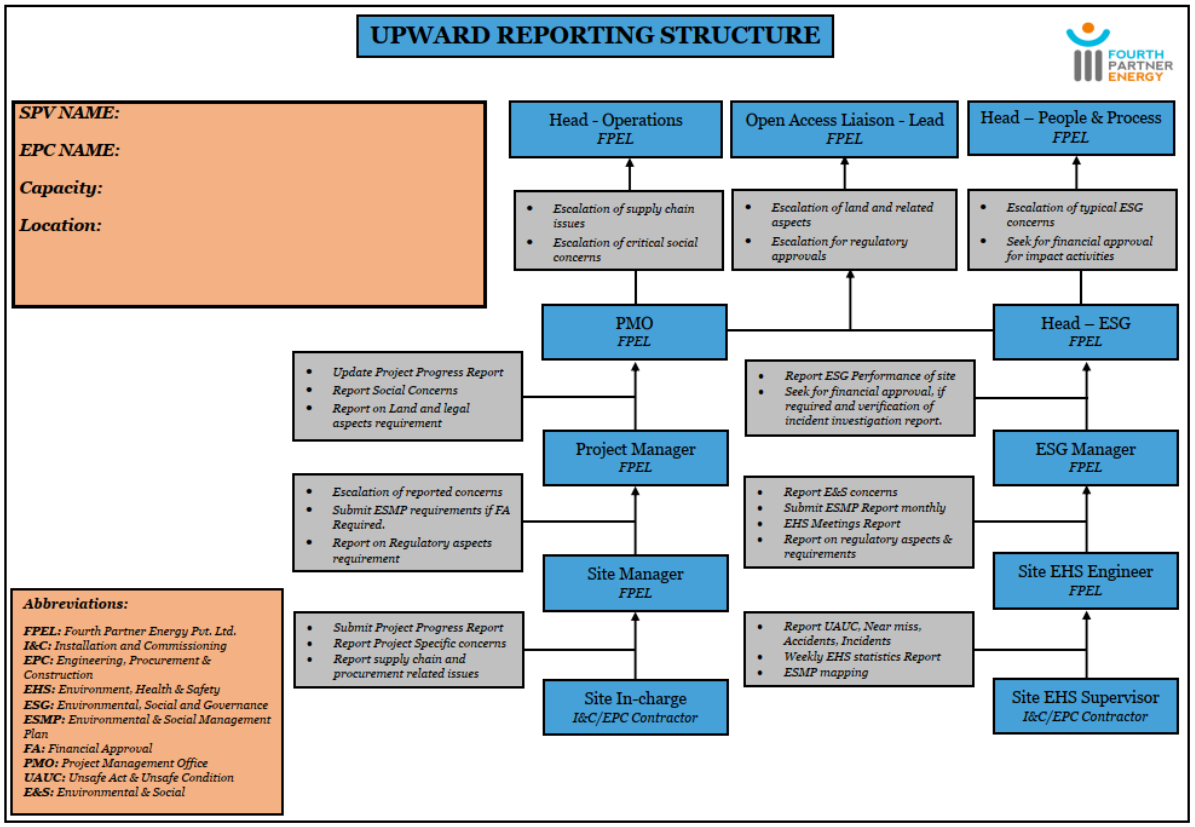


Figure 8-1: Project organization structure

The overall management and coordination of the project with respect to EHS will be managed through the Head, EHS at the corporate level. Also, a designated EHS professional/EHS Project (by FPEPL) is assigned at the project level to manage the EHS functions and activities during the construction stage (including supervising the day-to-day activities of the Sub-contractors and their team). The Site level EHS Project will in turn report to FPEPL Corporate.

FPEPL is responsible for the O&M of the project.

8.3 Roles and Responsibilities

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

Head-People and process as ESMS Head

- Lead the ESMS committee to ensure effective implementation of the ESMS and policy requirements at all levels of the organisation;
- Ensure that the EHS &Social Policy are approved and effectively communicated to relevant stakeholders, and provide directives for implementation and fulfilment of policy commitments;
- Ensure that E&S roles and responsibilities are properly defined, understood and carried out at all levels within the organisation;
- Ensure that adequate resources are provided for effective implementation of the ESMS;
- Report progress of ESMS implementation to the Board;
- Disclose information on material E&S aspects to other stakeholders as required, on periodic basis with due approval from the Board

ESG head as ESMS manager

ESG -Head at the corporate level would be appointed as the ESMS Manager and will be assigned with the following roles and responsibilities:

- Ensure all activities of the ESMS process are completed;
- Ensure ESDD & ESIA reviews are conducted and incorporated into the decision-making process at FPEPL;
- ESAP and ESMP are documented, accepted, and incorporated into the action plans at the site and all offices of FPEPL; and
- Report on progress and adherence to ESMS and items on ESAP/ESMP.

Apart from the project related aspects, Site In-charge with open access team will also have additional responsibilities of community lesioning such as:

- Managing all grievances of the project and their outcomes;
- Implementing, monitoring and updating the ESMP;
- Keep record of the CSR activities being undertaken for the project, if any;
- Keep the Project Manager informed on the progress of CSR activities undertaken at project site;
- Conduct periodic (formal and informal) meetings with local community for understanding their grievances and inform them about the Grievance Redressal Mechanism and ensure effective implementation.

Project Managers as ESMS Site in-charge

The asset level or onsite ESMS Site In-charge shall be responsible for:

- Ensuring ESAP and ESMP are implemented and followed-throughout the project lifecycle;
- Ensuring contractors, sub-contractors and vendors adhere to practices in line with ESMS; and
- Monitoring initiatives and progress against ESMS policy to be submitted to the ESMS Manager at the frequency established.

EPC Contractor (during construction phase)

The HSE officer of the EPC contractor will be overall responsible for management of environmental and social aspects, labour management during the construction phase. The detailed roles and responsibilities of the EPC Contractor have been provided in the table below:

Aspect	Roles and responsibilities
Air Quality Management	• Ensure the reduction and control of air emissions from construction activities by minimizing dust from material handling sources, loading and unloading of materials and stockpiles. • Sprinkling of water to be carried out to suppress dust from construction activities. • Ensure that the vehicles engaged for project have a valid “Pollution under Control” (PUC) certificate and the speed of vehicles shall be limited on village roads to reduce fugitive dust emissions. • Provide sufficient stack height to D.G. sets as per the CPCB norms.
Soil Quality	• Provide appropriate storage of topsoil in an isolated and covered area to prevent its loss during high wind and runoff. • Use topsoil at the time of plantation • Reuse Construction debris in paving on site approach road to prevent dust generation due to vehicular movement. • Re-vegetation to be done in the area after the completion of construction, in order to reduce the risk of soil erosion.
Surface and Ground Water Quality	• Construction of dedicated storm water drains considering natural topography for reduction any contamination to runoff due to project activities. Storm water drains shall be designed to avoid any obstruction to natural flow and final outlet shall be connected to propose storm water drains by Solar Power Park Developer;

	• Proper drainage to be provided for wastewater generated from the Porta Cabins and labour camps and shall be treated on Site septic tanks and soak pits as per the specifications in IS 2470:1995 (Part I and Part II); • Provide separate toilets for male and female workers (if any) in the ratio of 1:15 and 1:10 (toilet to workers) at the project site in order to maintain hygienic and clean surroundings. Washing and bathing areas should be provided with proper drainage system so that wastewater is not accumulated in the project site. • Conduct Periodic monitoring to ensure that the waste water is not finding its way into surface and groundwater; • All solid wastes such as construction debris, used or waste oil, paint cans, etc. will be stored on impervious surface in secure location to avoid soil and groundwater contamination; • Paved impervious surface and secondary containment to be used for fuel storage tanks; • Loading and unloading protocols should be prepared and followed for diesel oil and used oil; • Leak proof holding tanks for sanitary waste water to protect the shallow ground water level. • Conservation of water to be undertaken at all project locations and ancillary facilities and if possible, recycling and reuse of water to be taken utilising every opportunity.
Noise Level	• Mobile noise sources such as cranes, earth moving equipment and HGVs shall be routed in such a way that there is minimum disturbance to receptors. • EPC Contractor shall instruct their safety officers to arrange for inherently quiet construction equipment and machines to maintain the noise level to minimum. • Only manual construction activities shall be carried out during night-time (i.e. no use of machinery). It is also to be ensured that no village road will be utilized for movement of equipment during the night-time. All loud and sudden noises will be avoided wherever possible and fixed noise sources shall be located at least 50 m away from the site boundary. • Rubber padding/noise isolators will be used for construction equipment or machinery. • Temporary noise barriers shall be provided surrounding the high noise generating construction equipment. • The personnel involved in high noise generating activities shall be provided with adequate PPEs to minimize their exposure to high noise levels. • Construction vehicles and machinery will be well maintained and not kept idling when not in use.
Solid and Hazardous waste management	• Distribute appropriate number of properly contained litter bins and containers properly marked as "Municipal Waste" and ensure that the waste is disposed at a regular interval. • Ensure that the waste is • Domestic and construction waste like recyclables viz. paper, plastic, glass, scrap metal waste etc. will be properly segregated and stored in designated waste bins/containers and periodically sold to local recyclers. • Any wastage/damaged part of solar panel will be sent back to panel vendor for disposal. • Used oil, oil-soaked rags, empty oil lined containers and other hazardous waste should be stored in leak proof containers at designated locations in enclosed structures over impermeable surface with adequate labelling as per the provisions of the Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016. Hazardous wastes shall be disposed within ninety days of generation to MPCB approved vendors. • Maintain a register of all hazardous materials used and accompanying MSDS must present at all times. • Spilled material should be tracked and accounted for.
Traffic and Transport	• Only trained drivers with valid license shall be recruited by the EPC Contractor for transfer of material; • Ensure that all the traffic rules are obeyed at all the times and driving under the influence of any drug or alcohol shall be strictly prohibited; • Mitigation measures such as emphasizing on safety amongst drivers, adopting limits for trip duration and arranging driver roster to avoid overtiredness and avoiding dangerous routes and times of day to reduce risk of accident shall also be implemented; • Regular maintenance of vehicles and use of manufacturer approved parts should be adopted to minimize potentially serious accidents caused by equipment malfunction or premature failure; • The villagers shall be made aware about the schedule prior to the movement of trucks and transportation in the Project area.
Occupational Health and Safety	• Implement the H&S plan provided by the project proponent at the site; • Provide occupation health and safety orientation training to all employees and workers consisting of basic hazard awareness, incident management, site-specific hazards, safe working practices, and emergency procedures;

	• Ensure all Health and Safety measures are in place to prevent accidents and reduce the consequences of non-conformance events; • Provide training, awareness and supervision to ensure all of its construction workers comply with the OHS procedures; • Provide appropriate resources i.e. PPE to workers on Site; and • An emergency response procedure and infrastructure will be available on Site to ensure provision of first aid for personnel in case of emergency.
Heat related Stress management	• Increase air velocity for indoor workers by using natural cross-ventilation from windows and doors or mobile or ceiling fans. • Operate effective general and local exhaust ventilation and air conditioning; • Avoid non-essential sources of hot ventilation (e.g. air conditioner outlets adjacent to working areas); • Install a shield between employees and a source of radiant heat such as curtains on windows or other insulating barrier, enclose the heat source, or move the heat source away from employees; • Provide cooled drinking water as close as possible to the work site; • Arrange shade for outdoor workers where practicable; • Provide a cool rest area in which workers can take their meal breaks and tea breaks; • Modify the work schedule or shift times so that outdoor and physiologically demanding work is done in the early morning or late afternoon; • Allow workers to self-regulate their pace of work. • Workers should be encouraged to present to work in a well hydrated state, and take frequent small drinks throughout each shift to replace fluid lost through sweating; • Diuretic Fluids such as tea, coffee, alcohol and some soft drinks should not be used to replenish fluid lost due to heat; • Use PPE that reduces exposure to ultra violet radiation and heat (such as reflective masks or aprons, large brimmed hat, sunscreen); and • Workers returning from periods away from hot environments should be given the opportunity to acclimatise before being expected to undertake work in very hot conditions at full capacity.
Labour Management	• Ensure that no bonded labour, child labour or forced labour are engaged for project-specific construction activities; • Comply with all the applicable regulations concerning labour and working conditions; • Regularly report on issues relating to labour and working conditions to the project proponent; • Provide a platform for raising, processing and redressing grievances of all the contractual workers; • Undertake regular engagements with internal stakeholders with special reference to contractual workers; • Ensure non-discrimination in matters of terms of employment and payment of wages to all contractual workers including migrant workers; • Ensure usage of PPEs by all contractual workers while performing duty at site; and • Ensure that all facilities and basic amenities as required by relevant national legislations and international best practice are provide din the Labour Camp/ Worker Accommodation facilities.

Community Liaison Officer (CLO)

The CLO would be expected to undertake the following roles:

- Manage, review and develop the Social Program to ensure that it fulfils Project requirements, including measures observed in this ESMP and monitor the implementation;
- Co-ordinate and evaluate the effectiveness of all program elements;
- Manage the implementation of community health program, including coordination with HSE team on OHS measures associated with management of impact to community health;
- Coordinating the HSE team on implementation of the Project vehicle safety measures associated with management of impact to community safety;
- Coordinating with Human Resource (HR) team person to ensure implementation of labour related measures required in this ESMP;

- Consultation with community and liaison with relevant stakeholders in implementing the required stakeholder and grievance management measures, including liaison with related government bodies as necessary;
- Leading collaboration to establish and implement the Project grievance mechanism during construction phase, and supervise contractor's social performance as required in this ESMP; and
- Managing social monitoring and reporting the results to the Project Manager.

8.3.1.1 Inspection, Monitoring and Audit

Training is one common method of supplying individuals with additional skills and knowledge. In order to be successful in EHSS management, training programs need to be thought out carefully and systematically. A robust social and environmental, health and safety training plan is important for effective implementation of ESMS.

The EHS Engineer along with recommendations from EHS Projects and EHS Head (at corporate) will ensure that the job specific training and EHS induction training needs are identified based on the specific requirements of the ESMS and existing capacity of site and project personnel (including the Contractors and Sub-contractors) to undertake the required actions and monitoring activities. Some of the specific trainings that will be carried out routine basis are as follows:

- ESMS Checklists and procedural guidance;
- Occupational Health & Safety;
- Fire Safety and Prevention;
- Emergency Response Preparedness;
- Operational Training;
- HR Induction Training;
- PPE Training;
- Driver Safety; and
- Implementation of Environmental and Social Management/Action plans

The above listed trainings are the preliminary trainings which will be undertaken at the inception stage once the employee/worker joins the company and/or Project. Post that, monthly refresher trainings will be undertaken, especially for the workers. Other training will be identified and implemented during the project lifecycle as per the need assessment, as part of mitigation measure and also capacity building of the staffs.

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

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

In case of contractors or turnkey contractors having sufficiently well-developed standards on EHS management, the training can be sub-let to the same for their respective employees and FPEPL will monitor the completion and sufficiency status of these programs. In case of subcontractors, the training and capacity building will be done by the HSE Manager with site responsibilities, along with the contractor's EHS manager to ensure such trainings of the contracted staffs either directly or through trainers of FPEPL. Subsequently the responsibility can be passed on to the sub-contractors for all future training programs.

