Initial Environmental and Social Examination Report

PUBLIC

Project Number: 57072-001
Draft
May 2024

India: Engie Solar Power Project

PART 1: Main Report

Prepared by AECOM India Private Limited and ENREN Energy Private Limited for the Asian Development Bank (ADB).

FINAL REPORT

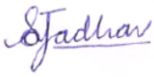
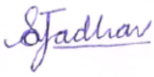
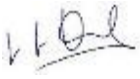
AECOM

ESIA 400 MW Solar Power Project Surendranagar, Gujarat, India

ENREN Energy Private Limited

29 Jan 2024

Quality information

Prepared by	Checked by	Verified by	Approved by
			
Akash Tiwari EHS Expert	Shubhangi Jadhav EHS Expert	Shubhangi Jadhav EHS Expert	Chetan Zaveri Vice-President
			
Amruta Dhamorikar Biodiversity Expert	Deepti Bapat Biodiversity Expert		
			
Karthick Chandrasekar Social Expert			

Revision History

Revision	Revision date	Details	Authorized	Name	Position
00	6 July 2023	Draft ESIA	Yes	Chetan Zaveri	Vice President
01	12 July 2023	Final ESIA	Yes	Chetan Zaveri	Vice President
02	5 Dec 2023	Final ESIA	Yes	Chetan Zaveri	Vice President
03	29 Jan 2024	Final ESIA	Yes	Chetan Zaveri	Vice President

Distribution List

# Hard Copies	PDF Required	Association / Company Name
No	Yes	ENREN Energy Private Limited

Prepared for:

ENREN Energy Private Limited
6th Floor, Tower 2, Phoenix Fountainhead,
Viman Nagar, City, Pune
411014, Maharashtra
India

Prepared by:

AECOM India Private Limited
3rd Floor
Tower A
Buiding No. 8
DLF Cyber City
DLF Phase II
Gurgaon 122002
Haryana
India

CIN: U74210KA2005PTC037770

T: +91 124 4871400
aecom.com

Table of Contents

Figures

Tables

1. Introduction

ENGIE is an energy company with a presence in 70 countries with an installed capacity of 115 GW. ENGIE develops its businesses (power, natural gas, energy services) around a model based on responsible growth to take up today's major energy and environmental challenges: The Group provides highly efficient and innovative solutions to individuals, cities and businesses by relying on diversified gas-supply sources, flexible and low-emission power generation as well as unique expertise in four key sectors: independent power production, liquefied natural gas, renewable energy and energy efficiency services.

Over the past 10 years in India, Engie has created a portfolio of 1103.18 MWp solar power capacity and are already in operational phase under different state and central schemes[1].

AECOM India Private Limited (hereinafter referred as 'AECOM' or 'We') is pleased to submit Environmental and social impact assessment (ESIA) report to ENREN Energy Private Limited (hereinafter referred as 'Client'), who is the SPV of ENGIE for the proposed 400MW AC Solar Power Plant at Surendra Nagar in Gujarat, India. (Hereinafter referred as 'Project')

1.1 Project Background

ENREN Energy Private Limited is a solar power company. The company was founded in 2006 with the mission of making solar power more competitive than other energy sources. It has developed a distinctive scalable business model as a pure play solar power company with the aim of creating value all along the value chain from development to construction, services and investment.

ENREN Energy Private Ltd. has participated in the bid initiated by GUVNL for 750 MW and secured 400 MW capacity in the successful competitive bidding. LOA issued and PPA has been signed between GUVNL & SEIPL.

The project is designed for 400 MW AC project with Single-axis tracker. The proposed project site is located at Sayla, Surendranagar, (near Rajkot-Surendranagar Highway), Gujarat, India.

1.2 Scope of Work

The broad scope of work for ESIA study includes the following aspects of the proposed project:

- To analyze, quantify the environmental, health, safety and social impacts of the construction and operation phases of the project;
- To establish the environmental baseline in the study area (5 Km radius from the project site center – considering 400 MW solar project) and to identify potential environmental issues;
- To develop appropriate planning and mitigation plan for transmission line land acquisition and access in the form of a Resettlement Plan (if physical displacement will occur) or Livelihoods Restoration Plan (for economic displacement impacts);
- To conduct critical habitat screening and other supplementary studies and/or drafting of ToRs for other supplementary studies that may be required as a result of the ESIA. To assess the key biodiversity (Flora and Fauna) affected due to the project activity;
- To analyze specific risks associated with the project (including associated facilities) and nearby infrastructure within a study area of (5 Km radius from the project site center – considering 400 MW solar project) in the vicinity of the project and its impact considering the project foot print (including associated facilities)
- To mitigate adverse impacts by provision of the requisite avoidance, mitigation and compensation measures of the proposed project activities;
- To identify and prepare a profile of stakeholders involved in the project, including community, through suitable survey using internationally acceptable tool/s, as applicable;

[1] Detailed Project Report

- To conduct consultations to identify expectations and concerns of project affected community;
- To establish the socio-economic status of the project affected community based on data collated through secondary as well as primary information;
- To assess the E&S permitting and licensing status and requirements of the project;
- To develop Environment and Social Management and Plan (ESMP) for implementation & monitoring of the mitigation measures.
- To categorize the Project as per IFC/ ADB Categorization, based on outcome of the ESIA study.

1.3 Applicable Framework

The following reference framework is referred to while developing the ESIA Report for the project,

- Applicable Indian EHS and Social regulations (including relevant approvals, permits and consents obtained);
- IFC Performance Standards Framework 2012;
- World Bank Group (WBG) Environment, Health and Safety (EHS) General Guidelines, 2007;
- IFC/World Bank EHS Guidelines for Electric Power Transmission and Distribution (2007).
- ADB Safeguard Policy Statement (SPS) (2009);
- ADB Social Protection Strategy (2001);
- ADB Gender and Development Policy (1998);
- ADB Access to Information Policy (2019);
- IFC/EBRD's Worker Accommodation Guidance Note (2009);
- International Covenant on Economic, Cultural and Social Rights and relevant ILO Core Labor Standards Conventions; and
- Other relevant good industry practice guidelines and related documents.

1.4 Approach and Methodology

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

- The relevant project documents and the 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).

1.4.1 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 the project processes. Since the proposed project is a renewable energy project and is located in the Surendranagar district Gujarat and is devoid of much habitation, industrial activity, or other pollution sources, though there are many other renewable energy projects in the nearby regions which are discussed in the cumulative impact assessment section of the report. Hence, primary impacts from the proposed solar power project have been assessed in the Project Area 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 from centre of the project) radius has been considered as the “Study Area” 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 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 Study Area of 5 km.

In order to include the farthest anticipated direct receptors of biodiversity-related impacts, any protected areas within 10 km from project site were also screened for.

1.4.2 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:

- Site layout plan;
- Various land related documents;
- Organizational chart; and
- Other Project related documents.

1.4.3 Screening and Scoping

At the initial stage of the impact assessment, a preliminary desktop 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, sub-station, 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 Study Area, 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) biodiversity expert undertook a site visit to the project location between 29th May 2023 – 2nd June 2023. As part of the site visit, the following key activities were undertaken:

- Meeting with the on-site project team;
- Site walk through the private and government land parcels finalized 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 in Sonpari, Nana Kandhashar, Ratanpar, Mngalkui, Shapar, Dhedhuki, Dhankaniya and nearby villages;
- Preliminary biodiversity observations on habitat types.

1.4.4 Site Survey

AECOM team conducted a site survey between 29th May 2023 to 2nd June 2023. 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 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 baselines environmental data;
- Undertake social assessments and consultations in the form of individual interviews and focussed 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.).

1.4.5 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.

1.4.6 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 Government Revenue Officials, School Teachers, Livestock Inspector, Forest officials, etc.
- **Local communities**: Consultations with landowners, women groups, farmers, cattle grazers, etc., were conducted; and
- **Client site representative**: Consultations were undertaken with the client site team along with land aggregator.

1.4.7 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.

1.4.8 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.

1.5 Layout of Report

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

Chapter 1: Introduction *(this section)*	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.
Chapter 2: Project Description	This section of the report provides detail of the project location, key project components and utilities, land requirements, power purchase agreement, current project status, etc.
Chapter 3: 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
Chapter 4: Environmental and Socio-economic Baseline	This chapter illustrates the environmental baseline, socio-economic baseline, and Ecology baseline
Chapter 5: Stakeholder Engagement and Consultation	This section presents the key stakeholders consulted during this study
Chapter 6: Analysis of Alternatives	This section presents the analysis of alternatives for the proposed solar project
Chapter 7: Impact Assessment	This chapter highlights the impact assessment criteria, key environmental risks, and key social risks

Chapter 8: Environment and Social Management Plan	This chapter highlights the organization structure, training, Inspection monitoring and audit and Documents and record keeping
Chapter 9: Conclusion	This chapter gives conclusion of above sections

1.6 Limitations

This report presents the observations made by AECOM 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 are 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. Since the project was in the initial phase of negotiations and land leasing process, during site visit only limited number of consultations with landowners and village representatives were made possible by the client. 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.

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 was proposed on about 2260.84 acres (914.929 hectares) of land, including private and government land and the ESIA study was focused on the entire land parcel. Currently, client is planning this project on roughly 1650 acres of land, including private and government land. The government land handover procedure is in process. Transmission line will be connected from the east side of the plant with the 400 kV shaper Getco grid substation (22°28'53.17"N, 71°18'26.10"E). The Project site can be accessed from two different locations Rajkot (~60 kms) and Ahmedabad (~160 kms) which are well connected with other parts of the countries, via road, rail, and flights. The Project site is connected with Rajkot city which is nearest city to the project through NH 47. Rajkot airport is located approximately 60 kms from project site and is connected with other cities in India like Mumbai, Delhi, Bangalore, Indore, Udaipur, Goa.
The Project site location has been depicted in the ***Figure 2-1*** below.

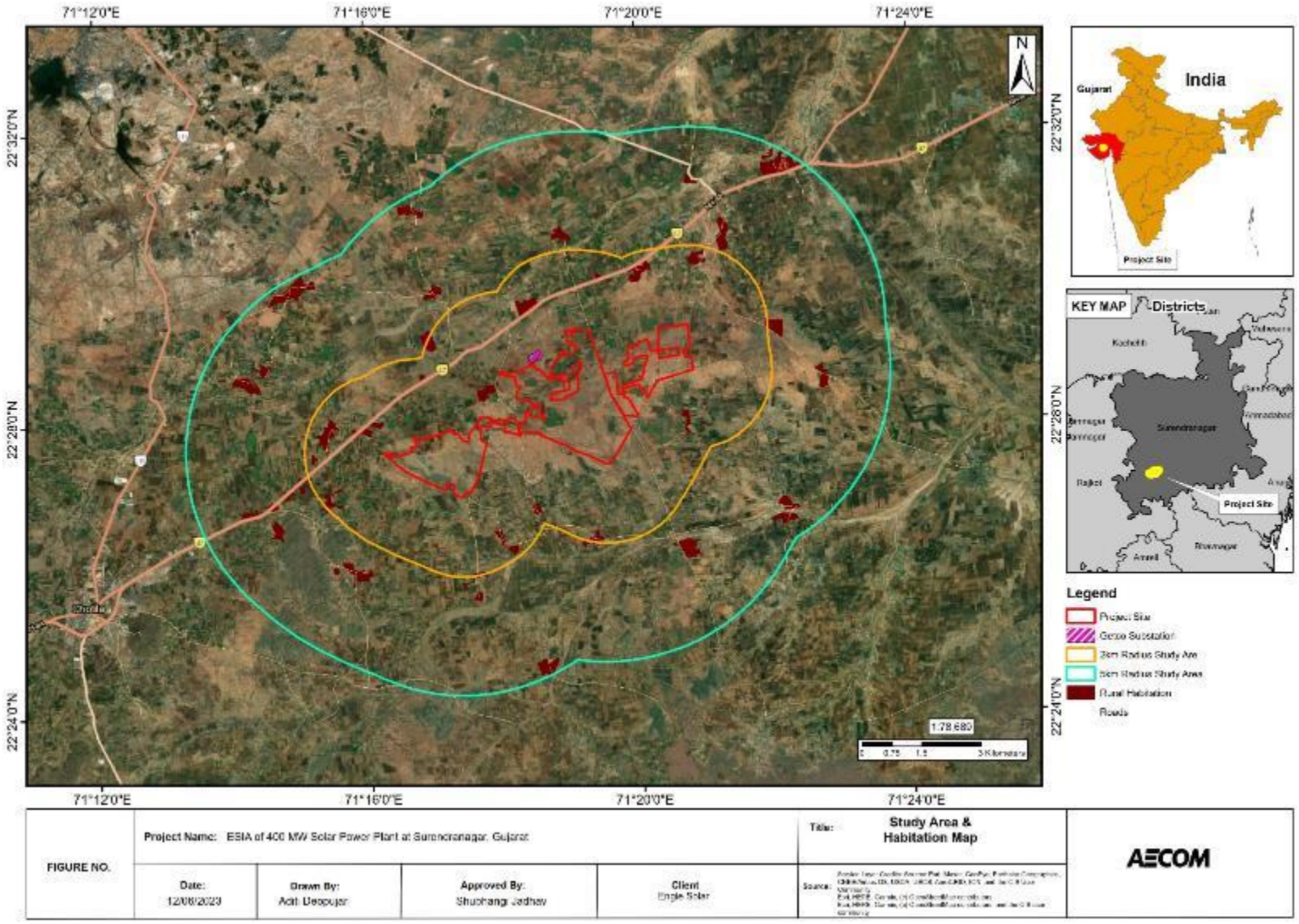


Figure 2-1: Map showing Project Location in Surendranagar, Gujarat

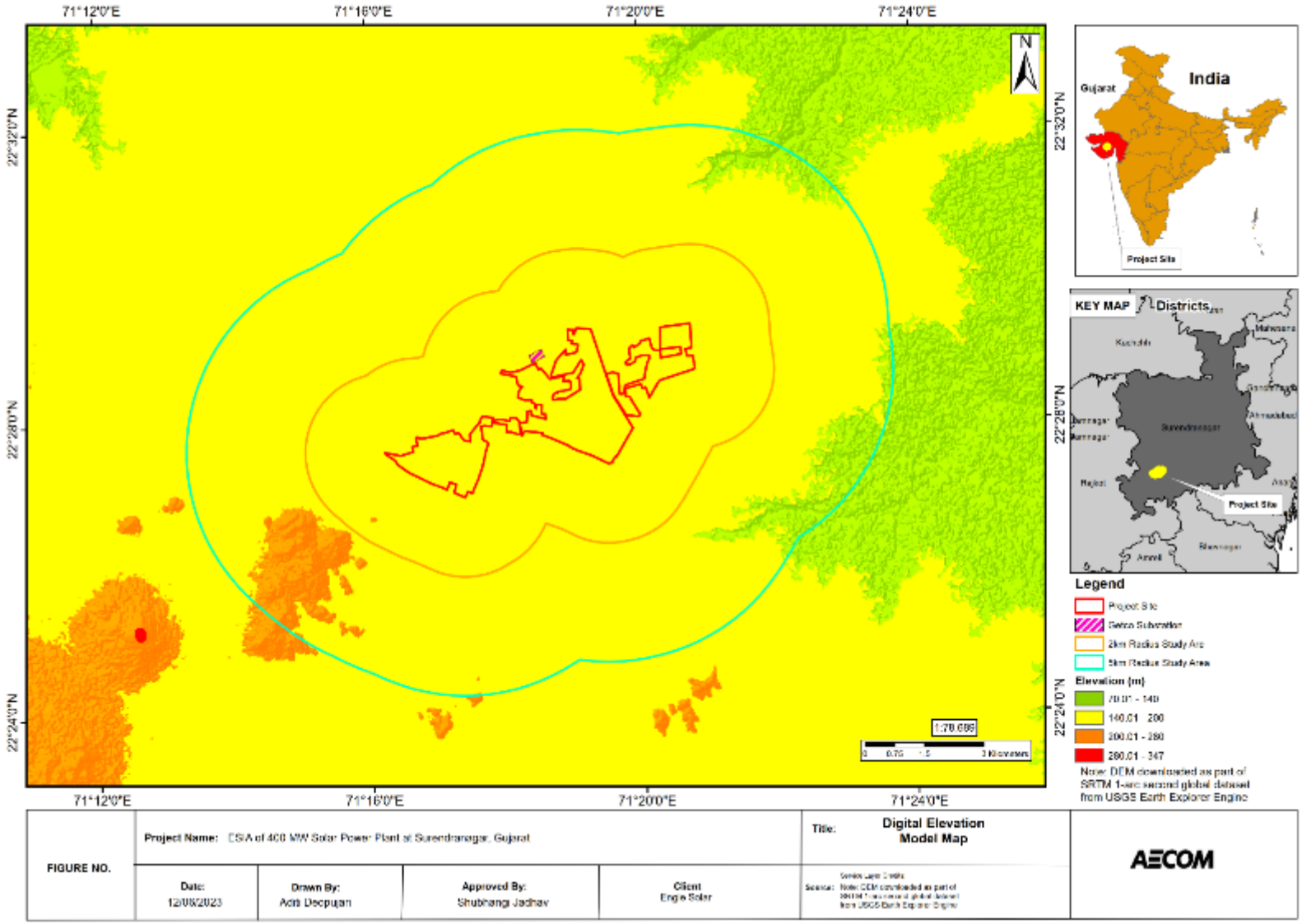


Figure 2-2: Digital elevation map of the Project Area

2.2 Site Settings

The Project was proposed on about 2260.84 acres (914.929 hectares) of land, including private and government land and the ESIA study was focused on the entire land parcel. Currently, client is planning this project on roughly 1650 acres of land, including private and government land. The government land handover procedure is in process. A major proportion of the project land is a barren land with very limited to negligible agricultural activities The selected site is a relatively flat terrain with a mix of rocky pieces of land patch.

2.2.1 Access Roads

The access road running parallel on the eastern side of the site is an existing paved National Highway. Project site is connected with Rajkot city which is nearest to the plant through NH 47 which at places also connects with SH 17.