8.4 Documentation and Record Keeping

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

- Documented Environment Management System;
- Legal Register (maintained at sites and copies available at corporate level);
- Preparation of site specific plans
- Work instructions;
- Incident reports;
- Emergency preparedness and response procedures;
- Resource consumption Records;
- Training records;
- Monitoring reports including ESMP implementation reports and copies of environmental compliance;
- Auditing reports; and
- Complaints register, and issues attended/closed.

8.5 Training

Training is one common method of supplying individuals with additional skills and knowledge. In order to be successful in EHSS management, training programs need to be thought out carefully and systematically. A robust social and environmental, health and safety training plan is important for effective implementation of ESMS.

The HSE Manager along with recommendations from Regional HSE Manager, Regional Project Manager and Site Manager will ensure that the job specific training and EHS induction training needs are identified based on the specific requirements of the ESMS and existing capacity of site and Project personnel (including the Contractors and Sub-contractors) to undertake the required actions and monitoring activities. Some of the specific trainings that will be carried out routine basis are as follows:

- ESMS Checklists and procedural guidance;
- Occupational Health & Safety;
- Fire Safety and Prevention;
- Emergency Response Preparedness;
- Operational Training;
- HR Induction Training;
- PPE Training;
- Driver Safety; and
- Implementation of Environmental and Social Management/Action plans

The above listed trainings are the preliminary trainings which will be undertaken at the inception stage once the employee/worker joins the company and/or Project. Post that, monthly refresher trainings will be undertaken, especially for the workers. Other training will be identified and implemented during the Project lifecycle as per the need assessment, as part of mitigation measure and also capacity building of the staffs.

An environmental and social management training program will be conducted to ensure effective implementation of the management and control measures during construction and operation of the Project. The training program will ensure that all concerned members of the team understand the following aspects:

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

To ensure the competency of the employees, the ESMS Manager will establish and maintain procedures to ensure that employees and workers working under each relevant function and level are aware of the significant environmental aspects and safety risks, actual or potential, of their work activities and consequences and the benefits of improved personal performance. Their role and responsibility in meeting policy and procedure requirements and health, safety and environmental arrangements including emergency preparedness and response requirements. The potential consequences if operating procedures are not followed. In case of subcontractors, the training and capacity building will be done by the HSE Manager with site responsibilities, along with the contractor's EHS manager to ensure such trainings of the contracted staffs either directly or through trainers of Cleantech Solar. Subsequently the responsibility can be passed on to the sub-contractors for all future training programs.

8.6 Environment and Social Management Plan and Procedures

At the project level, FPEPL need to develop and implement following plans for management of environmental and social aspects of the project during operation and decommissioning phase:

- Environment and Social Management Plan
- Waste Management Plan
- Storm Water Management Plan
- Occupational Health and safety Plan
- Traffic Management Plan
- Emergency Preparedness and Response Plan
- Climate Change Vulnerability Adaptability Measures
- Grievance Redressal Mechanism
- Stakeholder Engagement Plan
- Community Development Plan under CSR
- Budgetary provisions for ESMP Implementation

8.6.1 Environment and Social Management Plan

The environmental and social management plan proposed during planning and designing phase mainly focuses on the aspects related to land procurement and resettlement, permit compliances, procurement of materials and landscaping. Detailed ESMP proposed for the planning and designing phase is given in the sections below.

8.6.1.1 ESMP during Construction Phase

Major environmental, social, and biological aspects considered during the Construction phase are:

- Water resources (ground and surface water) and their quality
- Ambient Air and Noise quality
- Soil quality
- Noise levels
- Solid and hazardous waste generation

- Ecology and biodiversity
- Local Economy of the area

Detailed ESMP proposed during the construction phase is given in ***Table 8-1.***

8.6.1.2 ESMP during Operation Phase

The environmental and social management plan proposed during the operation phase has been prepared considering the impacts this project may have on the surround environment and human beings' due operational activities.

The major aspects covered during the operation phase are ambient temperature, solid and hazardous waste generation, wastewater management, ecology and biodiversity.

Detailed ESMP proposed during the construction phase is given in ***Table 8-2.***

8.6.1.3 ESMP during Decommissioning Phase

During decommissioning phase, all the environmental, social and biologicals aspects that were considered for the construction phase have been taken into consideration. The major aspects covered in the ESMP proposed during decommissioning phase are land use, air quality, water quality, soil quality, noise levels and solid and hazardous waste generation. Detailed ESMP proposed during decommissioning phase is presented in ***Table 8-3.***

Table 8-1: ESMP during Pre-Construction Phase

S. N.	Aspects	Impacts	Impact Intensity	Mitigation/ Control Measures	Impact Intensity with Mitigation	Monitoring/ Training Requirements/ Further Actions
1.	Permit Compliance	Non-compliance to various Environmental Permits required and pertaining to the proposed Solar Power project or there could be legal Implications to FPEPL	Major	• Site has to obtain various Environmental Permits such as no-objection certificate (NOC) for abstraction of ground water under Environment protection Act Environment Protection Act -1986, in case groundwater is used through installation of groundwater abstraction well or bore well, Factory License under Factories Act, 1948, NOC from Gram Panchayat for Initiation of construction activities, as applicable, and other permits related to workers and living conditions.	Minor	• FPEPL should ensure Periodic EHS audits should be conducted to verify permit requirements and associated compliances
2.	ESMP Implementation	Inadequate implication of ESMP by Developer/Contractor	Moderate	• Site Specific Environment management system and procedures should be prepared before construction work commences; • Social, Environment, Health and Safety Organization Chart shall be prepared at Corporate level and Site-specific level; • Proper procedure shall be developed for training of personnel & contractor, ESMP monitoring and reporting (externally & internally); • ESMP shall be part of the tender and bid documents so that contractor can include cost related to ESMP	Minor	• FPEPL and its contractor should ensure periodic audits should be conducted to verify the implementation and effectiveness of the management systems
3.	Procurement of Machineries and Construction Equipment (such as Diesel Generators, Batching Plant, Concrete mixing plant etc.)	Inadequate implication of ESMP by Developer/Contractor	Moderate	• The contractor shall follow all stipulated conditions for pollution control as suggested in ESMP and as per the regulatory requirements • No such installation by the Contractor shall be allowed till all the required legal clearances are obtained from the competent authority • Equipment's conforming to the latest noise and emission control measures shall be used. • PUC certificates for all vehicles and machinery shall be made available for verification whenever required.	Minor	• Development of EMS management system and procedures before construction work
4.	Biodiversity and Ecosystem Services	Loss of habitat for wildlife, possibly including 1 CR grassland species • Degradation of approximately • 0.035 square km of natural seasonal wetland and loss of • 0.22 square km of grassland in the Bhadgaon component of the Project Site.	Moderate	• Conservation of the approximately 0.035 square km of natural seasonal wetland and 0.22 square km of grassland in the Bhadgaon Project Site. Conservation of • 0.03 square km of seasonal wetlands and approximately • 0.1 square km of rocky area habitat in the Nagpur Project Site to the extent possible. • Conservation of the natural topography and drainage in and around the Project Site.	Minor	• Training of Project personnel, EPC contractors and labour to sensitize towards biodiversity and ecosystem services conservation • Monitoring for

S. N.	Aspects	Impacts	Impact Intensity	Mitigation/ Control Measures	Impact Intensity with Mitigation	Monitoring/ Training Requirements/ Further Actions
		• Degradation of rocky area habitat in the Nagpur Project Site (approximately 0.1 sq km) • Loss or degradation of priority provisioning ecosystem services • Loss of grassland habitat & potential TL-related collision/ electrocution in a precautionarily deemed CH for CR Sypheotides indicus (Lesser Florican or LF)		• Minimization of number, length and width of internal access roads. • Maintenance of connectivity and integrity of any existing natural water-channels while building internal roads or embankments. • Monitoring & identification of avian high use areas (HUAs) prior to TL installation. • Institution of a precautionary PS6-aligned BAP, structured around TL-mitigation & community-based conservation &/or restoration of grassland habitat in the Study Area.		qualitative and quantitative documentation of natural vegetation loss to inform compensatory plantations • Identification of an appropriate external agency to conduct the required community engagement, if necessary
5.	Restriction of Access to the neighbouring landowners / farmers	• Few landowners / farmers were observed to use the project site land for reaching their agriculture land. Though there are no designated access road, the farmers trespass the project site land as a shortcut to reach their agriculture land.	Moderate	• Consult the local / neighbouring farmers prior to construction of fencing • Take necessary actions like providing access road if in case no alternative solution satisfying the local farmers.	Minor	• SEP / GRM Records • Action Taken on the Grievances reported.

Table 8-2: ESMP during Construction Phase

S. N.	Aspects	Impacts	Impact Intensity	Mitigation/ Control Measures	Impact Intensity with Mitigation	Monitoring/ Training Requirements/ Further Actions
1.	Ambient Air Quality	• Fugitive Dust due to movement of project vehicles and site clearance; and • Emission from Diesel Generators.	Moderate	• The FPEPL and contractors shall ensure the reduction and control of air emissions from construction activities by minimizing dust from material handling sources. • Loading and unloading of raw materials should be carried out in the most optimum way to avoid fugitive emissions. • Sprinkling of water to be carried out by the respective contractors to suppress dust from construction activities. • Best practices such as halting of activity during sustained strong winds should be opted for. It shall be ensured that all stockpiles are covered, and storage areas provided with enclosures to minimize dust from open area source. • Stock piling and storage of construction material will be oriented after considering the predominant wind direction. • Vehicles engaged for the project will be required to obtain "Pollution under Control" (PUC) certificates. • Sufficient stack height needs to be provided to D.G. sets as per the CPCB norms. • Exhaust emissions of construction equipment to be adhered to emission norms as set out by MoEF&CC/ CPCB. • Speed of vehicles on the village road and on the internal roads shall be limited to 10-15 km/hr in order to reduce fugitive dust emissions. • Cease or phase down work if excess fugitive dust is observed, or there are any community grievance related to dust. Investigate the source of dust and ensure proper dust suppression.	Minor	• FPEPL /Contractor to ensure all vehicles used for transportation must have a PUC certificate. • Regular check on the exhaust emissions of the construction equipment's, periodic check on the ambient air quality.
2.	Soil Quality	• Topsoil Loss	Moderate	• Provide appropriate storage of top soil in an isolated and covered area to prevent its loss during high wind and runoff. • Allow only covered transportation of top soil within project site. • Use top soil at the time of plantation. • Construction debris to be reused in paving on site approach road to prevent dust generation due to vehicular movement. • Re-vegetation to be done in the area after the completion of construction, in order to reduce the risk of soil erosion.	Minor	• Procedure to be developed for utilization of top soil which may include isolated storage of top soil and its utilization for cover the surface or for gardening; • Records to be maintain for generation and utilization of top soil.

S. N.	Aspects	Impacts	Impact Intensity	Mitigation/ Control Measures	Impact Intensity with Mitigation	Monitoring/ Training Requirements/ Further Actions
3.	Surface and Ground Water Quality	• Possibility of contaminated runoff from the site entering ground; • Domestic water runoff from the portable toilets into the ground water can lead to degradation of water quality.	Moderate	• Construction of dedicated storm water drains for reduction any contamination to runoff due to project activities. Storm water drains shall be designed considering natural topography to avoid any obstruction to natural flow and final outlet shall be connected to propose storm water drains by Solar Power Park Developer; • Proper drainage to be provided for wastewater generated from the Porta Cabins and labour camps and shall be treated on Site septic tanks and soak pits as per the specifications in IS 2470:1995 (Part I and Part II); • Periodic monitoring shall be carried out to ensure that the waste water is not finding its way into surface and groundwater; • All solid wastes such as construction debris, used or waste oil, paint cans, etc. will be stored on impervious surface in secure location to avoid soil and groundwater contamination; • Paved impervious surface and secondary containment to be used for fuel storage tanks; • Loading and unloading protocols should be prepared and followed for diesel oil and used oil; • Drip paned provided to vehicles with leaks to prevent water contamination; • Leak proof holding tanks for sanitary waste water to protect the shallow ground water level.	Minor	• Regular monitoring of storm water drains to check any contamination into drains; • Regular monitoring of wastewater drains, septic tank and soak pit to check any waste findings or leakage find its way to surface and ground water; • Regular monitoring or inspection of fuel storage area, fuel loading/unloading area and hazardous waste storage area for any spillages or leakages into storage areas
4.	Impact on Water Availability	• Depletion on Ground and Surface water resources due to project water demand	Moderate	• Conservation of water to be undertaken at all project locations and ancillary facilities and if possible, recycling and reuse of water to be taken utilising every opportunity. • Restoration plan to accommodate the loss of groundwater to be undertaken.	Minor	• Water Consumption Records on daily basis; • Water recycling and reuse plan on yearly basis
5.	Noise Level	• Disturbance to habitants • Vehicular noise from heavy vehicles utilized to deliver construction materials and solar plant parts • Noise from DG sets • Construction noise from using mobile equipment, and concrete mixing	Moderate	• In case of complaints of uncomforting noise received from the inhabitants of nearby settlements through Grievance Redressal Mechanism (GRM) there should be considered possibility of putting noise barriers near to the receptor. • Mobile noise sources such as cranes, earth moving equipment and HGVs shall be routed in such a way that there is minimum disturbance to receptors. • Contractor shall instruct their safety officers to arrange for inherently quiet construction equipment and machines to maintain the noise level to minimum.	Minor	• Periodic monitoring of noise level should be conducted and compared with the ambient noise standard. It should also be made sure that the levels do not exceeded the national ambient air

S. N.	Aspects	Impacts	Impact Intensity	Mitigation/ Control Measures	Impact Intensity with Mitigation	Monitoring/ Training Requirements/ Further Actions
				• Only manual construction activities shall be carried out during night-time (i.e. no use of machinery). The hours of operation for specified pieces of equipment or operations, especially mobile sources operating through community areas should be limited. It is also to be ensured that no village road will be utilized for movement of equipment during the night-time. All loud and sudden noises will be avoided wherever possible and fixed noise sources shall be located at least 50 m away from the site boundary. • Rubber padding/noise isolators will be used for construction equipment or machinery. • Temporary noise barriers shall be provided surrounding the high noise generating construction equipment. • The personnel involved in high noise generating activities shall be provided with personal protective devices to minimize their exposure to high noise levels. • Construction vehicles and machinery will be well maintained and not kept idling when not in use.		quality standard (NAAQS) level; • Training to drivers of construction equipment
6.	Solid and Hazardous waste	Contamination of Land and water resources,	Moderate	• Distribute appropriate number of properly contained litter bins and containers properly marked as "Municipal Waste". • Domestic and construction waste like recyclables viz. paper, plastic, glass, scrap metal waste etc. will be properly segregated and stored in designated waste bins/containers and periodically sold to local recyclers. • Any wastage/damaged part of solar panel will be sent back to panel vendor for disposal. • Used oil should be stored at designated locations in enclosed structures over impermeable surface. • Maintain a register of all hazardous materials used and accompanying MSDS must present at all times. • Spilled material should be tracked and accounted for. • Hazardous wastes shall be stored in leak-proof containers and dispose, to disposal facilities registered with the Central Pollution Board.	Minor	• Periodic EHS audits should be conducted by FPEPL; • Training to Solid and Hazardous Waste Handlers
7.	Traffic and Transport	• Community Health and Safety • Traffic related accidents and injuries; • Increased pollution	Moderate	• Only trained drivers with valid license shall be recruited by Contractor for transfer of material; • Training program for all the drivers, regarding awareness about road safety and adopting best transport and traffic safety procedures shall be provided before initiation of the decommissioning activities;	Minor	• Traffic management plan; • Maintain records of driving licenses; • Training to drivers;