2.3 Status of the Project

For environmental and social impact assessment, a site visit was undertaken between 29th May to 2nd June 2023. As on the day of site visit, land procurement process was undergoing, and the land team was in process of negotiation with the landowners. The detailed design of the project was yet to be made available with the site team. Power purchase agreement between Enren Energy Pvt. Ltd. and GUVNL was executed on 15th December 2022 as per the certificate no *"IN-GJ54726453331876U"*. Transmission line which is less than 70 metres from the grid substation was finalised and was known to be underground. As per the information received, construction will be started in the mid of June 2023 which will go on till July 2024. Detailed project timeline is provided in the Appendix M of the report.

2.4 Project Overview

2.4.1 Project Technology[2]

The proposed project will be based on crystalline silicon technology solar panels and de-centralized inverter. The technology is selected on the basis of energy production and financial cash flow for 25 years. The project will be connected through 220KV underground Transmission line at GSS 220 KV bay of Shapar, GETCO Substation and metering point shall be installed at 220KV switch yard at Shapar SS of GETCO.

2.4.2 Capacity of the plant

The AC capacity of the project will be 400 MW whereas DC capacity will be 500 MWp at AC/DC ratio 1:1.25

2.4.3 Solar Power & P V Technology

Solar energy is the most abundant energy resource on earth. Solar energy as it is dispersed on the planet and radiated back to space. Although the energy coming from the Sun is significantly higher, it is very important to distinguish between the available and the potential solar energy. The available solar energy i.e. the part which can be effectively utilized by power systems and converted into electricity is significantly lower.

2.4.4 Importance of P V

Since the invention of solar cells in 1954, photovoltaic (PV) has gained the reputation of being a reliable power source for space and certain terrestrial applications. Photovoltaic (PV) offers a unique opportunity to solve the 21st century's energy and the environmental problems simultaneously because solar energy is essentially unlimited and solar cells can convert it into electrical energy.

Thus photovoltaic (PV) is an ideal clean and reliable renewable source of electricity generation for space and terrestrial applications.

Crystalline silicon (c-Si) modules represent 85-90% of the global annual market today. C-Si modules are subdivided in two main categories:

[2] Detailed project report

i) Mono crystalline (sc-Si)

ii) Multi-crystalline (mc-Si)

Thin films currently account for 10% to 15% of global PV module sales. They are subdivided into three main families:

i) Amorphous (a-Si) and micro amorphous silicon (a-Si/µc-Si)

ii) Cadmium-Telluride (CdTe)

iii) Copper-Indium-Diselenide (CIS) or Copper-Indium-Gallium-Diselenide (CIGS)

As of July 2022, the market was dominated by monocrystalline technology with a share of 160GWp followed by multi-crystalline technology of 20GWp and then by thin film technology of 10GWp.

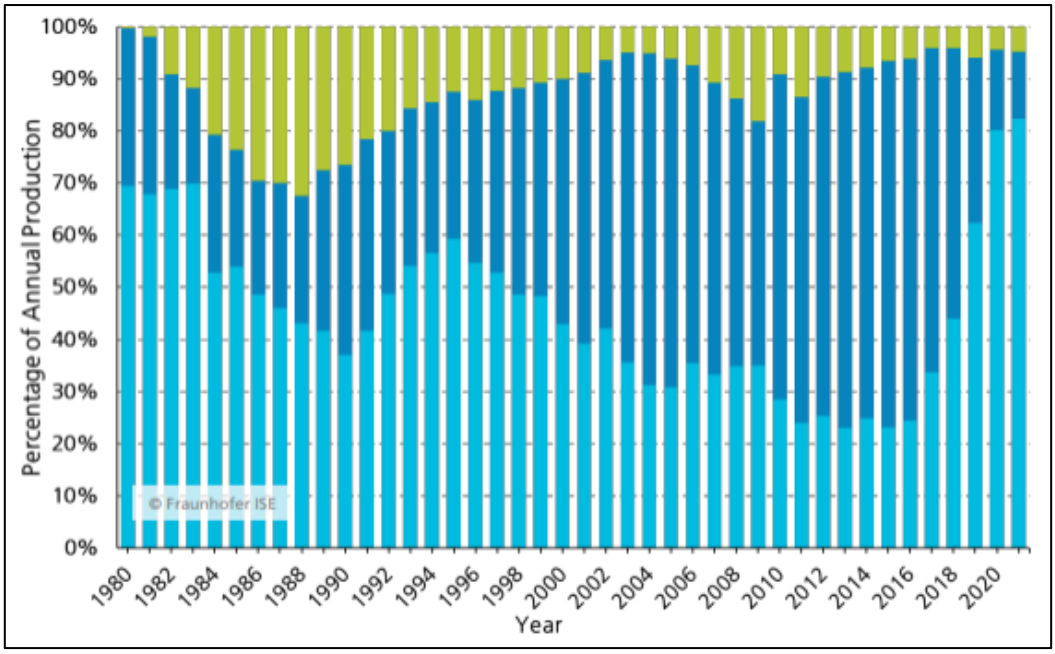


Figure 2-3: PV module production in 2021

2.5 Resource Requirement and Procurement

The resource requirement for construction and operation phases of the proposed project have been assessed based on the discussions with client Project team and information shared by them. The resource requirements are as elaborated below.

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 ENGIE, consultations with the land aggregator, landowners, revenue officials and review of land-related documents shared by ENGIE.

2.5.1.1 Project-Related Land Procurement and Existing Land Procurement Status

The proposed 400 MW Solar power project is proposed to be developed in Dhedhuki, Ratanpar and Shapar Villages, Sayla Taluk, Surendranagar District.

- **Extent of land:** The proposed project involves in sourcing of both Private and Government Land. Client had identified ~2407 acres of land belonging to four land parcels of 1376 acres (Option-A), 626 acres (Option-C) and 368 acres (Option-F). Based on updated land requirement, the project is proposed on approx. 1650 acres of land, including 992 acres of private and 658 acres of government land. The land parcels are lying in three revenue villages namely Dhedhuki, Ratanpar and Shapar villages of Sayla Taluk, Surendranagar District.

Based on the discussion with Client team and site visit observations, few government land parcels were under cultivation by illegal encroachers. Though there are no physical structures, agriculture equipment's or developments were observed within those land, use of government procedures and loss of livelihood for the encroachers is envisaged in taking procession of the Government land.

- Mode of procurement:
    - **Private Land:** It was reported that private land is to be sourced through executing long term lease agreement on willing lessor and willing lessee basis.
    - **Government Land:** government land are being sourced based on government allotment. As on date of site visit, the application was made for souring the land and it was reported to be in process.
    - **Transmission Line:** The proposed project site boundary is adjacent to the GSS at the distance of 70 meters. The project is proposed to be connected to GSS through underground cables. Hence the need for surface land for transmission line erection is not envisaged under the project.
- **Current procurement status:** Currently, the lease-deeds for approx. 285 acres of private land have been carried out till date and for the remaining private land it shall reportedly be executed by December 2023; whereas the government land parcels have not been finalized and approved by government authorities till date; nearly 310 acres of government land (under Phase 1) and 348 acres (under Phase 2) have reportedly been applied for approvals by EEPL.
- **Farming and irrigation:** Majority portion of the project site land is barren, and it was reported that due to poor soil quality & lack of irrigation facilities the land is unfit for extensive cultivation. The soil type seems to be gravel in nature. It was reported that preference would be given for barren land to the extent possible.

- **Access road:** Within the project site there are presence of Revenue village roads, however as reported by Client and review of project layout, those existing roads will not be restricted or altered for the purpose of the project development. Also, the Client proposed to strengthen the connecting village roads for easy movement of materials. Based on the field observations and review of satellite imagery, within the project site boundary there are few footpaths / cart tracks were observed which were to be used by locals and neighbouring landowners. During consultation with landowners and local grazers there will not be any impact on impeded access due to the proposed project development. Existing village road connecting NH47 and Dhandhalpur Village is to be used for the proposed project and there will not be any additional land procurement for the purpose of access / road development.
- **Grazing within and around the project site:** Grazing activities were observed within the vicinity of the project villages, and it was reported that the population in the project site villages are involved in cattle rearing as additional source of income. The milk produced are sold locally and to the local traders. Goats/sheep are sold to the nearby market / to the local traders. Based on the consultation with grazers and revenue officials, it was revealed that the project site land is not a designated grazing land and the proposed project will not affect / create hindrance to their grazing activity.
- Tools of Land Sourcing for the proposed solar power plant site:
    - **Private Land:** It is to be noted that no appropriation of land and using the tools of acquisition will not be involved in leasing the solar site land, as the land is proposed to be sourced by executing long term lease deed based on willing lessor and willing lessee.
    - **Government Land:** Based on the site visit observations, few government land parcels are under cultivation by few informal land users. As mentioned in the earlier sub-sections, the identified government land is proposed to be sourced on government allotment, which may result in use of government procedures. The land users dependent on the land will be losing their livelihood. Since the project being in initial stage, the details on the land users, dependents etc. were not available for review.
- **Project Induced Vulnerability:** Based on the preliminary information available, the proposed project site land is mostly barren and does not support extensive cultivation. The proposed private land is being sourced through long term lease. The rental compensation determined is three to four times the value of the average crop yield in the area (Bajra @ ₹8000/acre, Sesame @ ₹8400/acre, Moong dal @ ₹6000/acre) and three times the average lease rental rate. Loss of livelihood / induced vulnerability due to the sourcing of the government land is yet to be determined due to paucity of information on the people dependent on government lands.

2.5.1.2 Key Issues Aspects of Land Procurement

As indicated earlier, land required for the proposed project development is being sourced from private landowners on a willing lessor and willing lessee basis and government land on allotment basis. The position of the project/ land procurement vis-à-vis key socio-economic issues are as follows:

- **Schedule V Area and Tribal Land:** The Project Area does not fall under Schedule-V areas as defined in the Indian Constitution under Article 342. 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 there are no Scheduled Tribe population residing within the study area villages and no land belonging to tribes were involved in the project.
- **Forest land:** No forest land is being involved for the project and its associated facilities.
- **Common Property Resources (CPR):** No CPRs were reported on the project land parcels and no existing community access to CPRs are being blocked or restricted for the local community.
- **No Objection Certificate (NOC) from Panchayat:** Gram Panchayat NOC from all three project villages were obtained.
- **Landlessness:** The project is sourcing land through executing the long-term lease and the compensation is determined at three to four times the average value of crop yield and three time the average lease rate.
- **Encumbrance on Land/ Economic Impact:** Few of the government land parcels were observed to be used by informal land users for cultivation. During the site visit and based on the review of satellite

imagery, few government land parcels were observed to be under use for cultivation. Due to sourcing of this government land, the people dependent on those land may lose livelihood. However, encumbrance / economic impacts were not envisaged on the private land parcels, as they were entitled for the higher rate of compensation than the market rate.

- **Cultural Heritage sites:** Within the project site there are no cultural or religious important place.

2.5.2 Land Procurement Process

Land required for the proposed project development is being sourced through private landowners on a Willing Lessor and Willing Lessee basis and does not envisage any physical or economic displacement with respect to the private land. The project site is located adjacent to the GSS and hence the installation of TL towers is not envisaged under the project. The said land does not include any Notified tribal /land belonging to tribal or forest land. The procedure used for procurement of the said land has been highlighted in figure below.

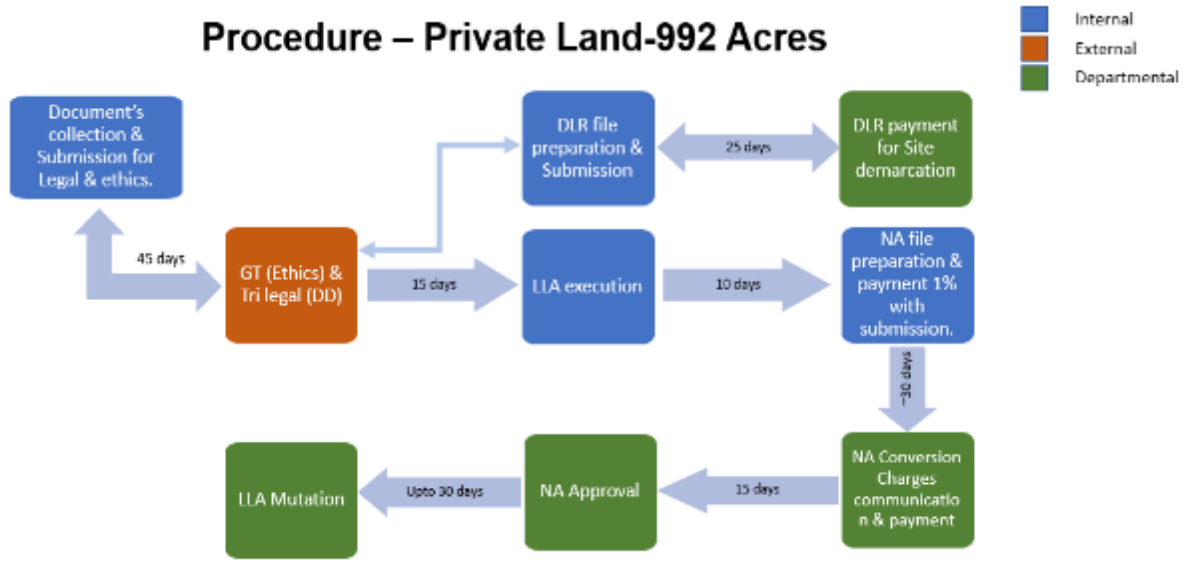


Figure 2-4: Private Land Leasing Process and Timeline

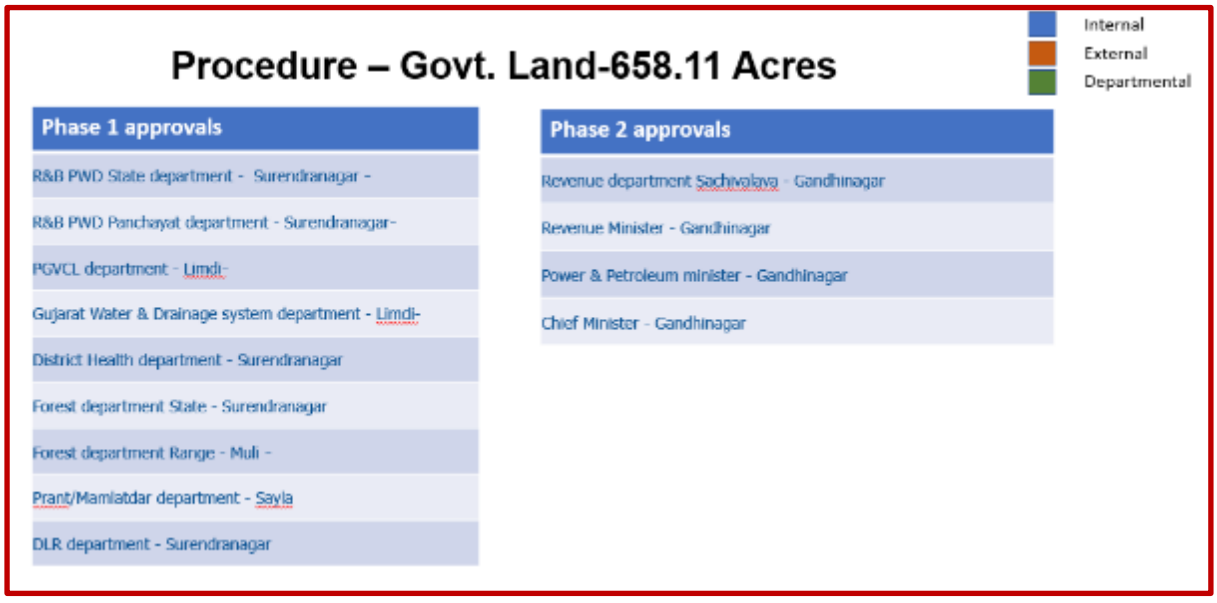


Figure 2-5: Govt. Land Approval Process

2.5.2.1 Role of Land Aggregator

Client had appointed M/s. Systems Renewable Energy as a land aggregator for the proposed project to support in land leasing process and liasoning with various government departments. Some of the key roles of the Land Aggregator in land leasing process for the proposed project are highlighted below.

- Identify and aggregate the project land suitable for the Project
- Conduct the survey of the project land through a government surveyor and submit soft copy of finalised boundary co-ordinates for engineering purposes (including sub-survey no wise marking)
- Obtain and provide documents related to the title, survey, revenue, marketability in connection with the Project Land and right of way (ROW) land.
- Obtain the ROW for the properties leading to the substations if applicable
- Co-ordinate the execution and registration of the conveyance/ lease deed in connection with the Project Land and ROW.
- Obtain No Objection Certificate (NOC) from the respective village panchayats / gram panchayats for the Land Aggregation.
- Liaison with the Government Authorities for obtaining such approvals/ permissions required for setting up of the Project on the Project Land and also for transfer of ownership of the Project Land on to the name of the SPVs.
- Support the Client in obtaining Non-Agriculture certificate from the district administration
- Execute Agreement to Lease on behalf of Client and supporting Client in executing lease deeds.
- Construct the approach road in connection the Project Land after obtaining all the necessary Approvals and ensuring all ROW issues / definitive pathway rights in favour of SPVs, if applicable

2.5.3 Workforce requirement

As on date of site visit, leasing of land for the project was in process and no project-related construction activities had started. 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 2000 workers will be employed for a duration of 6 months of which about 500 unskilled workers will be sourced from local workforce and around 1500 workers would be migrant. The technical staffs to be employed during the construction and operation phase would be around 90 which includes both Client and EPC staffs. 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 Surendranagar district, the manpower requirement in the skilled and highly skilled categories will be sourced by contractors. It was revealed by the site representative of Client that migrant workers will be provided accommodation in the labour camp which will be constructed near the project site during the construction phase. The location of the same was not finalised. As reported no migrant women workers or family members are to be involved for the project and labour camp would be provided for only men. However, facilities including separate toilets, restrooms, would be provided for local women workers being employed.

The workforce requirement during the operations phase was reportedly around ~200 people who will be engaged through contractors mostly for module cleaning, tilting, housekeeping, security, gardening etc.

2.5.4 Water Requirement

Construction Phase

As per the information shared by the Client, EPC contractor who is working on the site (both for the construction activities and providing to their labours) will be responsible for all kind of water requirements. Canal water, with all required permissions, will be used for construction activities and no borewell water will be used even though there are 9 borewells reported inside the project footprint to which the site team will do the complete closure of all

the borewells. The exact quantity of water requirement for domestic purpose will depend on the number of staffs/contract labours who will be deployed but approximately 5-6Ltrs per person will suffice the requirement whereas for construction activities 4000ltrs of water will be required.