S. N.	Aspects	Impacts	Impact Intensity	Mitigation/ Control Measures	Impact Intensity with Mitigation	Monitoring/ Training Requirements/ Further Actions
				• Mitigation measures such as emphasizing on safety amongst drivers, adopting limits for trip duration and arranging driver roster to avoid overtiredness and avoiding dangerous routes and times of day to reduce risk of accident shall also be implemented; • Regular maintenance of vehicles and use of manufacturer approved parts should be adopted to minimize potentially serious accidents caused by equipment malfunction or premature failure; • The villagers shall be made aware about the schedule prior to the movement of trucks and transportation in the Project area.		• Grievance Redressal of any complaint received related to traffic
8.	Occupational Health and Safety	• Material handling and storage • Possible injuries associated with working with transmission line laying • Other occupational hazards • Accidents during cutting, chipping and piling • Physical injuries when workers involved in loading/unloading activities and don't adhere to proper ergonomics discipline. • Trip and fall hazards • Violation of the privacy and dignity of women involved in the work force. • Other occupational hazards • Diseases due to unhygienic condition	Moderate	• Develop and implement a Health and Safety (H&S) plan to follow throughout the construction phase. Also, ensue that the H&S plan is provided to the EPC contactor for implementation at the site; • Provide occupation health and safety orientation training to all employees and workers consisting of basic hazard awareness, site-specific hazards, safe working practices, and emergency procedures; • The contractors will be committed to ensure all Health and Safety measures are in place to prevent accidents and reduce the consequences of non-conformance events; • The contractors will provide training, awareness and supervision to ensure all of its construction workers comply with the OHS procedures; • The contractor will provide appropriate resources i.e. PPE to workers on Site; and • An emergency response procedure and infrastructure will be available on Site to ensure provision of first aid for personnel in case of emergency.	Minor	• labour engaged for working at height should be trained for temporary fall • All the workers should be made aware of the possible occupational risks/hazards by the way of an OHS training/awareness program • An accident reporting, and monitoring record should be maintained • Proper hygienic and scientific sanitation facilities for all the labourer's working in the site with spate exclusive arrangements for men & women to ensure the privacy and dignity of all individuals • GRM is properly maintained and followed on site. • Contractor should inform the labour about Emergency Preparedness Plan

S. N.	Aspects	Impacts	Impact Intensity	Mitigation/ Control Measures	Impact Intensity with Mitigation	Monitoring/ Training Requirements/ Further Actions
						(EMP) and communication system to be followed during emergency situation.
9.	Biodiversity and Ecosystem Services	• Loss, degradation or fragmentation of habitat for grassland & shrubland species, possibly including globally threatened species • Increase in risk of injury or death through diversion, entrapment, collision or electrocution with respect to globally threatened resident and migratory and/or congregatory avifaunal species • Loss of or hindrance in access to priority provisioning (pasture/fodder) ecosystem services for the local pastoral community	Moderate	• Restriction of movement of vehicles and operation of heavy machinery to pre-designated routes • Restriction of movement of vehicles and operation of heavy machinery to pre-designated routes • Restriction of construction activities to daytime hours • Avoidance of artificial illumination during night-time • Avoidance or damping of construction noise and vibrations to the maximum extent possible • Institution of efficient systems for containment and disposal of waste or spillage • Prohibition of harvesting of water, fuelwood or wild foods (including fauna) by construction labour • Use of permeable paving to minimize obstruction of rain-water percolation • Organization of solar panelling into discrete clusters, if feasible, to minimize contiguous reflective surface • Installation of bird flight deflectors (BFDs) on overhead transmission cables to minimize collision-risk to aerially moving fauna • Undergrounding of internal transmission cabling, if feasible, to minimize collision/ electrocution-risk to aerially moving fauna • Monitoring for recording any bird collision/ electrocution incidents and identifying any additional avian high use areas (HUAs) after establishment of the transmission line • Re-routing of the transmission line to avoid avian HUAs, if feasible • Minimizing span of the transmission line to increase visibility, if feasible • Insulating phase conductors in any avian HUAs identified • Opting for horizontal configuration of power lines • Minimizing vertical configuration of power lines • Using bundling/clustering of multiconductor transmission lines • Increasing diameter of shield wires to increase visibility • Using blinking lights instead of steady-burning lights where required	Minor	• Trainings for site personnel, contractors and labour to sensitize towards biodiversity and ecosystem services conservation

S. N.	Aspects	Impacts	Impact Intensity	Mitigation/ Control Measures	Impact Intensity with Mitigation	Monitoring/ Training Requirements/ Further Actions
				• Restricting human activity around the transmission line corridor to avoid sudden avian flights in any HUAs identified		
10.	Local Economy (EPC Contractor)	• The project will lead to increase in local employment opportunities and increased demand for materials and services through local contracting.	Minor	• Efforts should be made to ensure that maximum proportion of the demand for manpower and materials is met locally through contractors and vendors.	Moderate	• Informal training to EPC Contractor on the need for local sourcing of manpower and materials.

Table 8-3: ESMP during Operation Phase

S. N.	Aspects	Impacts	Impact Intensity	Mitigation/ Control Measures	Impact Intensity with Mitigation	Monitoring/ Training Requirements
1.	Aesthetics and Visual	• Visual and landscape impacts due to presence of Solar Panels	Minor	• The solar panels to be installed at a low height and to be kept closer to the ground so that it does not pop out of the general landscape of the area. • The panels to be arranged in a systematic manner which will give an aesthetic sense. Also, the orientation should be such that it should not affects the normal flight path of nearby birds.	Minor	• Visual inspection of solar panels and ensure that panels are not pop out of the general landscape of the area
2.	Impact on Soil and Water Quality	• Contamination of land and soil; • Impacts due to improper waste handling	Moderate	• Disturbance to soil from repair and maintenance activity will be limited and will ensure proper restoration of soil wherever excavation is undertaken. • Options of buyback agreements for defunct panels and for replacement and disposal of transformer oil by the supplier are to be explored, otherwise arrangements for disposal of defunct panels and waste oil to authorized recyclers are to be made. • Fuel and used oil will be stored in demarcated storage areas with adequate secondary containment and appropriate capacity. Spill control and prevention mechanism will be developed, and all the staff will be trained. • If the solar panels are washed with chemicals, it should be ensured that the chemicals are non-hazardous and biodegradable; • Storage of oil/chemicals shall be undertaken on paved impervious surface and secondary containment shall be provided for fuel storage tanks; • During the washing and maintenance of the solar panels adequate storage area shall be designed to collect the washed water.	Minor	• Periodic checking of solid and hazardous waste storage areas, fuel storage areas, chemical storage areas for checking in spillage or leakages from these areas
3.	Water Availability	• Depletion of water resources due to project water demand	Major	• The site office shall be provided with sewage line and the collected sewage shall be channelized to a septic tank with soak pit arrangement. • If the solar panels are washed with chemicals, it should be ensured that the chemicals are non-hazardous in nature. • Fuel and used oil will be stored in demarcated storage areas with adequate secondary containment and appropriate capacity. Spill control and prevention mechanism will be developed, and all the staff will be trained.	Moderate	• Maintaining water consumption records on daily basis; • Prepare programme for water recycling and reuse and minimize tanker Water • There should not be a leakage in the storage tankers for which regular inspections should happen.

S. N.	Aspects	Impacts	Impact Intensity	Mitigation/ Control Measures	Impact Intensity with Mitigation	Monitoring/ Training Requirements
4.	Occupational Health and Safety of Workers	• Electrocution • Fire due to short-circuit • Possible injuries associated with working at height • Diseases due to unhygienic condition	Moderate	• Regular electrical safety training to workers with safety procedures and other safety requirements that pertain to their respective job assignments; • Implement Lock out/ Tag Out (LOTO) system; • Use work equipment or other methods to prevent a fall from occurring. Collective protection systems, such as edge protection or guardrails, should be implemented before resorting to individual fall arrest equipment. In addition, safety nets or airbags can be used to minimize the consequences of a fall should it occur. • Loading and unloading operation of equipment should be done under the supervision of a trained professional. • All materials will be arranged in a systematic manner with proper labelling and without protrusion or extension onto the access corridor. • Personal Protective Equipment (PPEs) e.g., shock resistant rubber gloves, shoes, other protective gear etc. should be provided to workers handling electricity and related components and monitored that they are used by the employees • The transformer yard should be provided with fire extinguishers and sand buckets at all strategic locations to deal with any incident of fire; and • There should be arrangement for hygienic and scientific sanitation facilities for all the labourers working in the site. • An accident reporting, and monitoring record shall be maintained. • Ensure proper sanitation facilities.	Minor	• Labour engaged for working at height should be trained for temporary fall • All the workers should be made aware of the possible occupational risks/hazards by the way of an OHS training/awareness program • An accident reporting, and monitoring record should be maintained • Proper hygienic and scientific sanitation facilities for all the labourer's working in the site with spate exclusive arrangements for men & women to ensure the privacy and dignity of all individuals • GRM is properly maintained and followed on site. • Contractor should inform the labour about Emergency Preparedness Plan (EMP) and communication system to be followed during emergency situation.
5.	Biodiversity and Ecosystem Services	• Degradation or fragmentation of habitat for wild faunal species • Increase in risk of injury or death through diversion, entrapment, collision or electrocution for aerially moving wild fauna.	Moderate	• Restoring the soil and natural vegetation of any construction-phase roads which are not required in the operation and maintenance phase. • Ensure that all on-ground electrical components are adequately insulated to prevent electrocution of fauna through accidental contact with Project-installations. • Avoid use of artificial lighting in and around the project site as far as possible.	Minor	• Trainings for site managers, contractors • and labour to sensitize towards biodiversity conservation • Internal monitoring for compliance with any mitigation measures adopted

S. N.	Aspects	Impacts	Impact Intensity	Mitigation/ Control Measures	Impact Intensity with Mitigation	Monitoring/ Training Requirements
				• Use low-intensity artificial lighting, such as LED, to prevent insects from being attracted to the site. • Ensure that lighting fixtures are provided with downward-facing shades to limit the dispersion of the illumination. • Ensure that operation or maintenance activities, that require illumination, are restricted to daylight hours to prevent disruption of the natural night period by artificial lighting. • Prohibit the use of herbicides in the Project Site. • Prohibit the use of dust-settling chemicals in the Project Site. • Institute effective training modules and operational systems to ensure prevention of spillages of toxic substances. • Install effective containment systems to prevent any accidental spillage from leaching into the local environment		• • •
6.	Employment Opportunities	• Most of the manpower requirement in the unskilled and semi-skilled categories will be sourced from the local area and will comprise of youth from the neighbouring villages; and • Employment of local youths in the project-specific construction/ operation activities will positively contribute to the livelihood of the local villages.	Minor	• Specific clauses facilitating the employment of local youths can be incorporated into the EPC contract agreement between FPEPL and the EPC contractor.	Moderate	• Review of a monthly statement prepared by the EPC/ O&M Contractor highlighting the details of the manpower employed – location-wise, skill-wise

Table 8-4: ESMP during Decommissioning Phase

S. N.	Aspects	Impacts	Impact Intensity	Mitigation/ Control Measures	Impact Intensity with Mitigation	Monitoring/ Training Requirements/ Further Actions
1.	Environment and Occupational Health and Safety	• Issue of loss of job when the workers will be asked to leave; • Improper disposal of demolition waste and obsolete machineries will lead to contamination of soil and discontent of community; • Demolition activity is anticipated to generate dust and exhaust emissions which can be carried downwind to habitations; • Risks associated with health and safety issues such as trip and fall, electrical hazard etc.; • The decommissioning activities of dismantling the solar power plant and removing the ancillary facilities can lead to increased noise levels; • During the dismantling of the solar power plant, visual intrusions will be likely by removal of ancillary facilities, but their consequence will be negligible due to fact that such impact would be temporary (over a short period); • Depending on the type used, photovoltaic cells may contain toxic substances such as gallium arsenide, copper-indium-gallium-selenide	Moderate	• The proponent shall inform the workers and local community about the duration of work; • The workers shall be clearly informed about the expected schedule and completion of each activity; • All waste generated from decommissioning phase shall be collected and disposed off at the nearest municipal disposal site; • Sprinkling of water is being carried out to suppress dust from decommissioning activities and transport movement; • All necessary PPEs shall be used by the workers during demolition work; • FPEPL will be committed to ensure all health and safety measures are in place to prevent accidents and/or reduce the consequences of non-conformance events; • Institution of suitable training modules for project personnel and labour contractors involved in the dismantling process to ensure avoidance or minimization of solar panel damage as far as possible and adherence to appropriate decontamination protocols in the event of any unavoidable damage and adhere to proper safe disposal methods. Appropriate OHS programme and procedures are also expected to be in place to align with the local regulations, as well as IFC PS-2. The procedure will include, at minimum, the following measures: • Develop and implement a health and safety plan to follow throughout all phases of a project; • Provide occupation health and safety orientation training to all employees consisting of basic hazard awareness, site-specific hazards, safe working practices, and emergency procedures; • The contractors will be committed to ensure that all Health and Safety measures are in place to prevent accidents and reduce the consequences of non-conformance events; • The contractors will provide training, awareness and supervision to ensure all of its construction workers comply with the OHS procedures; • The contractor will provide appropriate resources i.e. PPE to workers on Site; and • An emergency response procedure and infrastructure will be available on Site to ensure provision of first aid for personnel in case of emergency.	Minor	• Waste Management Plan for Decommissioning activities; • Training records to workers; • Waste Disposal Records; • OHS programmes and procedures confirming IFC PS-2

S. N.	Aspects	Impacts	Impact Intensity	Mitigation/ Control Measures	Impact Intensity with Mitigation	Monitoring/ Training Requirements/ Further Actions
		and cadmium telluride. If any solar panel is damaged during dismantling of the facility, these toxins are likely to spill and leach into the soil and water of the area, posing threat to environmental and public health; • If the solar panels are not handled or disposed of appropriately during the decommissioning phase, any toxic substances contained within them are likely to escape into the surrounding air, water or soil, creating serious environmental and public health risks.				
2.	Improper Waste Disposal	• Top Soil Loss • Contamination of land and soil by hazardous waste • Soil Contamination	Major	• Provide appropriate storage of topsoil in an isolated and covered area to prevent its loss in high wind and runoff. • Demolition debris would be properly transported in trucks outside the site with cover to prevent spillage and contamination of local soil • Re-vegetation done in the area after the completion of demolition and dismantling work in order to reduce the risk of soil erosion. • In case of any accidental spill, the soil will be cut and stored securely for disposal with hazardous waste. • Store hazardous material (like used oil) in isolated room with impervious surface. Filling and transfer of oil to and from the container shall be on impervious surface. • Hazardous wastes, when accumulated, be disposed to facilities registered with the MPCB. • Mini Spill Kit shall be provided at site to counter any spill incident. • Cleared or disturbed areas would be rehabilitated as soon as possible to prevent erosion. • Used and broken Solar panels shall be collected at a designated place and sent back to the manufacture.	Moderate	• The workforce shall be sensitized to handling and storage of hazardous substances viz. fuel oil, machine oil/fluid etc. • The workers engaged in handling hazardous substances shall be briefed about the possible hazards and the need to prevent contamination.