Potable water cans of 20 litres capacity will be used for drinking water at the worker's accommodation facility and will be procured on a daily basis from the local vendors. Similarly for bathing and other usage water tankers will be used.

Operation Phase

During consultations in the nearby area, it was observed that villages are very much dependent on the rainwater and almost every village have pond which can be used for 4 months (including 3 months of monsoon period) and for drinking water requirements Narmada water is fed in the overhead tanks.

Major portion of water consumption in an operational Solar PV Project is during the module cleaning. Usually, 2 to 2.5 litres per Module per wash water is required for cleaning. An alternative option to completely avoid such huge usage of water is to employ the Robotic Cleaning for Module Cleaning. Robotic cleaning is proposed as the appropriate technology for cleaning the Modules for this Project which will have an additional advantage of low operational cost of the PV Plant. For this Project, semi-robotic cleaning will be adopted which means that some of the panels will be cleaned through robotic cleaning and some will be cleaned using soft water.

As reported by the Project team, 590,000 litres of water will be required annually during the operations phase which includes the module cleaning and drinking water requirement. Module cleaning will be done twice or thrice a year for which the O&M team will have an agreement with the vendor for supplying the water. AECOM team was informed that mostly vendors in the nearby area supply water in tankers of various capacity having their source from the canal water. It was also informed that no groundwater will be used for this purpose. Drinking water for the employees will be procured via 20 litre Bisleri canned bottles.

2.6 Waste Generation

2.6.1 Wastewater

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

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

2.6.2 Solid Waste

Municipal 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.

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.

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 and will be responsibility of the EPC contractor to manage, store and dispose the hazardous waste.

During operation phase, oily cotton rags, oil waste and battery waste will be generated which will be given to the recycling agency. The waste oil will be disposed through SPCB approved hazardous waste recycler.

E waste

Solar panels/cells, solar Photovoltaic panels/cells/modules comes under e wastes. No of units of electrical and electronic equipment's (which include solar panels) is yet to be known as the designs are under development phase. As per the E-waste management rules[3] 2022, Bulk consumer[4] of electrical and electronic equipment listed in Schedule I shall ensure that e-waste generated by them shall be handed over only to the registered producer, refurbisher or recycler.

2.7 Implementation Schedule

Client will engage two EPC contractors at the time of construction, one for the AC/DC and other for the switch yard. As on the day of site visit, land procurement process was undergoing, and the land team was in process of negotiation with the landowners Project construction was to start from Mid of June 2023 which will carry on till July 2024. The construction works will comprise of carrying out geotechnical investigations (which is already been done through a third-party soil testing laboratory and samples form 15 different locations were collected and tested), foundation works, installation of switch yard, array yard installation, SCADA system, inverters modules and equipment installation. Currently land procurement is going on and EPC contractors are yet to be finalized. Post the construction phase, EPCs will be responsible for the O&M phase for few years (period of which will mentioned in the agreement and the document is under the drafting stage).

2.7.1 Construction Activities

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

- Soil investigations;
- Site clearing;
- Site levelling;
- Construction/strengthening of access roads;
- Fencing of site;
- Module laying; 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 Client outside the boundary wall of the site. Client 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.

[3] e-waste_rules_2022.pdf (cpcb.nic.in)
[4] As per the E-waste management rules 2022, 'bulk consumer' means any entity which has used at least one thousand units of electrical and electronic equipment listed in Schedule I, at any point of time in the particular Financial Year and includes e-retailer

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 kinds of faults will be immediately corrected.

3. Environmental and Social Regulatory Framework

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

- 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 SPCB in case any violation is undertaken in complying with the conditions of Hazardous Waste Authorization.
3.	Gujarat Pollution Control Board (GPCB)	Gujarat Pollution Control Board was constituted by Government of Gujarat on 15th October 1974 in accordance with the provisions of the Water Act, 1974. The GPCB, Head Office, Gandhinagar has been registered by the BIS- Bureau of Indian Standards, Delhi under the Quality Management Systems in accordance with IS: ISO: 9001:2015 and IS: ISO: 14001:2015 for Environmental Management System. Recently Board has also been accredited with IS: 18001:2007 certificate for occupational health and safety.
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*.

S. N.	Name of the Agency	Description
		The site will store a small quantity of fuel during construction phase. However, in case fuel storage exceeds the 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, Gujarat is required to be obtained for the project. Project proponent/ Construction contractor shall comply with all requirements of *Gujarat Factories Rules 1950* 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. As per F. No. 320/14/2017-NSM office memorandum, MoEFCC has clarified that the provisions of the EIA notification 2006 is not applicable to solar PV power projects, solar thermal power projects and development of solar parks subject to such projects following the statutory stipulations made in its office memorandum.
7.	Gujarat Energy Development Agency (GEDA)	GEDA (Gujarat Energy Development Agency), one of the premier organizations and a forerunner in India has been working in the field of renewable energy development and energy conservation. GEDA is shouldering the responsibility of a state nodal agency (SNA) for the Ministry of New and Renewable Energy Sources (MNRE) and the state designated agency (SDA) for Bureau of Energy Efficiency (BEE) The renewable energy promotion and popularization programmes in the state have crossed the over 3 decades of untiring efforts and pioneered several sustainable initiatives; many of which are the country's first. GEDA has virtually been the crucible, the melting pot of ideas to 'check out' renewable sources of energy as alternatives to conventional fuels. The convenient green-n-clean actions in these direction and milestones achieved have set the pace for Renewable Energy Development in India
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 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 freshwater 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 freshwater aquifers, NOC will only be

S. N.	Name of the Agency	Description
		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 3-2 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	Applicable Agency	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.	GPCB	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. Client and the EPC contractors are required to ensure that Project implementation adheres to the various clauses laid down in the Act
2.	Environmental clearance	Construction activities generating air, water and noise emissions	EIA notification 2006	MoEF&CC	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' are 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[5]
3.	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	GPCB	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. As per the GPCB categorization of industries, solar power plants of all capacities are kept under white categories where industries in this category are not included in the consent mechanism.[6]
4.	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.	GPCB	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 GPCB. Ambient air quality and emission norms will have to maintained as per regulations.

[5] *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.*

[6] White_Category_Industries_CPCB_Direction_30042020.pdf (gujarat.gov.in)

S. No.	Aspect	Relevance	Applicable Legislation	Applicable Agency	Applicable Permits and Requirements
5.	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.	GPCB	**Not Applicable** Plant will not have any batching plant during construction phase. Ready Mix concrete will be procured and used.
6.	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, Department of Factories, Boilers, Industrial Safety and Health Government of Gujarat	**Applicable** As per the section 2 and Section 6 of The Factories Act, 1948, Client would have to obtain registration of the power plant from the State Government or Chief Inspectorate of Factories, Gujarat if 10 or more workers are engaged, triggering the applicability of the Factories Act.
7.	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.	GPCB	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.
8.	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	GPCB	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: [7] An occupier shall not be required to 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.

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

S. No.	Aspect	Relevance	Applicable Legislation	Applicable Agency	Applicable Permits and Requirements
					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 Client: • 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.
9.	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 Client shall submit waste management plan and get appropriate approvals from the local authority before starting construction or demolition work. Client should also ensure responsible collection, store and disposal of the C&D waste.
10.	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, Client shall obtain license under the act. Under rules 12 and 7, Client and the Contractors to ensure preventive measures for health and safety of humans and plant.
11.	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, Client will be required to obtain a license from PESO, if the quantity of the fuel stored exceeds thresholds given in regulation. No licence is required for storage and transport of any such product (i.e. petroleum class B) if the total quantity in your possession does not exceed 2500 litres in non-bulk (i.e. drums) or 1000litres in a receptacle / tank (i.e. bulk)[8].
12.	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	State Transport Authority	Client to ensure compliance of the Section 39, Motor Vehicle Act, 1988 as amended in 2017 and Rule 47, Motor Vehicle Rule, 1989.

[8] FAQs under various heads | Petroleum & Explosive Safety Organisation (peso.gov.in)

S. No.	Aspect	Relevance	Applicable Legislation	Applicable Agency	Applicable Permits and Requirements
			(Fourth Amendment) Rules 2004.		
Biodiversity related laws					
13.	Forest Protection	Presence of notified Forest Lands in proximity to the project site	The Indian Forest Act, 1927	Gujarat State Forest Department	Permission of the Forest Department is required if project-related infrastructure, activities, or personnel occur on land notified as Forest Land. As informed by the Client, the project does not involve any notified Forest Land. Hence, any permission from the Forest Department is not applicable to the project. However, damage to, or harvest of, forest produce by Project-personnel would constitute a punishable offence.
14.	Wildlife Conservation	The Project Site overlaps the reported ranges of legally protected faunal species. Capture/killing of the said species, as also, destruction of their eggs/nests/habitats is prohibited.	The Wildlife (Protection) Act, 1972	National Board for Wildlife (NBWL)	Wildlife Clearance is required only if project-related infrastructure, activities, or personnel occur on land notified as a wildlife habitat, including wildlife corridors. As informed by the Client, no project components are planned in any notified wildlife habitat. Hence, Wildlife Clearance is not applicable to the project. However, capture/killing of legally protected faunal species, as also destruction of their eggs/nests/habitats by Project-personnel would constitute a punishable offence.
15.	Forest Conservation	Presence of notified Forest Lands in proximity to the project site	The Forest (Conservation) Act, 1980	Gujarat State Forest Department	Forest Clearance is required if land notified as Forest Land is proposed to be diverted for any project-related non-forest use. As informed by the Client, the project does not involve any notified forest land. Hence, Forest Clearance is not applicable to the project.
Social and labour-related Laws, Regulations and Acts					
16.	Labour	Engagement of workers for construction and operation of the plant	The Factories Act, 1948 and The Gujarat Factories Rules, 1950	Labour Department, Government of Gujarat	Client / EPC Contractor shall comply with all requirements of Factories Rules and participate in periodic inspection.
17.	Contract Workers	Engagement of contract workers	The Contract Labour (Regulation and Abolition) Act, 1970 as amended in 2017	Labour Department, Government of Gujarat	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.
18.	Child Labour	Engagement of Child Labour at site	The Child Labour (Prohibition and Regulation) Act, 1986	Labour Department, Government of Gujarat	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.
19.	Bonded Labour	Engagement of Bonded Labour at site	Bonded Labour (Abolition) Act 1976	Labour Department, Government of Gujarat	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."

S. No.	Aspect	Relevance	Applicable Legislation	Applicable Agency	Applicable Permits and Requirements
20.	Payment of Wages	Provision of wages to labour engaged at the site	Minimum Wages Act, 1948	Labour Department, Government of Gujarat	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. Every employer shall be responsible for the payment to persons employed by him of all wages required to be paid under this Act.
21.	Payment of Wages.	Equal wages to male and female workers at site	Equal Remuneration Act 1976	Labour Department, Government of Gujarat	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.
22.	Payment of Wages	Engagement of Labour at site	Workmen's Compensation Act, 1923	Labour Department, Government of Gujarat	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.
23.	Women at Workplace	Engagement of Female Labour at site	Maternity Benefit Act, 1961	Labour Department, Government of Gujarat	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;

S. No.	Aspect	Relevance	Applicable Legislation	Applicable Agency	Applicable Permits and Requirements
					The maximum period for which any woman shall be entitled to maternity benefit shall be twenty-six weeks of which not more 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."
24.	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.	Labour Department, Government of Gujarat	Section 7 of the Act mandates the registration of establishments. Client 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.
25.	Contract Labour	Principal Employer registration for engaging contract labour through third party is required.	The Contract Labour (Regulation and Abolition) Act, 1970	Labour Department, Government of Gujarat	Section 7 of the Act mandates the Principal Employer registration for engaging contract labour through third party.
26.	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	Labour Department, Government of Gujarat	Section 4 of the Act mandates that the Principal Employer registration should be obtained for engaging migrant labour through third party.
27.	Working Conditions	Working conditions of contracted Labour working at the site	Contract Labour (Regulations and Abolition) Act, 1970	Labour Department, Government of Gujarat	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 Gujarat, focusing on the solar power, as released by the Government of India and Government of Gujarat from time to time and applicable to the project are discussed briefly in Table 3-3.

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 Mission targets installing 100 GW grid-connected solar power plants by the year 2022. This is line with India's Intended Nationally Determined Contributions (INDCs) target to achieve about 40 percent cumulative electric power installed capacity from non-fossil fuel-based energy resources and to reduce the emission intensity of its GDP by 33 to 35 percent from 2005 level by 2030. 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.	Gujarat Solar Energy Policy 2021	The Government of Gujarat ("State") recognizes the growing impacts of climate change at local and national levels and has taken various policy initiatives to mitigate the impact. The State is having a significant potential of solar energy resource due to its topography and has witnessed the deployment of both large scale and distributed solar PV systems indigenously. Since the inception of the Solar Policy in 2009 and the subsequent revision in 2015 and 2019, the State has installed over 3,200 MW of solar PV technology across all segments until 2020. The State intends to meet its sustainable development goals by advancing the development of solar energy in a manner that would position it as a mainstream source of energy supply as well as a primary contributor to the national target of 100 GW Solar Capacity by 2022 as part of India's Global Commitment.[9]

[9] Gujarat-Solar-Power-Policy-2021.pdf (guvnl.in)

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;
- 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 office waste,

S. No.	Performance Standard	Description and Applicability
		road dust, wastewater, hazardous waste like used oil from DG sets (if any in use) 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.
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	**CONDITIONAL APPLICABILITY** PS 5 recognizes that project-related land acquisition and restrictions on land use can have adverse impacts on communities and persons that use this land. Its main aim is to anticipate and avoid, or where avoidance is not possible, minimize adverse social and economic impacts from land acquisition or restrictions on land use by providing compensation for loss of assets at replacement cost and ensuring that resettlement activities are implemented with appropriate disclosure of Information, consultation, and the informed participation of those affected. The proposed project involves in sourcing of both Private and Government Land. It was reported that private land is to be sourced through executing long term lease agreement on willing lessor and willing lessee basis and government land on basis of allotment from the district administration. Based on the discussion with Client team and site visit observations, few government land parcels were under cultivation by illegal encroachers. Though there are no physical structures, agriculture equipment's or developments were observed within those land, use of government procedures and loss of livelihood for the encroachers is envisaged in taking procession of the Government land. Hence PS is applicable for the proposed project if such land is taken for project.
6.	PS6 – Biodiversity Conservation and Sustainable Management of Living Natural Resources	**APPLICABLE** The requirements of this Performance Standard apply to projects (i) that are situated in modified, natural, and critical habitats; (ii) that potentially impact on or are dependent on ecosystem services over which the client has direct management control or significant influence; or (iii) that include the production of living natural resources e.g., agriculture, animal husbandry, fisheries, and forestry. PS-6 considers relevant threats to biodiversity and ecosystem services, owing to project-related direct and indirect impacts, with a focus on habitat loss, degradation and fragmentation, introduction or spread of invasive alien species and loss or degradation of priority ecosystem services, while recognizing the differing values attached to biodiversity and ecosystem services by Affected Communities and any other stakeholders, especially Indigenous Peoples.PS6 recognizes that protecting and conserving biodiversity, maintaining ecosystem services, and sustainably managing living natural resources are fundamental to sustainable development. The Project Site, as well as the estimated area of influence of the project, contain natural and modified habitats. The Project infrastructure & activities can potentially impact biodiversity & ecosystem services. 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

S. No.	Performance Standard	Description and Applicability
		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 Indigenous Population in the study area villages • Only 4 Scheduled Tribe population was present in Shapar Village. • No tribal land has been procured for the project; • No livelihood dependence on the land has been reported of tribal or non-tribal; and • No notified Schedule-V land is located within the project district. The proposed Transmission line route does not traverse on any notified tribal land and no land belonging to scheduled tribe is falling within RoW.
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.

3.5 ADB Policies

3.5.1 ADB Safeguard Policy Statement, 2009

In July 2009, ADB's Board of Directors approved the new Safeguard Policy Statement (SPS) governing the environmental and social safeguards of ADB's operations. The SPS builds upon ADB's previous safeguard policies on the Environment, Involuntary Resettlement, and Indigenous Peoples, and brings them into one consolidated policy framework with enhanced consistency and coherence, and more comprehensively addresses environmental and social impacts and risks. The SPS also provides a platform for participation by affected people and other stakeholders in the project design and implementation.

The SPS applies to all ADB-financed and/or ADB-administered projects and their components, regardless of the source of financing, including investment projects funded by a loan; and/or a grant; and/or other means, such as equity and/or guarantees. ADB works with borrowers and clients to put into practice the requirements of SPS.

The SPS supersedes ADB's Involuntary Resettlement Policy (1995), Policy on Indigenous Peoples (1998), and Environment Policy (2002). In accordance with the SPS, these previous policies apply to all projects and tranches of multi-tranche financing facility projects that were reviewed by ADB's management before 20 January 2010.The objectives of ADB's safeguards are to:

- Avoid adverse impacts of projects on the environment and affected people, where possible;
- Minimize, mitigate, and/or compensate for adverse project impacts on the environment and affected people when avoidance is not possible; and
- Assist borrowers and clients to strengthen their safeguard systems and develop the capacity to manage environmental and social risks.

ADB's SPS sets out the policy objectives, scope and triggers, and principles for three key safeguard areas:

- Environmental safeguards;
- Involuntary Resettlement safeguards; and
- Indigenous Peoples safeguards.

To help borrowers and clients and their projects achieve the desired outcomes, ADB adopts a set of specific safeguard requirements that borrowers and clients are required to meet in addressing environmental and social impacts and risks. These safeguard requirements are as follows:

- Safeguard Requirements 1: Environment (Appendix 1 of SPS);
- Safeguard Requirements 2: Involuntary Resettlement (Appendix 2 of SPS);
- Safeguard Requirements 3: Indigenous Peoples (Appendix 3 of SPS); and
- Safeguard Requirements 4: Special Requirements for Different Finance Modalities (Appendix 4 of SPS).

In addition, ADB does not finance activities on the prohibited investment activities list (Appendix 5 of SPS). Furthermore, ADB does not finance projects that do not comply with its safeguard policy statement, nor does it finance projects that do not comply with the host country's social and environmental laws and regulations, including those laws implementing host country obligations under international law.