S. N.	Aspects	Impacts	Impact Intensity	Mitigation/ Control Measures	Impact Intensity with Mitigation	Monitoring/ Training Requirements/ Further Actions
3.	Biodiversity and Ecosystem Services	• Loss, degradation or fragmentation of habitat for wild fauna • Increase in risk of injury or death through diversion, entrapment, collision or electrocution for aerially moving wild fauna	Moderate	• Restoration of the natural vegetation of the Project Site • Restoration of land under the footprint of access roads • Restriction of movement of vehicles and operation of heavy machinery to pre-designated routes • Restriction of decommissioning activities to daytime hours • Avoidance of artificial illumination during night-time • Avoidance or damping of construction noise and vibrations to the maximum extent possible • Institution of efficient systems for containment and disposal of waste or spillage • Prohibition of harvesting of water, fuelwood or wild foods (including fauna) by labour • Meticulous removal and sensitive disposal of solar panels and other waste, following the best prescribed practices	Minor	• Trainings for site managers, contractors and labour to sensitize towards biodiversity and ecosystem services conservation
5.	Labour Rights and Welfare	• Skilled and highly skilled categories to be which will be sourced from locally & outside the project area.	Minor	• The workers should be aware of their rights and benefits due to them so that no issues emerge. • Adequate sanitation, drinking water and waste disposal facilities should be provided to all workers on site as well; • The project shall ensure that no child or forced labour is engaged by contractors and all wage payments are done without any discriminations or delays by the contractors; and • Grievance Redressal Mechanism for workers should be developed and communicated to the workers so that the workers can approach the management if any concerns or issues are faced by them without any fear of retribution or intimidation.	Moderate	• Periodic/ surprise audits and checks

8.6.2 Waste Management Plan

All project generated wastes will need to be managed and disposed of in a manner to prevent potential impacts on the environment and risks to human health. A Waste Management Plan (WMP) for the proposed project has been developed.

The construction, operation and decommissioning phase of the proposed project will generate various type of waste which will need appropriate collection, transportation, primary treatment and disposal. Hence, to serve the purpose, a Waste Management Plan has been formulated to demonstrate:

- Inventorization of waste in different type of categories like domestic solid waste, construction debris, wastewater, sludge from wastewater septic tanks, hazardous waste etc.;
- Maintain the site in a clean and tidy state to reduce the attraction of pest species, impacts on the local environment and negative impacts on visual amenity; and
- Suggestion of options for waste handling and disposal during construction and operation phase of the project.

The plan shall be applicable to the FPEPL and O&M Contractor engaged by FPEPL for the proposed project. The elements of the plan will be directly implemented by the O&M staff deployed on site while overall management and responsibility will lie with FPEPL.

8.6.2.1 Waste Type and Quantity Generated

All wastes generated from the project will be categorised as either non-hazardous or hazardous following an assessment of the hazard potentials of the material, in line with local and national requirements.

Construction Phase

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

- Scrap metal;
- Soil waste;
- Food waste from kitchen premises of labour accommodation;
- Construction debris;
- Broken or damaged solar panels; and
- Sewage from temporary toilets.

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

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

Operation Phase

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

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

- Oily contaminated rags from cleaning activities;
- Used oil/ waste oil from DG set or construction machinery.

Decommissioning Phase

Waste generated during decommissioning phase of the project will generate:

- Demolition waste; and
- Obsolete Machinery

8.6.2.2 Waste Management, Handling and Disposal

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

- A buy back agreement for defunct solar panels is required by FPEPL / O&M contractor;
- A designated area needs to be demarcated within the module premises for storage of defunct and broken solar panels with restricted access and on impervious surface;
- All fuel storage should be equipped with secondary containment and spillage trays;
- It is to be ensured that hazardous waste (defunct/broken solar panels, used oil, oily rags etc.) is disposed of through MPCB authorized vendor/ recycler;
- Transportation of defunct solar panels is required to be undertaken as per the procedures specified by the Manufacture of Solar Panels.
- Proper PPEs are to be provided to the workers handling the broken solar panels;
- The workers at site are also on regular basis appraised about the potential health risks associated with handling of solar panels.
- Domestic solid waste will be segregated onsite and will be disposed of at site as approved by local authority.
- Excavated material to be used for backfilling and levelling and other debris shall be used for road construction.
- Wastewater generated from module cleaning will be used for groundwater discharge. Waste from site office and SCADA (Supervisory control and data acquisition) will be disposed through soak pits and septic tank.
- All the hazardous waste needs to be collected and disposed of through approved recyclers in accordance to the Hazardous and other wastes (Management and transboundary Movement) Rules, 2016.

8.6.3 Storm Water Management Plan

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

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

- The peripheral drains will be provided outside the plant boundary during construction phase, which will prevent the silt contaminated surface run-off from site to enter into the adjoining lands.
- No surface run-off from within the solar power plant site will be directly discharged into any nallah/water body.
- Rainwater collected from the project site will be used to stored and if feasible recharge to the ground water through onsite rainwater harvesting tank/pits.

- Adequate arrangements for storm water management during construction period to be made to avoid sediment runoff from the site and to avoid water logging. Storm water flow would be directed to the existing channels with silt traps to avoid sedimentation of the channels or the receiving water body;
- Avoidance of disturbance of flows into natural watercourses i.e. provision should be made for temporary or permanent measures that allow for attenuation, control of velocities and capturing of sediment upstream of natural watercourses.

8.6.4 Occupational Health and Safety Plan (OHSP)

OHSP provides a guidance document for identifying the potential risks involved in a project operation. This section provides the OHSP applicable to the proposed project, during operation phase of the proposed project. This section also covers the training requirements and safe work practices to be followed onsite to manage various risks involved during the operation phase of the project.

The occupational health and safety plan (OHSP) will address the following:

- Evaluation and Identification of hazards;
- Defining responsibilities to prevent risks;
- Elimination and removal of hazards;
- Control of Hazards which cannot be eliminated; and
- Recovery from accidents.

8.6.4.1 Risk Assessment

Risk assessment is an important step in protecting workers. FPEPL / O&M Contractor shall ensure a risk assessment to be performed by a competent person before commencement of operations on site. Such an assessment shall as a minimum:

- identify the risks and hazards to which persons may be exposed to;
- analyze and evaluate the identified risks and hazards;
- document a plan of safe work procedures, including the use of any personal protective equipment or clothing and the undertaking of periodic “tool box talks” or inductions before undertaking hazardous work, to mitigate, reduce or control the risks and hazards that have been identified;
- provide a monitoring plan; and
- provide a review plan.

Risk assessment includes:

- Identification of hazards, discuss with workers and employees actually working at site, check manufacturer’s instructions or data sheets for chemicals and equipment, review accident and ill-health records, long-term hazards to health (e.g. high levels of noise or exposure to harmful substances) as well as safety hazards etc.;
- Identify who may be harmed and what type of injury or ill health might occur;
- Evaluate the risks and decide on precautions to protect people from harm. Consider if the hazard can be eliminated and controlled so that harm is unlikely.

8.6.4.2 Control Measures

Operation of a solar power project involves many on job hazards which need to be identified and eliminated or minimized to an expectable level in order to achieve a safe and healthy work environment. Following control measures can be implemented to prevent risks identified on project site:

- Organize work to reduce exposure to the hazard;
- Identification of unsafe working conditions, e.g., falls, electrical hazards, heat/cold stress.
- Provide personal protective equipment (e.g. clothing, footwear, goggles etc.);

- Provide welfare facilities (e.g. First aid and washing facilities for removal of contamination);
- Implementation of LOTO; and
- Record the findings by writing down the findings of the risk assessment.

8.6.4.3 Training Requirements

FPEPL to ensure that every employee / worker (direct or contractual) is aware of the EHS risks associated with the work being carried out at the site and is trained and competent in the relevant work practices and maintenance procedures. FPEPL shall also establish procedures to identify training needs and provide adequate safety training for all levels of employees including contractors. The safety training should provide staff with the knowledge and skills necessary for organising and managing occupational safety and health programmes; team leaders with leadership skills and knowledge to lead, implement and apply occupational safety and health activities; and workers with the knowledge, skills and right attitudes to enable them to work safely. Training proposed for the project includes but not limited to:

- Induction Training on Health and Safety covering
- HSE policy;
- Hazards and risks associated with operation and workplace;
- Control measure to eliminate or minimize HSE risks, including safe working systems and procedures; use of personal protective equipment; action to be carried out during emergency;
- Emergency response procedures, such as firefighting and evacuation procedure;
- Tool Box Training or pre-task briefings, highlighting hazards and the method of dealing with them;
- Special Job Hazard Training including entry into confined space and another hazardous environment; and
- Training on first aid

8.6.4.4 Documentation and Record Keeping

FPEPL should maintain data and records concerning the identification of hazards, assessment and control of risks of the ongoing activities. The document should establish and maintain procedures for controlling all relevant EHS documents and data. Such documents can include but not limited to:

- EHS Policy;
- Hazard Identification Records;
- Risk Register;
- Licenses, Certificates, Permits;
- Control Methods including process control and machine design, safe work procedures, in-house work rules;
- Design Drawings;
- Organization Structure;
- HSE group meeting records;
- Training Records;
- Drill Reports;
- Inspection and Audit Records;
- Incident/ Accident Records; and
- Medical and Health Surveillance Records

FPEPL should communicate and inform any person affected by risks about:

- The nature of risks involved; and

- The control measures or safe work procedures to be taken to address the risks involved.

The risk assessment should be reviewed and revised upon the occurrence of any injuries to any person as a result of exposure to a hazard in the workplace; or where there is a significant change in work practices or procedures.

8.6.5 Contract Worker Accommodation Plan

As indicated earlier, it was estimated that, during the peak construction phase, 200-300 workers will be employed for a duration of 6 months. While most of the workers in the unskilled and semi-skilled categories will be hired from the neighbouring villages and from within the Dhule district, the manpower requirement in the skilled and highly skilled categories will be sourced from outside the state based on their availability. It was reported by the FPEPL representatives that the migrant workers will be provided accommodation in the labour camps which is to setup during the construction phase. Labour camps are to be developed as per the Worker Accommodation Plan developed by FPEPL to comply with Indian legislation and IFC and EBRD requirements.

The guidelines/ principles to be followed while undertaking the various key activities during the construction and operations of the labour camp by the EPC Contractor are as follows: -

8.6.5.1 Design / Construction standard

- The height of the rooms should at least be 10 feet;
- The floor should be constructed from PCC Brick work in cement mortar and cement pointing with truss supporting roof or Prefabricated Insulated plastic-coated sheets;
- The minimum area of each room should be 22.5 square mtrs and the minimum area per person should be 3.5 square mtrs;
- Maximum 6 numbers of people should be provided accommodation in one room and all of them should belong to the same gender;
- Separate room should be provided to family members;
- There should be separate entry for Bachelors and workers living with their family members in order to ensure privacy of the family members of the workers;
- All rooms should be provided with at least one window for ventilation and adequate illumination;
- External lighting should be provided in the camp area to allow persons to move safely during the night time;
- Toilets/ drains should be connected to the septic tank and cleaning of the septic tank should be ensured regularly;
- Before construction of the Labour Camp, fire safety assessment should be done of the proposed site by qualified Fire Safety Personnel and all the suggests proposed therein should be incorporated while construction of the Labour Camp;
- Electrical safety norms should be adhered to ensure electrical safety in the Labour Camp e.g. earthing, MCBs, wiring as per electrical load etc.;
- Adequate drinking water should be provided as per generic standards and the same should be monitored on a monthly basis; and
- Sanitation and drainage should be ensured in order to maintain proper hygiene in the Labour Camp.

8.6.5.2 Drinking water

- All containers used for distribution of water shall be clearly marked ‘Drinking Water Only’ or equivalent and are not to be used for any other purpose;
-

- Portable containers used for dispensing of drinking water shall have right fitting lids and equipped with a tap. These containers should be kept clean and free from contamination;
- Tanker trucks used for transporting portable water shall be clearly identified and shall not be used for any other purpose;
- Outlets dispensing non-drinking water – for washing, bathing and toilets shall be marked 'caution – water unfit for drinking and cooking'; and
- Drinking water should meet national/ local drinking water standards.

8.6.5.3 Toilet/ Washing/ Showering Facilities

- Adequate toilet/ washing/ showering facilities should be provided in the Labour Camp. The number of toilets and showering facilities will depend on the size of the Labour Camp and the number of workers being accommodated therein;
- Toilet/ Washing facilities should be provided as required to maintain healthy and sanitary conditions in the Labour Camp. Such facilities should be properly maintained and provided with potable water and drainage to prevent pooling of water; and
- The areas shall be checked and cleaned daily by a crew comprising of Sanitation workers. Disinfection of floors, sinks and toilet bowls should be carried out by the EPC Contractor.

8.6.5.4 Hygiene and housekeeping

- High standard of hygiene and housekeeping shall always be maintained in the Labour Camp;
- The disposal of waste shall be done regularly as required and disposed of in accordance with the applicable local and national regulations;
- Containers for waste materials shall be placed in all areas and cleaned on a regular basis;
- Rubbish should not be dumped or disposed of indiscriminately but shall be stored in sealed rubbish bags at designated collection points for removal by the sanitary crew for disposal;
- No open fires shall be allowed within the Labour Camp; and
- Pest control measures should be in place to control insects and this should include flogging and spraying during the mosquito breeding season.

8.6.5.5 First aid/ Medical facilities

Access to adequate medical facilities is important to maintain workers' health and to provide adequate responses in case of health emergency situations. The availability or level of medical facilities provided in the Labour Camp/ Worker's accommodation is likely to depend on the number of workers living on site, the medical facilities already existing in the neighbouring communities and the availability of transport. However, first aid must always be available in the Labour Camp.

8.6.5.6 Audit and Inspection

EPC Contractor and the caretaker of the Labour Camp shall make a weekly inspection and record the observations along with any required corrective actions.

The EPC Contractor Site-in-Charge will inspect the Camp on a monthly basis along with the Site representative and the Project HR representative of FPEPL. The proposed inspection should use the points illustrated in this document as a guiding tool.

Non-conformances identified must be corrected within the agreed timeline.

Non compliances observed during the audit will attract penalty which will be decided by the Project Manager in line with the terms and conditions of the EPC Contract.

8.6.6 Traffic Management Plan

Traffic of more than daily average is anticipated during project decommissioning phase. A Traffic Management Plan is however, required for the management of traffic due to movement of vehicles for transport of equipment and material. Additional traffic on the village road can be managed by measures mentioned below.