3.5.2 ADB Prohibited Investment Activities List

The following do not qualify for Asian Development Bank financing:

- Production or activities involving harmful or exploitative forms of forced labor, child labor;
- Production of or trade in any product or activity deemed illegal under host country laws or regulations or international conventions and agreements or subject to international phaseouts or bans, such as (a) pharmaceuticals, pesticides, and herbicides, (b) ozone-depleting substances, (c) polychlorinated biphenyls and other hazardous chemicals, (d) wildlife or wildlife products regulated under the Convention on International Trade in Endangered Species of Wild Fauna and Flora, and (e) transboundary trade in waste or waste products;
- Production of or trade in weapons and munitions, including paramilitary materials;
- Production of or trade in alcoholic beverages, excluding beer and wine;
- Production of or trade in tobacco;
- Gambling, casinos, and equivalent enterprises;
- Production of or trade in radioactive materials, including nuclear reactors and components thereof;
- Production of, trade in, or use of unbonded asbestos fibers;
- Commercial logging operations or the purchase of logging equipment for use in primary tropical moist forests or old-growth forests; and
- Marine and coastal fishing practices, such as large-scale pelagic drift net fishing and fine mesh net fishing, harmful to vulnerable and protected species in large numbers and damaging to marine biodiversity and habitats.

- The proposed project does not involve the above-mentioned activities in the purview of the project development.

3.5.3 ADB Access to Information Policy, 2019

ADB's Access to Information Policy (AIP), which went into effect on 1 January 2019, reflects ADB's ongoing commitment to transparency, accountability, and participation by stakeholders.

The policy, led by a new overarching principle of clear, timely, and appropriate disclosure, contains principles and exceptions to information sharing with external stakeholders.

3.5.4 ADB Social Protection Strategy, 2001

ADB has designed a set of policies and programs for social protection in 2001, that is, to reduce poverty and vulnerability by promoting efficient labour markets, diminishing people's exposure to risks, and enhancing their capacity to protect themselves against hazards and interruption/loss of income. The basic aim of the Social Protection Strategy (SPS) is to assist individuals to break the cycle of poverty and enhance the quality of growth through adequate and developed social protection systems in the member countries of ADB. The type of risks covered through the SPS may be economic, environment or social/governance related.

The proposed project shall ensure that the requirements of the ADB's SPS are complied with. Priority shall be given to any identified vulnerable groups. Based on the gender analysis and status of women in the Project Area, measures for ensuring their overall development shall be taken up by the project proponent. Client shall comply with applicable labor laws in relation to the Project and shall also take the following measures to comply with the core labor standards[10]

- carry out its activities consistent with the intent of ensuring legally permissible equal opportunity, fair treatment and non-discrimination in relation to recruitment and hiring, compensation, working conditions and terms of employment for its workers (including prohibiting any form of discrimination against women during hiring and providing equal work for equal pay to men and women engaged by Client and its sub-contractors.
- no restriction to workers from developing a legally permissible means of expressing their grievances and protecting their rights regarding working conditions and terms of employment;
- engage contractors and other providers of goods and services:
    a. who do not employ child labor[11] or forced labor[12]
    b. who have appropriate management systems that will allow them to operate in a manner which is consistent with the intent of (a) ensuring legally permissible equal opportunity and fair treatment and non-discrimination for their workers, and (b) not restricting their workers from developing a legally permissible means of expressing their grievances and protecting their rights regarding working conditions and terms of employment; and
    c. whose subcontracts contain provisions which are consistent with paragraphs above.

3.5.5 Gender and Development Strategy, 1998

The proposed Project will address and comply with the ADB's Policy on Gender and Development 1998. ADB's Policy on Gender and Development will adopt mainstreaming as a key strategy in promoting gender equity in all aspects of ADB operations. The emerging areas of concern for women are discussed; and the recommendations to development finance institutions contained in the Platform for Action were endorsed by the United Nations (UN). The key elements of ADB's policy will include the following.

- Gender sensitivity: to observe how ADB operations affect women and men, and to take into account women's needs and perspectives in planning its operations.
- Gender analysis: to assess systematically the impact of a project on men and women, and on the economic and social relationship between them.
- Gender planning: to formulate specific strategies that aim to bring about equal opportunities for men and women.
- Mainstreaming: to consider gender issues in all aspects of ADB operations, accompanied by efforts to encourage women's participation in the decision-making process in development activities.
- Agenda setting: to assist DMC governments in formulating strategies to reduce gender disparities and in developing plans and targets for women's and girls' education, health, legal rights, employment, and income-earning opportunities.

[10] The core labor standards are the elimination of all forms of forced or compulsory labor; the abolition of child labor; elimination of discrimination in respect of employment and occupation; and freedom of association and the effective recognition of the right to collective bargaining, as per the relevant conventions of the International Labor Organization.
[11] Child labor means the employment of children whose age is below the statutory minimum age of employment in the relevant country, or employment of children in contravention of International Labor Organization Convention No. 138 'Minimum Age Convention" (www.ilo.org)
[12] Forced labor means all work or services not voluntarily performed, that is, extracted from individuals under threat of force or penalty

In this Project, the GAD policy will be taken into consideration during all stages of project activities to promote gender equity in providing compensation to the affected people, providing employment opportunities, in getting benefit out of the mitigation measures and community development programs implemented by Client

An overview of ADB's Safeguard Policy Statement (SPS) and their applicability to the project is provided in the table below.

Table 3-5: Broad Overview ADB SPS and Their Applicability to the Project

S. No.	ADB's Policy/SPS	Overview	Applicability to the Project
1.	SPS 1: Environment	The Environmental safeguards are triggered if a project is likely to have potential environmental risks and impacts. The projects are initially screened to determine the level of assessment that is required. ADB categorises the projects into three project categories based on the severity, sensitivity and the magnitude of its potential environmental impacts: Category A (if the project likely to have significant adverse environmental impacts that are irreversible, diverse, or unprecedented. An environmental impact assessment (EIA), including an environmental management plan (EMP), is required); Category B (if the project likely to have potential impacts are less adverse than category A and minor impacts expected can be mitigated. An initial environmental examination (IEE), including an EMP, is required); and Category C (if the projects likely to have minimal or no adverse environmental impacts. An EIA or IEE is not required).	**Applicable** This SPS is applicable to environmental aspects like but not limited to air emissions, water and wastewater management, noise emissions, chemical management, hazardous material management.
2.	SPS 2: Involuntary Resettlement (IR)	The policy is designed to avoid the risk of impoverishment among those displaced as a direct result of ADB investment. The policy recognizes that restoring the incomes and living standards of the affected people is complex, and requires a development strategy that encompasses compensation, resettlement and rehabilitation packages to improve, or at least restore, their social and economic base. The ADB's Policy on Involuntary Resettlement stipulates three important elements in involuntary resettlement: (i) compensation for lost assets and loss of livelihood and income, (ii) assistance in relocation including provision of relocation sites with appropriate facilities and services, and (iii) assistance with rehabilitation to achieve at least the same level of well-being with the project as before.	Conditionally Applicable The proposed project involves in sourcing of both Private and Government Land. It was reported that private land is to be sourced through executing long term lease agreement on willing lessor and willing lessee basis and government land on basis of allotment from the district administration. Based on the discussion with Client team and site visit observations, few government land parcels were under cultivation by illegal encroachers. Though there are no physical structures, agriculture equipment's or developments were observed within those land, use of government procedures and loss of livelihood for the encroachers is envisaged in taking procession of the Government land. Hence PS is applicable for

			the proposed project if such land is taken for project.
3.	SPS 3: Indigenous People	The Policy on Indigenous Peoples is triggered if a project directly or indirectly affects the dignity, human rights, livelihood systems, or culture of indigenous peoples or affects the territories or natural or cultural resources that indigenous peoples own, use, occupy, or claim as an ancestral domain or asset. The policy on states that the borrower/ client will ensure (i) that affected indigenous peoples receive culturally appropriate social and economic benefits; and (ii) that when potential adverse impacts on indigenous peoples are identified, these will be avoided to the maximum extent possible. Where this avoidance is not feasible, based on meaningful consultation with indigenous communities, the Indigenous Peoples Plan (IPP) will be prepared which outlines measures to minimize, mitigate, and compensate for the adverse impacts.	Not applicable The region where the project is located does not fall under the Schedule V area and does not have any significant presence of tribal communities. The same was confirmed through community consultations. Based on the above inferences, it can be presumed that no indigenous people were been affected due to project activities.
4.	Policy on Gender and Development	ADB's Policy on Gender and Development (1998) is the guiding framework for gender and development activities. The policy adopts gender mainstreaming as the key strategy for promoting gender equality and women's empowerment across the ADB funded projects. The Policy on Gender and Development (GAD) is guiding document to ensure that their needs and concerns are addressed and that gender issues in resettlement are mitigated. The policy adopts gender mainstreaming as a key strategy for promoting gender equity, and for ensuring that women participate and that their needs are explicitly addressed in the decision-making process.	Applicable This policy is applicable to social aspects such as recruitment and selection, terms of employment, equal opportunity and non-discrimination, parity in salary/ wages etc.