8.6.6.1 Management Measures

- Only trained drivers with valid license shall be recruited by FPEPL/ Contractor for transfer of material during decommission phase;
- Training program for all the drivers, regarding awareness about road safety and adopting best transport and traffic safety procedures shall be provided before initiation of the decommissioning activities;
- Mitigation measures such as emphasizing on safety amongst drivers, adopting limits for trip duration and arranging driver roster to avoid overtiredness and avoiding dangerous routes and times of day to reduce risk of accident shall also be implemented;
- Regular maintenance of vehicles and use of manufacturer approved parts should be adopted to minimize potentially serious accidents caused by equipment malfunction or premature failure;
- Turning to the access road from the nearest arterial road to be maintained taking into consideration commuter's safety;
- Drivers will be adequately trained on the requirements of EHS Policy and national & local legal requirements to drive a vehicle.
- All heavy vehicles like JCB, cranes, battery operated trolleys etc. to be provided with reversing siren and locked.
- Vehicles will not be allowed to park anywhere else outside the dedicated parking area. Parking area will be provided with oil and fuel adsorbent materials or drip trays in case of any leakages.
- The villagers shall be made aware about the schedule prior to the movement of trucks and transportation in the project area.
- Appropriate speed limits (20-30km/hr) on community roads for various motor vehicles to be determined as part of the traffic management based on type of roads available en-route the location to and fro of the project component where construction material is to be transported project; and

8.6.7 Environment and Social Monitoring Plan

8.6.7.1 Environmental Monitoring Plan

Regular monitoring of environmental aspects during the project operations phase is important to assess the status of environment with respect to baseline conditions. The monitored data can serve as an indicator for any change in environmental quality due to the project activities, and further to take adequate mitigation measures to safeguard the environment.

Monitoring indicators have been developed for each of the activity considering the mitigation measures proposed. Monitoring results would be documented, analysed and reported internally. Monitoring requirements (including monitoring frequency) have been presented in ***Table 8-5.***

Table 8-5 Environmental Monitoring Plan

S. No.	Environmental Attribute	Monitoring Parameters	Frequency of Monitoring	Responsibility
1.	Ambient Air Quality	Measurement of PM_{10}, $PM_{2.5}$, SO_x, NO_x, CO	Every Six Months	Site Manager
2.	Ambient Noise quality	Measurement of Noise Pressure Level in dB(A)	Every Six Months	Site Manager
3.	Soil Quality	Physico-chemical parameters monitored for baseline data collection	Every Six Months	Site Manager

S. No.	Environmental Attribute	Monitoring Parameters	Frequency of Monitoring	Responsibility
4.	Water Resources	Physico-chemical parameters monitored for Surface and Ground water baseline data collection	Every Six Months	Site Manager
		Water meter readings to be maintained on daily basis	Monthly	Site Manager
5.	Waste	Waste inventory for both hazardous and non-hazardous waste, Waste Labelling, storage and disposal records Visual inspection for spilling/ leakages in the waste storage area	Weekly	Site Manager
		Agreements with vendors for waste collection and storage for both hazardous and non- hazardous waste	Every Six Months	Site Manager
6.	Ecological	Visual inspection of the site area for death or injury of any higher faunal species due to electrocution, habitat disturbances due to project activities.	Weekly	Site Manager
		Inspection of site area for any spillage of waste materials and possibility of their mixing into natural water resources.	Monthly	

8.6.7.2 Social and Health and Safety Monitoring Plan

Working conditions on site with respect to health and safety of the workers and concerns from the communities are required to be monitored regularly to ensure the positive impacts of the mitigation and management measures taken for the anticipated impacts.

Table 8-6 Social and Health and Safety Monitoring Plan

S. No.	Attribute	Monitoring Parameter	Monitoring Frequency	Responsibility
1	Health and Safety Risks	• Sanitation status of onsite office building • Potable nature of drinking water with respect to BIS drinking water standards 10500:2012; • Usage of adequate PPEs; • Electromagnetic field • Adequate Health and Safety Training to workers • Fire Safety measures on site • Incident/ Accident Records • Permit to Work Records • LOTO records	Monthly	Site Manager

8.6.7.3 Monitoring Plan during Decommissioning Phase

Following aspects are required to be monitored throughout during the decommission phase, regularly by the Site Manager.

- Local community and workers shall be informed for the duration of works;
- All waste generated from decommissioning phase shall be collected and disposed of to the authorized vendor;
- All necessary PPEs shall be used by the workers during demolition work;
- Vehicle maintenance records, accident records
- Visual inspection of waste storage area;
- Broken/defunct solar panels shall be disposed of to authorized vendor through buy back agreements;

- It is to be ensured that dismantling is carried out during non-monsoon season and all the drainage channels will keep intact by creating bunds around them;
- FPEPL should ensure that retrenchment packages are provided for all staff who stand to lose their jobs when the plant is decommissioned.

8.6.8 Emergency Preparedness and Response Plan

The primary objective of formulating Emergency Preparedness and Response Plan (EPRP) is to undertake immediate rescue and relief operations and stabilize the mitigation process as quickly as possible. The main parameters of a response plan based on such mechanism include:

- Identification and declaration of potential emergencies;
- Signal/warning mechanism;
- Activities and their Levels;
- Command and control structure;
- Individual roles and responsibilities of each specified authority to achieve the activation as per response time;
- Emergency procedures;
- Alternate plans & contingency measures; and
- Co-ordination with external parties

8.6.8.1 Responsibilities

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

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

8.6.8.2 Identification of Emergencies

All the anticipated hazards and risks associated with each project activity, which may lead to an emergency are identified in the section, along with the required actions to be taken before or after the emergency arises. This section identifies the hazardous areas and activities in the operation phases. Probable emergencies that might arise due to these hazards for the duration of the project have been listed below.

Hazardous Areas

Following potentially hazardous areas and activities have been identified at the construction site:

- Fuel storage areas
- Electrical installations – improper laying of cables
- Switch Yard
- Transformer Area
- Hazardous waste storage area
- Broken/ defunct panel storage area

Emergency Situations

The possible emergency situations identified for the operation phases of the Project are as listed below:

Fire and Explosion

- Leakage of fuel from storage areas; and
- Short-circuit at project site.

Mechanical and Electrical Hazards

- Accidentally dropped object;
- Electrocution.

Occupational Hazards

- Handling of chemicals;
- Electrocution;
- Accidents due to vehicle movement; and
- Vandalism.

8.6.8.3 Declaration of Emergencies

Level 1 (Minor Emergency)

All events with no escalation potential and which can be controlled and contained by the action of Safety Officer at the site will be considered as Level 1. In such cases of local alert, Site EHS Manager will be notified. Some typical incidents are:

- Vehicle collision (involving no loss of life);
- Equipment damage;
- Medical Evacuation (not very serious cases);
- Minor fires.

Level 2 (Serious Emergency)

All events with escalation potential, depending on the effectiveness of the local response will be considered as Level 2. These incidents may impact the entire project operations or have cascading effect. For such type of incidents Site Manager will take the lead. Some typical incidents are:

- Substantial security incident / Vandalism;
- Structural collapse;
- Minor Flooding;
- Serious damage to structures;
- Substantial fire; and
- Cultural conflict.

Level 3 (Major Emergency)

The crisis that requires assistance from external resources in order to save lives, minimize damage and to bring the abnormal situation back under control are Level 3 emergencies. These incidents have the potential to impact beyond the project footprints and affect the community. In such cases appropriate government / regulatory authorities will be informed and involved. Some typical Level 3 incidents are:

- Major fire/explosion;
- Fatality;
- Severe flooding.

Personnel on site will know that a Major Emergency has been declared if the site fire alarm siren and /or the local fire alarm systems are activated. The Emergency Siren Modes will be demonstrated and shared with all workers to identify with them.

Level 2 and level 3 will be declared using emergency siren and evacuation shall be done.

8.6.8.4 Emergency Equipment

The following points should be implemented to tackle emergency situations:

- Onsite emergency equipment such as first aid boxes, firefighting equipment, PPEs etc. shall be maintained at project site;
- The adequacy and availability of emergency equipment shall be assessed at periodic intervals by the EHS Manager;
- Inventory and locations of respective emergency equipment shall be displayed at project office building and other work areas;
- It is to be ensured that the site staff is trained on usage of each type of emergency equipment.

First Aid Boxes

First aid boxes shall be provided at identified locations within the plant premises. A first aid box shall contain, but not limited to the following articles:

- Cotton wool
- Sterile gauze
- Antiseptic lotion
- Box of adhesive dressing (Plasters) for small wounds
- Blunt-ended scissors
- Tweezers for removing splinters
- Triangular bandages (for making a sling or emergency bandage)
- Safety pins
- Sterile eye dressings
- Crepe bandages
- Aspirin/ Paracetamol tablets
- Skin creams for treating burns
- Anti-histamine cream for insect bites and stings

Fire Fighting Equipment

During operation phase, fire extinguishers and sand buckets shall be provided at critical areas such as fuel storage area, waste storage area, areas with electrical installations and project office.

Other firefighting systems to be installed should include:

- Heavy-duty ABC powder type fire extinguishers kept at important electrical equipment areas;
- Portable CO_2 extinguishers provided throughout the plant

Provision of Personal Protective Equipment (PPE)

Onsite workers and site staff should be provided with adequate number of personal protective equipment (PPEs) to deal with emergency situations. The PPEs shall be stored at the designated Emergency Control Centre (ECC) in the plant premises and will be easily accessible during times of emergency. Training of proper use of PPEs shall be provided to all working personnel on periodic basis.

Assembly Area

Safe assembly area shall be identified and marked and employees to be instructed to gather at the assembly area during emergencies.

Codification of Sirens

The following codes of siren will be following during emergencies:

Table 8-7 Codification of Siren

S. No.	Siren	Indicate	Authority
7.	120 seconds Continuous Whelming Sound	ON SITE EMERGENCY (ALERT) for evacuation	Plant Head/ EHS Manager
2.	30 + 30 + 30 seconds Sound with an interval of 5 seconds each	EMERGENCY CONTROLLED	Site Manager/ Site EHS Manager

Below points shall be noted during prevalence of emergency situation:

- Emergency siren to be sounded only if required.
- All staff shall be prior informed of use of emergency sirens during mock drills.
- No worker will leave the emergency spot unless 'all clear' siren blown.

8.6.8.5 Coordination with External Agencies

During emergency situations, Site Manager and Site EHS Manager shall form the Emergency Control Centre (ECC). Site EHS Manager shall coordinate with the following departments:

- Fire brigade;
- Police department;
- Hospitals/ Ambulance Services;
- Utility departments (electricity and water);
- Technical departments such as MPCB, Factory Inspectorate etc.
- Local Authorities and District Administration
- District Disaster Control Room, Tharad

8.6.8.6 Emergency Response Team

- The Emergency Response Team (ERT) shall be set up immediately for the project;
- Each personnel identified as part of the ERT shall be designated specific roles and responsibilities for handling emergency situations.
- The ERT at the operating site under its control will have following role:
- Control the emergency and render the facility premises safe by the application of local resources; and
- Support the local response effort by coordinating additional equipment, personnel, and other external resources for the direct response effort.
- The ERT will comprise of the following personnel:
  - Site Manager;
  - Site EHS Manager;
  - Safety Officer(s);
  - Evacuation Officer;
  - Employee/Workers

8.6.8.7 Emergency Response Procedure

Effective command and control start with a clear definition of the overall command and control structure, and description of the duties of key personnel with specific responsibilities for emergency response. The control of

emergencies will consider the minimum number of persons required to provide an adequate response to emergencies.

All emergencies occurring as a result of project activities shall be managed according to the following order of priorities:

- Preservation of Life (self, team, community);
- Protection of the Environment;
- Protection or Property/assets; and,
- Preservation of Evidence.

8.6.8.8 Reporting and Documentation

The following aspects need to be communicated for the emergency reporting:

- While witnessing or receiving notification of an emergency, as much information as possible should be taken and/or conveyed to the relevant emergency activation authority;
- Where possible, all information should be logged in written form with time and date included and provided to EHS Manager;
- Personnel working on the site may, at any time, be exposed to an emergency which could take many forms, for example (but not limited to):
  - Injuries and/or fatalities
  - Fires and/or explosions
  - Extreme weather
- When an emergency occurs, an appropriate and prompt response is required, providing precise action to control, correct and return the site to a safe condition. Timely action will also be required to protect people, the environment and property from damage; and
- All near misses and unsafe acts will be written in logbooks / reported in the 'near miss, unsafe acts, hazards and sub-standard conditions report' and verbally communicated to the concerned Site Supervisor within a reasonable time.

9. Conclusions

The Environmental and Social Assessment study for the proposed 100 MW solar power project to be developed by FPEPL in Dhule District of Maharashtra has been undertaken in accordance with International Finance Corporation (IFC) Sustainability Framework (Policy and Performance Standards on Environmental and Social Sustainability) 2012 and the associated World Bank Group Environmental Health and Safety Guidelines.

The ESIA study aimed to identify and evaluate potential environmental and social impacts associated with all aspects of the proposed project. The conclusion and recommendations of this study are result of on-site inspections, evaluation of impacts identified, and the process of stakeholder consultation. The proposed project is an opportunity to utilize the solar potential of the state for power generation. There are no fuel requirements or large quantities of water required for the operation of the plant. GHG emissions and other environmental pollution (stack emissions, ash management etc.) issues are also limited.

Categorisation of Project as per IFC Environment and Social Sustainability Standards:

Based on the data available for the project at this stage and applying the criteria stipulated by the IFC Policy on Environmental and Social Sustainability for environmental and social categorization of projects, FPEPL's proposed 100 MW solar project may be assigned as '***Category B***' with respect to environmental and social impacts. This is so basis the primary data available to date which indicates that the environmental and social risks and impacts of the proposed project activities are expected to be few in number, generally site-specific, largely reversible, and readily addressed through mitigation measures, which supports the *'**Category B**'* classification.

Additional rationale for the above categorization is as below:

- Solar power project is a clean technology project using solar energy for generation of electricity;
- No harmful emissions are expected from the project operations;
- The Project Site does not coincide or overlap with any Designated Area; and
- Available data suggests that the construction, operation and decommissioning of the proposed solar project are likely to have limited environmental and social impacts which can be readily addressed with mitigation measures.

Appendix A Participant list of Stakeholder Consultations

S.No	Stakeholder Type	Name & Address	Date of Consultation
1	Site Representatives	Mr. Abhay Bhavrar ESG FPEPL	22nd Feb 2022
2	Site Representatives	Mr. Pranay Warhade ESG FPEPL	22nd Feb 2022
3	Site Representatives	Mr. Vishal Toro OA Team, FPEPL	22nd Feb 2022
4	Site Representatives	Mr. Dharma Teja Projects, FPEPL	22nd Feb 2022
5	Site Representatives	Mr. Akshay Kharde OA Team, FPEPL	22nd Feb 2022
6	Site Representatives	Mr. Chetan Lagate FPEPL	22nd Feb 2022
7	Site Representatives	Mr. Hardik Site In-charge, Bhadgaon Site, FPEPL	23rd Feb 2022
8	Site Representatives	Mr. Mano Rahangadile EHS In-Charge, Bhadgaon Site, FPEPL	23rd Feb 2022
9	Site Representatives	Mr. Sathish Project Manager, Bhadgaon Site, FPEPL	23rd Feb 2022
10	Land Aggregator	Mr. Navnath Jaganath Kenjane Atlanta Power	23rd Feb 2022
11	Land Aggregator	Mr. Maaraj Janathan Ghadia Atlanta Power	23rd Feb 2022
12	Shephard	Mr. Karan Raipur Village, Sakri Tehsil	23rd Feb 2022
13	Shephard	Mr. Dileep Raipur Village, Sakri Tehsil	23rd Feb 2022
14	Panchayat Representatives	Mr. Ravindra Uttam Paghari Sarpanch, Nagpur village	23rd Feb 2022
15	Panchayat Representatives	Mr. Sanjoy Ratan Pawar Panchayat Member, Nagpur Village	23rd Feb 2022
16	Village Representatives	Dr. Bhim Rao Deore Private Medical Practitioner	23rd Feb 2022
17	Village Representatives	Mr. Gibhau Daga Chawan Chairmen of Nomadic Tribal School, Nagpur Village	23rd Feb 2022
18	Landowners	Mr. Dinesh Chavan Nagpur Village	23rd Feb 2022
19	Landowners	Mr. Hari Pawar Nagpur Village	23rd Feb 2022
20	Landowners	Mr. Baidyanath Pawar Nagpur Village	23rd Feb 2022
21	Landowners	Mr. Youraj Chavan Nagpur Village	23rd Feb 2022
22	Landowners	Mr. Shambu Rathod Nagpur Village	23rd Feb 2022
23	Landowners	Mr. Malkhan Chavan Nagpur Village	23rd Feb 2022
24	Landowners	Mr. Ramesh Pawar Nagpur Village	23rd Feb 2022
25	Landowners	Mr. Manoj Pawar Police Patil, Nagpur Village	23rd Feb 2022
26	Panchayat Representatives	Mr. Sunita K.S (Krishna Damu Sonaune) Sarpanch, Bhadgaon village	23rd Feb 2022
27	Panchayat Representatives	Mr. Sakaram Bhatuk Ex-Sarpanch & Panchayat Member, Bhadgaon Village	23rd Feb 2022
28	Panchayat Representatives	Mr. Nanubhaw Mukunda Patil	23rd Feb 2022

S.No	Stakeholder Type	Name & Address	Date of Consultation
		Deputy Sarpanch, Bhadgaon Village	
29	Village Representatives	Mr. Aslam Sheikh, Villager, Bhadgaon Village	23rd Feb 2022
30	Village Representatives	Mr. Ahire Raasheb Bhimrao, Villager, Bhadgaon Village	23rd Feb 2022
31	Workforce	Mr. Naren Makuvana Supervisor, Thiranga Infra (Fencing Contractor)	23rd Feb 2022
32	Workforce	Mr. Kuman Patel Worker, Thiranga Infra (Fencing Contractor)	23rd Feb 2022

Appendix B Mammals of the Study Area

S. No.	Scientific Name	Common Name	IUCN Status*	WPA Schedule**
1	*Anathana ellioti*	Southern Tree Shrew	LC	-
2	*Antilope cervicapra*	Blackbuck	LC	I
3	*Axis axis*	Spotted Deer	LC	III
4	*Bandicota bengalensis*	Lesser Bandicoot Rat	LC	V
5	*Bandicota indica*	Large Bandicoot Rat	LC	V
6	*Boselaphus tragocamelus*	Nilgai	LC	III
7	*Canis aureus*	Golden Jackal	LC	II
8	*Canis lupus*	Grey Wolf	LC	I
9	*Cynopterus sphinx*	Greater Shortnosed Fruit Bat	LC	V
10	*Felis chaus kutas*	Jungle Cat	LC	II
11	*Felis silvestris*	Asiatic Wildcat	LC	I
12	*Funambulus palmarum*	Three-striped Palm Squirrel	LC	-
13	*Funambulus pennantii*	Five-striped Palm Squirrel	LC	IV
14	*Gazella bennettii*	Indian Gazelle	LC	I
15	*Golunda ellioti*	Indian Bush Rat	LC	V
16	*Herpestes edwardsii*	Grey Mongoose	LC	II
17	*Herpestes smithii*	Ruddy Mongoose	LC	II
18	*Hipposideros fulvus*	Fulvus Leaf-nosed Bat	LC	-
19	*Hipposideros galeritus*	Cantor's Leaf-nosed Bat	LC	-
20	*Hipposideros lankadiva*	-	LC	-
21	*Hipposideros speoris*	-	LC	-
22	*Hyaena hyaena*	Striped Hyena	NT	III
23	*Hystrix indica*	Indian Crested Porcupine	LC	IV
24	*Lepus nigricollis*	Indian Hare	LC	IV
25	*Lutrogale perspicillata*	Smooth-coated Otter	VU	II
26	*Lyroderma lyra*	Greater False Vampire	LC	-
27	*Macaca mulatta*	Rhesus Monkey	LC	II
28	*Macaca radiata*	Bonnet macaque	LC	II
29	*Madromys blanfordi*	White-tailed Wood Rat	LC	V
30	*Manis crassicaudata*	Indian Pangolin	EN	I
31	*Megaderma lyra*	Greater False Vampire	LC	-
32	*Mellivora capensis*	Honey Badger	LC	-
33	*Millardia meltada*	Soft-furred Field Rat	LC	V

S. No.	Scientific Name	Common Name	IUCN Status*	WPA Schedule**
34	*Moschiola indica*	Indian Chevrotain	LC	I
35	*Muntiacus muntjak*	Indian Muntjac	LC	III
36	*Muntiacus vaginalis*	Northern Red Muntjac	LC	III
37	*Mus booduga*	Little Indian Field Mouse	LC	V
38	*Mus musculus*	House Mouse	LC	V
39	*Mus platythrix*	Brown Spiny Mouse	LC	V
40	*Mus saxicola*	Brown Spiny Mouse	LC	V
41	*Mus terricolor*	-	LC	V
42	*Panthera pardus*	Common Leopard	VU	I
43	*Paradoxus hemaphroditus*	Common Palm Civet	NA	II
44	*Pipistrellus ceylonicus*	Kelaart's Pipistrelle	LC	-
45	*Prionailurus rubiginosus*	Rusty spotted Cat	NT	I
46	*Pteropus giganteus*	Indian Flying Fox	LC	IV
47	*Rattus rattus*	House Rat	LC	V
48	*Rhinolophus lepidus*	Blyth's Horseshoe Bat	LC	-
49	*Rhinopoma hardwickii*	Lesser Mouse-tailed Bat	LC	-
50	*Rhinopoma microphyllum*	Greater Mouse-tailed Bat	LC	-
51	*Rousettus leschenaultii*	Leschenault's Rousette	NT	IV
52	*Rusa unicolor*	Sambar	VU	III
53	*Scotophilus heathii*	Greater Asiatic Yellow House Bat	LC	-
54	*Scotophilus kuhlii*	Greater Asiatic Yellow House Bat	LC	-
55	*Scotozous dormeri*	-	LC	-
56	*Semnopithecus hypoleucos*	Black-footed Gray Langur	LC	II
57	*Semnopithecus hypoleucos achates*	Southern Plains Grey Langur	VU	II
58	*Suncus etruscus*	Pygymy white-toothed Shrew	LC	-
59	*Suncus murinus*	House Shrew	LC	-
60	*Suncus stoliczkanus*	-	LC	-
61	*Sus scrofa*	Indian Wild Pig	LC	III
62	*Tadarida aegyptiaca*	Egyptian Free-tailed Bat	LC	-
63	*Taphozous longimanus*	Long-winged Tomb Bat	LC	-
64	*Taphozous melanopogon*	-	LC	-
65	*Taphozous nudiventris*	Naked-rumped Tomb Bat	LC	-
66	*Taphozous perforatus*	Egyptian Tomb Bat	LC	-
67	*Tatera indica*	Indian Gerbil	LC	-
68	*Tetracerus quadricornis*	Four-horned Antelope	VU	I
69	*Tragulus kanchil*	Indian Chevrotain	LC	I
70	*Vandeleuria oleracea*	Indian Long-tailed Tree Mouse	LC	V

S. No.	Scientific Name	Common Name	IUCN Status*	WPA Schedule**
71	*Viverricula indica*	Small Indian Civet	LC	II
72	*Vulpes bengalensis*	Indian Fox	LC	II
73	*Vulpes vulpes*	Red Fox	LC	II

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

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

Sources: Vivek Menon (2014), Indian Mammals: A Field Guide. Hachette Book Publishing India Pvt. Ltd., Gurgaon, India, pp 1 - 522; The IUCN Red List of Threatened Species. Version 2021-3; Schedules I to VI: Indian Wildlife (Protection) Act, 1972.

Appendix C Resident Birds of the Study Area

S. No.	Scientific Name	Common Name	IUCN Status*	WPA Schedule**
1	*Accipiter badius*	Shikra	LC	-
2	*Acridotheres ginginianus*	Bank Myna	LC	IV
3	*Acridotheres tristis*	Common Myna	LC	IV
4	*Acrocephalus stentoreus*	Clamorous Reed Warbler	LC	-
5	*Aegithina tiphia*	Common Iora	LC	IV
6	*Alauda gulgula*	Oriental Skylark	LC	IV
7	*Alcedo atthis*	Common Kingfisher	LC	IV
8	*Alexandrinus krameri*	Rose-ringed Parakeet	LC	IV
9	*Amandava formosa*	Green Avadavat	VU	IV
10	*Amaurornis phoenicurus*	White-breasted Waterhen	LC	-
11	*Ammomanes phoenicura*	Rufous-tailed Lark	LC	IV
12	***Anas poecilorhyncha***	**Indian Spot-billed Duck**	**LC**	**IV**
13	*Anthus rufulus*	Paddyfield Pipit	LC	IV
14	*Apus affinis*	Little Swift	LC	-
15	*Aquila fasciata*	Bonelli's Eagle	NT	-
16	*Aquila rapax*	Tawny Eagle	VU	-
17	*Ardea alba*	Great Egret	LC	IV
18	***Ardea intermedia***	**Intermediate Egret**	**LC**	**IV**
19	*Ardea purpurea*	Purple heron	LC	IV
20	***Ardeola grayii***	**Indian Pond Heron**	**LC**	**IV**
21	*Ardeotis nigriceps*[33]	Great Indian Bustard (GIB)	CR	I
22	*Argya caudata*	Common Babbler	LC	IV
23	*Argya malcolmi*	Large Grey Babbler	LC	IV
24	*Argya striata*	Jungle Babbler	LC	IV
25	*Artamus fuscus*	Ashy Woodswallow	LC	-
26	*Asio flammeus*	Short-eared Owl	LC	W
27	*Athene brama*	Spotted Owlet	LC	IV
28	*Bubo bengalensis*	Indian Eagle Owl	LC	IV
29	*Burhinus indicus*	Indian Thick-knee	LC	IV
30	*Butastur teesa*	White-eyed Buzzard	LC	-
31	*Butorides striata*	Striated Heron	LC	IV
32	*Cacomantis passerinus*	Grey-bellied Cuckoo	LC	IV

[33] GIB range overlaps the 5km buffer Study Area but not the main Project Site itself.

S. No.	Scientific Name	Common Name	IUCN Status*	WPA Schedule**
33	*Cacomantis sonneratii*	Banded Bay Cuckoo	LC	IV
34	*Caprimulgus affinis*	Savanna Nightjar	LC	IV
35	*Caprimulgus asiaticus*	Indian Nightjar	LC	IV
36	*Caprimulgus atripennis*	Jerdon's Nightjar	LC	IV
37	*Caprimulgus indicus*	Jungle Nightjar	LC	IV
38	*Cecropis daurica*	Red-rumped Swallow	LC	-
39	*Centropus sinensis*	Southern Coucal	LC	IV
40	*Ceryle rudis*	Pied Kingfisher	LC	IV
41	*Charadrius dubius*	Little Ringed Plover	LC	-
42	*Chloropsis aurifrons*	Golden-fronted Leafbird	LC	IV
43	*Chloropsis jerdoni*	Jerdon's Leafbird	LC	IV
44	*Chrysocolaptes festivus*	White-naped Woodpecker	LC	IV
45	*Chrysomma sinense*	Yellow-eyed Babbler	LC	IV
46	*Ciconia episcopus*	Woolly-necked Stork	NT	IV
47	*Cinnyris asiaticus*	Purple Sunbird	LC	IV
48	*Circaetus gallicus*	Short-toed Snake Eagle	LC	-
49	*Cisticola juncidis*	Zitting Cisticola	LC	-
50	*Clanga hastata*	Indian Spotted Eagle	VU	-
51	***Columba livia***	**Common Pigeon**	**LC**	IV
52	***Copsychus saularis***	**Oriental Magpie Robin**	**LC**	-
53	*Coracias benghalensis*	Indian Roller	LC	-
54	*Coracina macei*	Indian Cuckooshrike	LC	-
55	*Corvus macrorhynchos*	Indian Jungle Crow	LC	-
56	***Corvus splendens***	**House Crow**	**LC**	V
57	*Curruca crassirostris*	Eastern Orphean Warbler	LC	-
58	*Cursorius coromandelicus*	Indian Courser	LC	-
59	*Cypsiurus balasiensis*	Asian Palm Swift	LC	-
60	*Dendrocitta vagabunda*	Rufous Treepie	LC	IV
61	*Dendrocygna javanica*	Lesser Whistling Duck	LC	IV
62	*Dicaeum agile*	Thick-billed Flowerpecker	LC	IV
63	*Dicaeum erythrorhynchos*	Pale-billed Flowerpecker	LC	IV
64	*Dicrurus caerulescens*	White-bellied Drongo	LC	IV
65	***Dicrurus macrocercus***	**Black Drongo**	**LC**	**IV**
66	*Dicrurus paradiseus*	Greater Racquet-tailed Drongo	LC	IV
67	*Dinopium benghalense*	Lesser Goldenback	LC	IV
68	*Dumetia hyperythra*	Tawny-bellied Babbler	LC	IV
69	***Egretta garzetta***	**Little Egret**	**LC**	**IV**

S. No.	Scientific Name	Common Name	IUCN Status*	WPA Schedule**
70	*Elanus caeruleus*	Black-winged Kite	LC	-
71	*Emberiza lathami*	Crested Bunting	LC	IV
72	*Ephippiorhynchus asiaticus*	Black-necked Stork	NT	IV
73	*Eremopterix griseus*	Ashy-crowned Sparrowlark	LC	IV
74	*Esacus recurvirostris*	Great Thick-knee	NT	IV
75	*Eudynamys scolopaceus*	Asian Koel	LC	IV
76	*Euodice malabarica*	Indian Silverbill	LC	-
77	*Falco chicquera*	Red-headed Falcon	NT	I
78	*Falco jugger*	Laggar Falcon	NT	IV
79	*Falco peregrinus*	Peregrine Falcon	LC	I
80	*Francolinus pictus*	Painted Francolin	LC	IV
81	*Francolinus pondicerianus*	Grey Francolin	LC	IV
82	***Fulica atra***	**Eurasian Coot**	**LC**	**IV**
83	***Galerida deva***	**Sykes's Lark**	**LC**	**IV**
84	*Gallicrex cinerea*	Watercock	LC	-
85	*Gallinula chloropus*	Common Moorhen	LC	-
86	*Galloperdix lunulata*	Painted Spurfowl	LC	IV
87	*Galloperdix spadicea*	Red Spurfowl	LC	IV
88	*Gallus sonneratii*	Grey Junglefowl	LC	IV
89	*Geokichla citrina*	Orange-headed Thrush	LC	IV
90	*Glaucidium radiatum*	Jungle Owlet	LC	IV
91	*Gracupica contra*	Asian Pied Starling	LC	IV
92	*Grus antigone*	Sarus Crane	VU	IV
93	*Gymnoris xanthocollis*	Chestnut-shouldered Petronia	LC	-
94	*Gyps bengalensis*	White-rumped Vulture	CR	I
95	*Gyps indicus*	Indian Vulture	CR	I
96	***Halcyon smyrnensis***	**White-throated Kingfisher**	**LC**	**IV**
97	*Haliastur indus*	Brahminy Kite	LC	-
98	*Hemicircus canente*	Heart-spotted Woodpecker	LC	IV
99	*Hemiprocne coronata*	Crested Treeswift	LC	-
100	*Hemipus picatus*	Bar-winged Flycatcher-shrike	LC	-
101	*Hierococcyx varius*	Common Hawk Cuckoo	LC	IV
102	*Himalayapsitta cyanocephala*	Plum-headed Parakeet	LC	IV
103	*Hirundo smithii*	Wire-tailed Swallow	LC	-
104	*Hydrophasianus chirurgus*	Pheasant-tailed Jacana	LC	IV
105	*Hypothymis azurea*	Black-naped Monarch	LC	-
106	*Ictinaetus malaiensis*	Black Eagle	LC	-

S. No.	Scientific Name	Common Name	IUCN Status*	WPA Schedule**
107	*Ketupa zeylonensis*	Brown Fish Owl	LC	IV
108	*Lanius excubitor*	Southern Grey Shrike	LC	-
109	*Lanius schach*	Long-tailed Shrike	LC	-
110	*Lanius vittatus*	Bay-backed Shrike	LC	-
111	*Leiopicus mahrattensis*	Yellow-crowned Woodpecker	LC	IV
112	***Leptocoma zeylonica***	**Purple-rumped Sunbird**	**LC**	**IV**
113	*Lonchura punctulata*	Scaly-breasted Munia	LC	IV
114	*Machlolophus xanthogenys*	Black-lored Tit	LC	IV
115	*Megalurus palustris*	Striated Grassbird	LC	-
116	***Merops orientalis***	**Green Bee-eater**	**LC**	**-**
117	***Milvus migrans***	**Black Kite**	**LC**	**-**
118	*Mirafra erythroptera*	Indian Bushlark	LC	IV
119	*Mirafra javanica*	Singing Bushlark	LC	IV
120	*Motacilla maderaspatensis*	White-browed Wagtail	LC	-
121	*Mycteria leucocephala*	Painted Stork	NT	IV
122	*Myophonus horsfieldii*	Malabar Whistling-thrush	LC	IV
123	*Neophron percnopterus*	Egyptian Vulture	EN	IV
124	*Nettapus coromandelianus*	Cotton Pygmy-goose	LC	IV
125	*Ninox scutulata*	Brown Boobook	LC	-
126	*Nisaetus cirrhatus*	Crested Hawk Eagle	LC	-
127	*Nycticorax nycticorax*	Black-crowned Night Heron	LC	IV
128	*Nyctyornis athertoni*	Blue-bearded Bee-eater	LC	-
129	*Ocyceros birostris*	Indian Grey Hornbill	LC	-
130	*Oenanthe fusca*	Brown Rockchat	LC	-
131	*Oriolus xanthornus*	Black-hooded Oriole	LC	IV
132	*Orthotomus sutorius*	Common Tailorbird	LC	-
133	*Otus bakkamoena*	Indian Scops Owl	LC	IV
134	*Otus sunia*	Oriental Scops-owl	LC	-
135	*Palaeornis eupatria*	Alexandrine Parakeet	NT	-
136	*Parus major*	Great Tit	LC	IV
137	*Passer domesticus*	House Sparrow	LC	-
138	*Pavo cristatus*	Indian Peafowl	LC	I
139	*Pelargopsis capensis*	Stork-billed Kingfisher	LC	IV
140	*Pelecanus philippensis*	Spot-billed Pelican	NT	IV
141	*Perdicula argoondah*	Rock Bush Quail	LC	IV
142	*Perdicula asiatica*	Jungle Bush Quail	LC	IV
143	*Pericrocotus cinnamomeus*	Small Minivet	LC	IV

S. No.	Scientific Name	Common Name	IUCN Status*	WPA Schedule**
144	*Pericrocotus erythropygius*	White-bellied Minivet	LC	IV
145	*Pernis ptilorhynchus*	Oriental Honey-buzzard	LC	-
146	*Petrochelidon fluvicola*	Streak-throated Swallow	LC	-
147	*Phaenicophaeus viridirostris*	Blue-faced Malkoha	LC	-
148	*Picoides nanus*	Brown-capped Pygmy Woodpecker	LC	IV
149	*Picus chlorolophus*	Lesser Yellownape	LC	-
150	*Platalea leucorodia*	Eurasian Spoonbill	LC	-
151	*Plegadis falcinellus*	Glossy Ibis	LC	IV
152	*Ploceus philippinus*	Baya Weaver	LC	IV
153	*Pomatorhinus horsfieldii*	Indian Scimitar-babbler	LC	IV
154	***Porphyrio porphyrio***	**Purple Swamphen**	**LC**	**-**
155	*Prinia buchanani*	Rufous-fronted Prinia	LC	-
156	*Prinia hodgsonii*	Grey-breasted Prinia	LC	-
157	*Prinia inornata*	Plain Prinia	LC	-
158	*Prinia socialis*	Ashy Prinia	LC	-
159	*Prinia sylvatica*	Jungle Prinia	LC	-
160	***Psilopogon haemacephalus***	**Coppersmith Barbet**	**LC**	IV
161	*Psilopogon zeylanicus*	Brown-headed Barbet	LC	IV
162	*Psittacula cyanocephala*	Plum-headed Parakeet	LC	IV
163	*Psittacula krameri*	Rose-ringed Parakeet	LC	IV
164	*Pterocles exustus*	Chestnut-bellied Sandgrouse	LC	-
165	*Pterocles indicus*	Painted Sandgrouse	LC	IV
166	*Ptyonoprogne concolor*	Dusky Crag Martin	LC	-
167	***Pycnonotus cafer***	**Red-vented Bulbul**	**LC**	**IV**
168	*Pycnonotus jocosus*	Red-whiskered Bulbul	LC	IV
169	*Pycnonotus luteolus*	White-browed Bulbul	LC	IV
170	*Rhipidura albogularis*	White-spotted Fantail	LC	IV
171	*Rhipidura aureola*	White-browed Fantail	LC	IV
172	*Riparia chinensis*	Asian Plain Martin	LC	-
173	*Rostratula benghalensis*	Greater Painted-snipe	LC	IV
174	*Salpornis spilonota*	Indian Spotted Creeper	LC	-
175	*Sarcogyps calvus*	Red-headed Vulture	CR	IV
176	***Saxicola caprata***	**Pied Bushchat**	**LC**	**-**
177	***Saxicoloides fulicatus***	**Indian Robin**	**LC**	**-**
178	*Schoenicola platyurus*	Broad-tailed Grassbird	VU	-
179	*Sitta castanea*	Indian Nuthatch	LC	-
180	*Sitta frontalis*	Velvet-fronted Nuthatch	LC	-

S. No.	Scientific Name	Common Name	IUCN Status*	WPA Schedule**
181	*Spilopelia senegalensis*	Laughing Dove	LC	IV
182	*Spilopelia suratensis*	Spotted Dove	LC	IV
183	*Spilornis cheela*	Crested Serpent Eagle	LC	-
184	*Sterna aurantia*	River Tern	NT	-
185	*Streptopelia decaocto*	Eurasian Collared Dove	LC	IV
186	*Streptopelia orientalis*	Oriental Turtle Dove	LC	IV
187	***Streptopelia tranquebarica***	**Red-collared Dove**	**LC**	**IV**
188	*Strix ocellata*	Mottled Wood Owl	LC	IV
189	*Sturnia pagodarum*	Brahminy Starling	LC	IV
190	*Sylvia curruca*	Lesser Whitethroat	LC	-
191	*Synoicus chinensis*	King Quail	LC	IV
192	*Sypheotides indicus*	Lesser Florican	EN	I
193	*Taccocua leschenaultii*	Sirkeer Malkoha	LC	-
194	*Tachybaptus ruficollis*	Little Grebe	LC	IV
195	*Tachymarptis melba*	Alpine Swift	LC	-
196	*Tephrodornis pondicerianus*	Common Woodshrike	LC	-
197	*Treron phoenicopterus*	Yellow-footed Green Pigeon	LC	IV
198	*Turdoides striata*	Jungle Babbler	LC	IV
199	*Turdus simillimus*	Indian Blackbird	LC	-
200	*Turnix suscitator*	Barred Buttonquail	LC	-
201	*Turnix sylvaticus*	Small Buttonquail	LC	-
202	*Tyto alba*	Barn Owl	LC	IV
203	*Upupa epops*	Common Hoopoe	LC	-
204	*Vanellus indicus*	Red-wattled Lapwing	LC	-
205	*Vanellus malabaricus*	Yellow-wattled Lapwing	LC	-
206	*Zapornia akool*	Brown Crake	LC	-
207	*Zapornia pusilla*	Baillon's Crake	LC	-
208	*Zosterops palpebrosus*	Oriental White-eye	LC	IV

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

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

Sources: R. Grimmett, C. Inskipp & T. Inskipp (2011). Birds of the Indian Subcontinent. Oxford University Press, pp 1-528; IUCN (2021). The IUCN Red List of Threatened Species. Version 2021-3.; Schedules I to VI: Indian Wildlife (Protection) Act, 1972.

Appendix D Migratory Birds of the Study Area

S. No.	Scientific Name	Common Name	IUCN Status*	Migratory Status	WPA Schedule**
1	*Accipiter nisus*	Eurasian Sparrowhawk	LC	Winter	I
2	*Actitis hypoleucos*	Common Sandpiper	LC	Winter	IV
3	*Anas acuta*	Northern Pintail	LC	Winter	IV
4	*Anas crecca*	Common Teal	LC	Winter	IV
5	*Anas platyrhynchos*	Mallard	LC	Winter	IV
6	*Anastomus oscitans*	Asian Openbill	LC	Winter	IV
7	*Anhinga melanogaster*	Darter	NT	Winter	IV
8	*Anser indicus*	Bar-headed Goose	LC	Winter	IV
9	*Anthropoides virgo*	Demoiselle Crane	LC	Winter	IV
10	*Anthus godlewskii*	Blyth's Pipit	LC	Winter	IV
11	*Anthus hodgsoni*	Olive-backed Pipit	LC	Winter	IV
12	*Anthus richardi*	Richard's Pipit	LC	Winter	IV
13	*Anthus similis*	Long-billed Pipit	LC	Winter	IV
14	*Anthus trivialis*	Tree Pipit	LC	Winter	IV
15	*Apus pacificus*	Pacific Swift	LC	Winter	-
16	*Aquila nipalensis*	Steppe Eagle	EN	Winter	-
17	*Ardea cinerea*	Grey Heron	LC	Winter	IV
18	*Aythya ferina*	Common Pochard	LC	Winter	IV
19	*Aythya fuligula*	Tufted Duck	LC	Winter	IV
20	*Botaurus stellaris*	Eurasian Bittern	LC	Winter	IV
21	***Bubulcus ibis***	**Cattle Egret**	**LC**	**Winter**	**IV**
22	*Calandrella dukhunensis*	Mongolian Short-toed Lark	LC	Winter	IV
23	*Calidris minuta*	Little Stint	LC	Winter	-
24	*Calidris temminckii*	Temminck's Stint	LC	Winter	-
25	*Caprimulgus mahrattensis*	Sykes's Nightjar	LC	Winter	IV
26	*Carpodacus erythrinus*	Common Rosefinch	LC	Winter	IV
27	*Charadrius alexandrinus*	Kentish Plover	LC	Winter	-
28	*Chlidonias hybrida*	Whiskered Tern	LC	Winter	-
29	*Ciconia ciconia*	White Stork	LC	Winter	IV
30	*Ciconia nigra*	Black Stork	LC	Winter	IV
31	*Circus aeruginosus*	Eurasian Marsh Harrier	LC	Winter	-
32	*Circus macrourus*	Pallid Harrier	LC	Winter	-
33	*Circus melanoleucos*	Pied Harrier	LC	Winter	-

S. No.	Scientific Name	Common Name	IUCN Status*	Migratory Status	WPA Schedule**
34	*Circus pygargus*	Montagu's Harrier	LC	Winter	-
35	*Clamator coromandus*	Chestnut-winged Cuckoo	LC	Winter	IV
36	*Clamator jacobinus*	Jacobin Cuckoo	LC	Summer	IV
37	*Clanga clanga*	Greater Spotted Eagle	VU	Winter	-
38	*Columba eversmanni*	Yellow-eyed Pigeon	VU	Winter	IV
39	*Coturnix coromandelica*	Rain Quail	LC	Winter	IV
40	*Coturnix coturnix*	Common Quail	LC	Winter	IV
41	*Cuculus micropterus*	Indian Cuckoo	LC	Summer	IV
42	*Cuculus poliocephalus*	Lesser Cuckoo	LC	Passage	IV
43	*Curruca curruca*	Lesser Whitethroat	LC	Winter	-
44	*Cyanecula svecica*	Bluethroat	LC	Winter	-
45	*Cyornis tickelliae*	Tickell's Blue Flycatcher	LC	Winter	IV
46	*Dendrocygna bicolor*	Fulvous Whistling-duck	LC	Passage	IV
47	*Dicrurus leucophaeus*	Ashy Drongo	LC	Winter	IV
48	*Emberiza bruniceps*	Red-headed Bunting	LC	Winter	IV
49	*Emberiza buchanani*	Grey-necked Bunting	LC	Winter	IV
50	*Emberiza melanocephala*	Black-headed Bunting	LC	Winter	IV
51	*Eumyias thalassinus*	Verditer Flycatcher	LC	Winter	IV
52	*Falco amurensis*	Amur Falcon	LC	Passage	IV
53	*Falco naumanni*	Lesser Kestrel	LC	Winter	-
54	*Falco tinnunculus*	Common Kestrel	LC	Winter	IV
55	*Ficedula albicilla*	Taiga Flycatcher	LC	Winter	IV
56	*Ficedula parva*	Red-breasted Flycatcher	LC	Winter	IV
57	*Ficedula ruficauda*	Rusty-tailed Flycatcher	LC	Winter	IV
58	*Ficedula superciliaris*	Ultramarine Flycatcher	LC	Winter	IV
59	*Gallinago gallinago*	Common Snipe	LC	Winter	IV
60	*Gallinago stenura*	Pintail Snipe	LC	Winter	IV
61	*Gelochelidon nilotica*	Gull-billed Tern	LC	Winter	-
62	*Hieraaetus pennatus*	Booted Eagle	LC	Winter	-
63	***Himantopus himantopus***	**Black-winged Stilt**	**LC**	**Winter**	**IV**
64	*Hirundo rustica*	Barn Swallow	LC	Winter	-
65	*Iduna caligata*	Booted Warbler	LC	Winter	-
66	*Jynx torquilla*	Eurasian Wryneck	LC	Winter	-
67	*Lalage melanoptera*	Black-headed Cuckooshrike	LC	Passage	-
68	*Lalage melaschistos*	Black-winged Cuckooshrike	LC	Winter	-
69	*Lanius cristatus*	Brown Shrike	LC	Winter	-
70	*Lanius cristatus*	Brown Shrike	LC	Summer	-

S. No.	Scientific Name	Common Name	IUCN Status*	Migratory Status	WPA Schedule**
71	*Lanius isabellinus*	Isabelline Shrike	LC	Winter	-
72	*Larus fuscus*	Lesser Black-backed Gull	LC	Winter	-
73	*Larus ichthyaetus*	Pallas's Gull	LC	Winter	-
74	*Limosa limosa*	Black-tailed Godwit	NT	Winter	-
75	*Lymnocryptes minimus*	Jack Snipe	LC	Winter	IV
76	*Mareca penelope*	Eurasian Wigeon	LC	Winter	IV
77	*Marmaronetta angustirostris*	Marbled Teal	VU	Winter	IV
78	*Merops philippinus*	Blue-tailed Bee-eater	LC	Summer	-
79	***Microcarbo niger***	**Little Cormorant**	**LC**	**Winter**	**IV**
80	*Monticola cinclorhyncha*	Blue-capped Rock-thrush	LC	Winter	
81	*Monticola solitarius*	Blue Rock Thrush	LC	Winter	IV
82	*Motacilla alba*	White Wagtail	LC	Winter	-
83	*Motacilla cinerea*	Grey Wagtail	LC	Winter	-
84	*Motacilla citreola*	Citrine Wagtail	LC	Winter	-
85	*Motacilla flava*	Yellow Wagtail	LC	Winter	-
86	*Muscicapa dauurica*	Asian Brown Flycatcher	LC	Winter	IV
87	*Netta rufina*	Red-crested Pochard	LC	Winter	IV
88	*Oenanthe isabellina*	Isabelline Wheatear	LC	Winter	-
89	*Oriolus chinensis*	Black-naped Oriole	LC	Winter	IV
90	*Oriolus kundoo*	Indian Golden Oriole	LC	Winter	IV
91	*Pandion haliaetus*	Osprey	LC	Winter	I
92	*Pastor roseus*	Rosy Starling	LC	Winter	IV
93	*Phalacrocorax carbo*	Great Cormorant	LC	Winter	IV
94	*Phoenicopterus roseus*	Greater Flamingo	LC	Winter	IV
95	*Phoenicurus ochruros*	Black Redstart	LC	Winter	-
96	*Phylloscopus affinis*	Tickell's Leaf-warbler	LC	Winter	-
97	*Phylloscopus griseolus*	Sulphur-bellied Warbler	LC	Winter	-
98	*Phylloscopus humei*	Hume's Leaf-warbler	LC	Winter	-
99	*Phylloscopus magnirostris*	Large-billed Leaf-warbler	LC	Winter	-
100	*Phylloscopus nitidus*	Green Warbler	LC	Summer	-
101	*Phylloscopus occipitalis*	Western Crowned Leaf-warbler	LC	Winter	-
102	*Phylloscopus tristis*	Siberian Chiffchaff	LC	Winter	-
103	*Phylloscopus trochiloides*	Greenish Warbler	LC	Winter	-
104	*Phylloscopus tytleri*	Tytler's Leaf-warbler	NT	Winter	-
105	*Pitta brachyura*	Indian Pitta	LC	Summer	-
106	*Porzana porzana*	Spotted Crake	LC	Winter	-

S. No.	Scientific Name	Common Name	IUCN Status*	Migratory Status	WPA Schedule**
107	*Ptyonoprogne rupestris*	Eurasian Crag Martin	LC	Winter	-
108	*Recurvirostra avosetta*	Pied Avocet	LC	Winter	IV
109	*Saxicola torquatus*	Common Stonechat	LC	Winter	-
110	*Saxicola torquatus*	Common Stonechat	LC	Winter	-
111	*Scolopax rusticola*	Eurasian Woodcock	LC	Winter	-
112	*Spatula clypeata*	Northern Shoveler	W	Winter	IV
113	*Spatula querquedula*	Garganey	LC	Winter	IV
114	*Sturnia malabarica*	Chestnut-tailed Starling	LC	Winter	IV
115	*Sylvia althaea*	Hume's Whitethroat	-	Winter	-
116	***Tadorna ferruginea***	**Ruddy Shelduck**	**LC**	**Winter**	**IV**
117	*Terpsiphone paradisi*	Asian Paradise Flycatcher	LC	Winter	IV
118	*Threskiornis melanocephalus*	Black-headed Ibis	NT	Winter	IV
119	*Tringa erythropus*	Spotted Redshank	LC	Winter	-
120	*Tringa glareola*	Wood Sandpiper	LC	Winter	IV
121	*Tringa nebularia*	Common Greenshank	LC	Winter	-
122	*Tringa ochropus*	Green Sandpiper	LC	Winter	IV
123	*Tringa stagnatilis*	Marsh Sandpiper	LC	Winter	IV
124	*Tringa totanus*	Common Redshank	LC	Winter	-
125	*Turnix tanki*	Yellow-legged Buttonquail	LC	Winter	-

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

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

Sources: R. Grimmett, C. Inskipp & T. Inskipp (2011). Birds of the Indian Subcontinent. Oxford University Press, pp 1 -528; IUCN (2021). The IUCN Red List of Threatened Species. Version 2021-3.; Schedules I to VI: Indian Wildlife (Protection) Act, 1972.

Appendix E Reptiles of the Study Area

S. No.	Scientific Name	Common Name	IUCN Status*	WPA Schedule**
1	*Ahaetulla nasuta*	Long-nosed Tree Snake	LC	-
2	*Amphiesma stolatum*	Buff Striped Keelback	LC	-
3	*Argyrogena fasciolata*	Banded Racer	LC	-
4	*Atretium schistosum*	Olive Keelback Water Snake	LC	II
5	*Boiga forsteni*	Forsten's Cat Snake	LC	IV
6	*Boiga trigonata*	Indian Gamma Snake	LC	-
7	*Bungarus caeruleus*	Common Krait	LC	-
8	*Bungarus walli*	Wall's Krait	-	-
9	*Calliophis melanurus*	Slender Coral Snake	LC	-
10	*Calotes versicolor*	Changeable Lizard	LC	-
11	*Chamaeleo zeylanicus*	Indian Chamaeleon	LC	II
12	*Chrysopelea ornata*	Ornate Flying Snake	LC	-
13	*Coelognathus helenae*	Trinket Snake	LC	-
14	*Coronella brachyura*	Indian Smooth Snake	LC	-
15	*Crocodylus palustris*	Mugger	VU	-
16	*Cyrtodactylus varadgirii*	Giri's Geckoella	LC	-
17	*Daboia russelii*	Western Russel's Viper	LC	II
18	*Dendrelaphis tristis*	Daudin's Bronzeback	LC	-
19	*Echis carinatus*	-	LC	-
20	*Elachistodon westermanni*	Indian Egg-eater	LC	I
21	*Eryx conicus*	Rough-tailed Sand Boa	NT	-
22	*Eryx johnii*	Red Sand Boa	NT	-
23	*Eublepharis fuscus*	Western Indian Leopard Gecko	-	-
24	*Eurylepis taeniolatus*	Ribbon-sided Skink	LC	-
25	*Eutropis allapallensis*	Schmidt's Mabuya	LC	-
26	*Eutropis carinata*	Many-keeled Grass Skink	LC	-
27	*Eutropis macularia*	Bronze Mabuya	LC	-
28	*Eutropis trivittata*	Three-banded Mabuya	LC	-
29	*Fowlea piscator*	Chequered Keelback	LC	-
30	*Grypotyphlops acutus*	Beaked Worm Snake	LC	-
31	*Hemidactylus brookii*	Brooke's House Gecko	LC	-
32	*Hemidactylus flaviviridis*	Yellow-bellied House Gecko	LC	-
33	*Hemidactylus frenatus*	Asian House Gecko	-	-
34	*Hemidactylus gracilis*	Graceful Leaf-toed Gecko	LC	-
35	*Hemidactylus leschenaultii*	Bark Gecko	-	-

S. No.	Scientific Name	Common Name	IUCN Status*	WPA Schedule**
	Hemidactylus sahgali	Sahgal's Termite Hill Gecko	LC	-
37	*Indotyphlops braminus*	Brahminy Blindsnake	LC	-
38	*Indotyphlops porrectus*	Stoliczka's Slender Blind Snake	LC	-
39	*Lepidodactylus lugubris*	Mourning Gecko	LC	-
40	*Liopeltis calamaria*	Calamaria Reed Snake	LC	-
41	*Lissemys punctata*	Indian Flapshell Turtle	VU	I
42	*Lycodon aulicus*	Common Wolf Snake	LC	-
43	*Lycodon flavomaculatus*	Yellow-spotted Wolf Snake	LC	-
44	*Lycodon striatus*	Barred Wolf Snake	LC	-
45	*Lycodon travancoricus*	Travancore Wolf Snake	LC	IV
46	*Lygosoma guentheri*	Günther's Writhing Snake	LC	IV
47	*Lygosoma lineata*	Lined Supple Skink	LC	-
48	*Lygosoma punctata*	Common Dotted Garden Skink	LC	-
49	*Monilesaurus rouxii*	Roux's Forest Calotes	LC	-
50	*Naja naja*	Indian Cobra	LC	II
51	*Oligodon arnensis*	Common Kukri Snake	LC	-
52	*Oligodon taeniolatus*	Streaked Kukri Snake	LC	IV
53	*Ophisops jerdonii*	Punjab-snake-eyed Lacerta	LC	-
54	*Ophisops leschenaultii*	Leschenault's Snake Eye	LC	-
55	*Psammophis condanarus*	Sand Snake	LC	-
56	*Psammophis leithii*	Leith's Sand Snake	LC	-
57	*Ptyas mucosa*	-	LC	II
58	*Python molurus*	Indian Rock Python	NT	I
59	*Rhabdophis plumbicolor*	Green Keelback	LC	-
60	*Sibynophis sagittarius*	Cantor's Black-headed Snake	LC	-
61	*Sibynophis subpunctatus*	Dumeril's Black-headed Snake	LC	-
62	*Sitana ponticeriana*	Fan Throated Lizard	LC	-
63	*Sitana spinaecephalus*	Spiny-headed Fan-throated Lizard	LC	-
64	*Trimeresurus gramineus*	Common Bamboo Viper	LC	-
65	*Varanus bengalensis*	Indian Monitor	LC	I

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

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

Sources: Patel, H., Vyas, R. (2019) Reptiles of Gujarat, India: Updated Checklist, Distribution, and Conservation Status. Herpetology Notes, Vol. 12 pp. 765-777.; The IUCN Red List of Threatened Species (2021). Version 2021-3.; Schedules I to VI: Indian Wildlife (Protection) Act, 1972.

Appendix F Amphibians of the Study Area

S. No.	Scientific Name	Common Name	IUCN Status*	WPA Schedule**
1	*Duttaphrynus melanostictus*	Asian Common Toad	LC	-
2	*Duttaphrynus stomaticus*	Marbled Toad	LC	-
3	*Euphlyctis cyanophlyctis*	Indian Skittering Frog	LC	-
4	*Euphlyctis hexadactylus*	Indian five-fingered frog	LC	IV
5	*Fejervarya limnocharis*	Boie's Wart Frog	LC	-
6	*Fejervarya syhadrensis*	Bombay Wart Frog	LC	-
7	*Hoplobatrachus tigerinus*	Indian Bullfrog	LC	IV
8	Hydrophylax malabaricus	Malabar Fungoid Frog	LC	-
9	*Microhyla ornata*	Ant Frog	LC	-
10	*Microhyla rubra*	Guangdong Rice Frog	LC	-
11	Minervarya syhadrensis	Bombay Wart Frog	LC	-
12	*Polypedates maculatus*	Indian Tree Frog	LC	-
13	*Sphaerotheca breviceps*	Indian Burrowing Frog	LC	-
14	*Uperodon globulosus*	Indian Balloon Frog	LC	-
15	*Uperodon variegatus*	Eluru Dot Frog	LC	-

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

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

Sources: Vyas, R. (2008) Review of the current diversity and richness of amphibians of Gujarat, India. Indian Forester Vol 134 (10) pp 1381-1392.; The IUCN Red List of Threatened Species (2021). Version 2021-3.; Schedules I to VI: Indian Wildlife (Protection) Act, 1972.

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Appendix G Fishes of the Study Area

S. No.	Scientific Name	Common Name	IUCN Status*	WPA Schedule**
1	*Anabas testudineus*	Climbing Perch	LC	-
2	*Anguilla bicolor*	Shortfin Eel	NT	-
3	*Aplocheilus parvus*	Dwarf panchax	LC	-
4	*Bagarius yarrelli*	-	NT	-
5	*Channa gachua*	Dwarf Snakehead	LC	-
6	*Channa marulius*	-	LC	-
7	*Channa punctata*	Spotted Snakehead	LC	-
8	*Channa striata*	Snakehead Murrel	LC	-
9	*Cirrhinus mrigala*	Mrigal	LC	-
10	*Esomus danrica*	Flying barb	LC	-
11	*Gymnostomus ariza*	Ariza Labeo	LC	-
12	*Indoreonectes evezardi*	-	LC	-
13	*Labeo bata*	Minor Carp	LC	-
14	*Labeo boggut*	Boggut labeo	LC	-
15	*Lepidocephalichthys guntea*	-	LC	-
16	*Mastacembelus armatus*	-	LC	
17	*Monopterus albus*	Rice swampeel	LC	-
18	*Monopterus javanensis*	Oriental Swamp Eel	LC	
19	*Morone saxatilis*	Striped Bass	LC	-
20	*Mystus gulio*	-	LC	-
21	*Nandus nandus*	-	LC	-
22	*Nemacheilus denisoni*	-	LC	-
23	*Neotropius atherinoides*	-	LC	-
24	*Notopterus notopterus*	-	LC	
25	*Ompok bimaculatus*	-	NT	-
26	*Osteobrama vigorsii*	-	LC	-
27	*Parachiloglanis hodgarti*	-	LC	-
28	*Parambassis ranga*	Indian Glassy Fish	LC	
29	*Proeutropiichthys taakree*	-	LC	-
30	*Pseudapocryptes elongatus*	-	LC	-
31	*Pseudetroplus maculatus*	Orange Chromide	LC	-
32	*Puntius vittatus*	-	LC	-
33	*Rasbora daniconius*	Slender Barb	LC	-
34	*Rasbora microcephalus*	-	LC	-
35	*Rita gogra*	Gogra Rita	LC	-

S. No.	Scientific Name	Common Name	IUCN Status*	WPA Schedule**
36	*Rita kuturnee*	Deccan rita	LC	-
37	*Salmophasia balookee*	Bloch Razorbelly Minnow	LC	-
38	*Salmophasia novacula*	Novacula Razor Belly Minnow	LC	-
39	*Sperata aor*	Long-whiskered Catfish	LC	-
40	*Wallago attu*	-	VU	-

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

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

Sources: Harinder Singh Banyal, Sanjeev Kumar and R. H. Raina, (2019). Rec. zool. Surv. India: Vol. 119(3)/ 282 -288; https://www.fishbase.se/search.php; IUCN (2021). The IUCN Red List of Threatened Species. Version 2021-3; Schedules I to VI: Indian Wildlife (Protection) Act, 1972.