3.5.6 Applicable International Conventions

Environmental problems which migrate beyond the jurisdiction (Trans-boundary) require power to control such issues through international co-operation by either becoming a Contracting Party (CP) i.e., ratifying treaties or as a Signatory by officially signing the treaties and agreeing to carry out provisions of various treaties on environment and social safeguards. The relevant international conventions are as provided in Table 3-6.

Table 3-6: 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

S. N.	International Conventions	Salient Features
		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 fishponds, rice paddies, reservoirs and salt pans. Contracting Parties commit to work towards the wise 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

S. N.	International Conventions	Salient Features
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.

3.6 Categorisation of Project

The section below gives detail pertaining to categorization of the project.

3.6.1 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 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[13].

3.6.2 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

[13] 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.

- Applying the criteria stipulated by the IFC Policy on Environmental and Social Sustainability for environmental and social categorization of projects, Client's proposed 400 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[14].

Additional rationale for the above categorization is as below[15]:

- **Potentially limited risks/impacts and reversible**: Environmental and social impacts of the Project are anticipated during the operation, construction and decommissioning phase and will encompass changes in land-use, increased noise levels, changes in air quality, use and changes in water availability and quality, occupational health & safety, etc. Most of these impacts are limited to the Project site during construction phase and their immediate vicinity which and can be minimized through application of mitigation measures as proposed in the ESMP;
- **Unprecedented**: Development of solar parks and other renewable energies, is occurring in large numbers in the last decade and therefore several such projects are located across India. The proposed Project and its surrounding areas consist of a number of upcoming and solar and other renewable projects. Hence, the proposed 400 MW solar project can therefore not be considered an unprecedented activity; and
- **Limited adverse impacts on the baseline**: Solar energy development Projects are less polluting source of energy and thus not likely to lead to any adverse impacts on the baseline environment during the operation phase. In terms of social impacts, the land required is composed of private land, agricultural land and gravel waste land. The site location of the project although covers two structures; however, the same can be carved out/ omitted from the site boundary and counter the negative impact of physical displacement on the project.

3.6.3 Classification as per ADB Safeguard Policy Statement (SPS) (2009)

3.6.4 ADB Safeguard Categories

3.6.4.1 Safeguard Requirement 1: - Environment

Proposed projects are screened according to type, location, scale, and sensitivity and the magnitude of their potential environmental impacts, including direct, indirect, induced, and cumulative impacts. Projects are classified into the following four categories:

- ***Category A.*** A proposed project is likely to have significant adverse environmental impacts that are irreversible, diverse, or unprecedented. These impacts may affect an area larger than the sites or facilities subject to physical works. An environmental and social impact assessment (ESIA), including an environmental management plan (EMP), is required.

[14] Considering that project will not use government land which has informal land users

[15] 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 categorisation.

- ***Category B.*** The proposed project's potential adverse environmental impacts are site-specific, few if any of them are irreversible, and in most cases mitigation measures can be designed more readily than for category A projects. An initial environmental examination (IEE), including an EMP, is required.
- ***Category C.*** A proposed project is likely to have minimal or no adverse environmental impacts. An EIA or IEE is not required, although environmental implications need to be reviewed.
- ***Category FI.*** A proposed project involves the investment of ADB funds to or through a financial intermediary. The financial intermediary must apply and maintain an environmental and social management system, unless all of the financial intermediary's business activities have minimal or no environmental impacts or risks.

3.6.4.2 Safeguard Requirement 2: -Involuntary Resettlement

The involuntary resettlement impacts of an ADB-supported project are considered significant if 200 or more persons will be physically displaced from home or lose 10% or more of their productive or income-generating assets. For those involving involuntary resettlement, a resettlement plan is prepared that is commensurate with the extent and degree of the impacts: the scope of physical and economic displacement and the vulnerability of the affected persons. Projects are classified into the following four categories:

- ***Category A.*** A proposed project is likely to have significant involuntary resettlement impacts. A resettlement plan, which includes assessment of social impacts, is required.
- ***Category B.*** A proposed project includes involuntary resettlement impacts that are not deemed significant. A resettlement plan, which includes assessment of social impacts, is required.
- ***Category C.*** A proposed project has no involuntary resettlement impacts. No further action is required.
- ***Category FI.*** A proposed project involves the investment of ADB funds to or through a financial intermediary. The financial intermediary must apply and maintain an environmental and social management system, unless all of the financial intermediary's business activities are unlikely to generate involuntary impacts.

3.6.4.3 Safeguard Requirement 3: -Indigenous Peoples

The impacts of an ADB-supported project on indigenous people is determined by assessing the magnitude of impact in terms of:

- customary rights of use and access to land and natural resources;
- socioeconomic status;
- cultural and communal integrity;
- health, education, livelihood, and social security status; and
- the recognition of indigenous knowledge; and
- the level of vulnerability of the affected Indigenous Peoples community. Projects are classified into the following four categories:
  - ***Category A.*** A proposed project is likely to have significant impacts on indigenous peoples. An Indigenous Peoples Plan (IPP), including assessment of social impacts, is required.
  - ***Category B.*** A proposed project is likely to have limited impacts on indigenous peoples. An IPP, including assessment of social impacts, is required.
  - ***Category C.*** A proposed project is not expected to have impacts on indigenous peoples. No further action is required.
  - ***Category FI.*** A proposed project involves the investment of ADB funds to or through a financial intermediary. The financial intermediary must apply and maintain an environmental and social management system, unless all of the financial intermediary's business activities unlikely to have impacts on indigenous peoples.

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 classification as below

Safeguard Requirements 1: Environment: The proposed project site is a solar power project which is a clean technology project using solar energy for generation of electricity and no harmful emissions are expected from

the project operations, though the monitoring at the site was not done due to land procurement activities. Based on the ADB Policy on categorization of projects, the current project can be categorized as '***Category B***' with respect to environmental impacts. This is based solely on the primary data available to date. Environmental monitoring data was yet to be obtained for the project due to ongoing land purchase.

Safeguard Requirements 2: Involuntary Resettlement: The proposed project involves in sourcing of both Private and Government Land. It was reported that private land is to be sourced through executing long term lease agreement on willing lessor and willing lessee basis and government land on basis of allotment from the district administration. Based on the discussion with Client team and site visit observations, few government land parcels were under cultivation by illegal encroachers. Though there are no physical structures, agriculture equipment's or developments were observed within those land, use of government procedures and loss of livelihood for the encroachers is envisaged in taking procession of the Government land. Hence, considering Involuntary resettlement impacts are deemed not significant the project is **Categorized as B** for SR2-IR[16].

Safeguard Requirements 3: Indigenous Peoples: The proposed solar site land including the TL route does not fall under Schedule-V areas as defined in the Indian Constitution under Article 342. The land being involved for solar plant and TL does not comprise of any tribal land/ land parcels owned by members belonging to the Indigenous Peoples (IP) or their dependency on the land for livelihood. Moreover, it is to be noted that there are no significant Scheduled Tribe population residing within the project villages. Hence the proposed project is not expected to have impacts on indigenous peoples and is **Categorized as C.**

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.

3.7 Applicable Environmental Standards

3.7.1 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 ***in*** Table 3-7**.**:

Table 3-7: National Ambient Air Quality Standards

Pollutant	Time Weighted Average	Concentration in Ambient Air	
		Industrial, Residential, Rural and other Areas	Ecologically Sensitive Area (notified by Central Government)
Sulphur Dioxide (SO_2), µg/m^3	Annual*	50	20
	24 Hours**	80	80
Nitrogen Dioxide (NO_2), µg/m^3	Annual*	40	30
	24 Hours**	80	80
Particulate Matter (size less than 10 µm) or PM_{10}, µg/m^3	Annual*	60	60
	24 Hours**	100	100
Particulate Matter (size less than 2.5 µm) or $PM_{2.5}$, µg/m^3	Annual*	40	40
	24 Hours**	60	60

[16] Considering that project will not use government land which has informal land users

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

3.7.2 Ambient Noise Standards

As per 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 3-8.

Table 3-8: Ambient Noise Standards

Area Code	Category of Area	Limits in dB(A) Leq	
		Day time	Nighttime
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, loudspeakers and bursting of crackers are banned in these zones.*

3.7.3 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 3-9: 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.

3.7.4 Water Quality Standards

The designated best use classification as prescribed by CPCB for surface water is as given in Table 3-10.

Table 3-10: Primary Water Quality Criteria for Designated Best Use Classes

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

Source: Central Pollution Control Board

3.7.5 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 Sonpari, Nana Kandhashar, Ratanpar, Mngalkui, Shapar, Dhedhuki, Dhankaniya villages. Primary data was collected in between of 1st June to 6th June 2023. Environmental baseline monitoring was undertaken for ambient air 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.

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 for 24 hrs at 5 different locations 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), oxygen (O_3), Ammonia, Carbon monoxide (CO), Lead, Benzene, Benzo Alpha Pyrene, Arsenic, Nickel were recorded for assessment.
3)	Water Quality[17]	2 Ground water samples from 2 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	2 Soil samples 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.
6)	Traffic monitoring analysis	Traffic data was monitored for 24 hrs. Monitoring was performed for the vehicles which were then using the village road and NH 47 and also the vehicles turning into the road used for project purpose.

Environmental monitoring locations have been represented in the below figure

[17] Surface water quality could not be tested due to unavailability of surface water anywhere inside the study during the time when monitoring was conducted

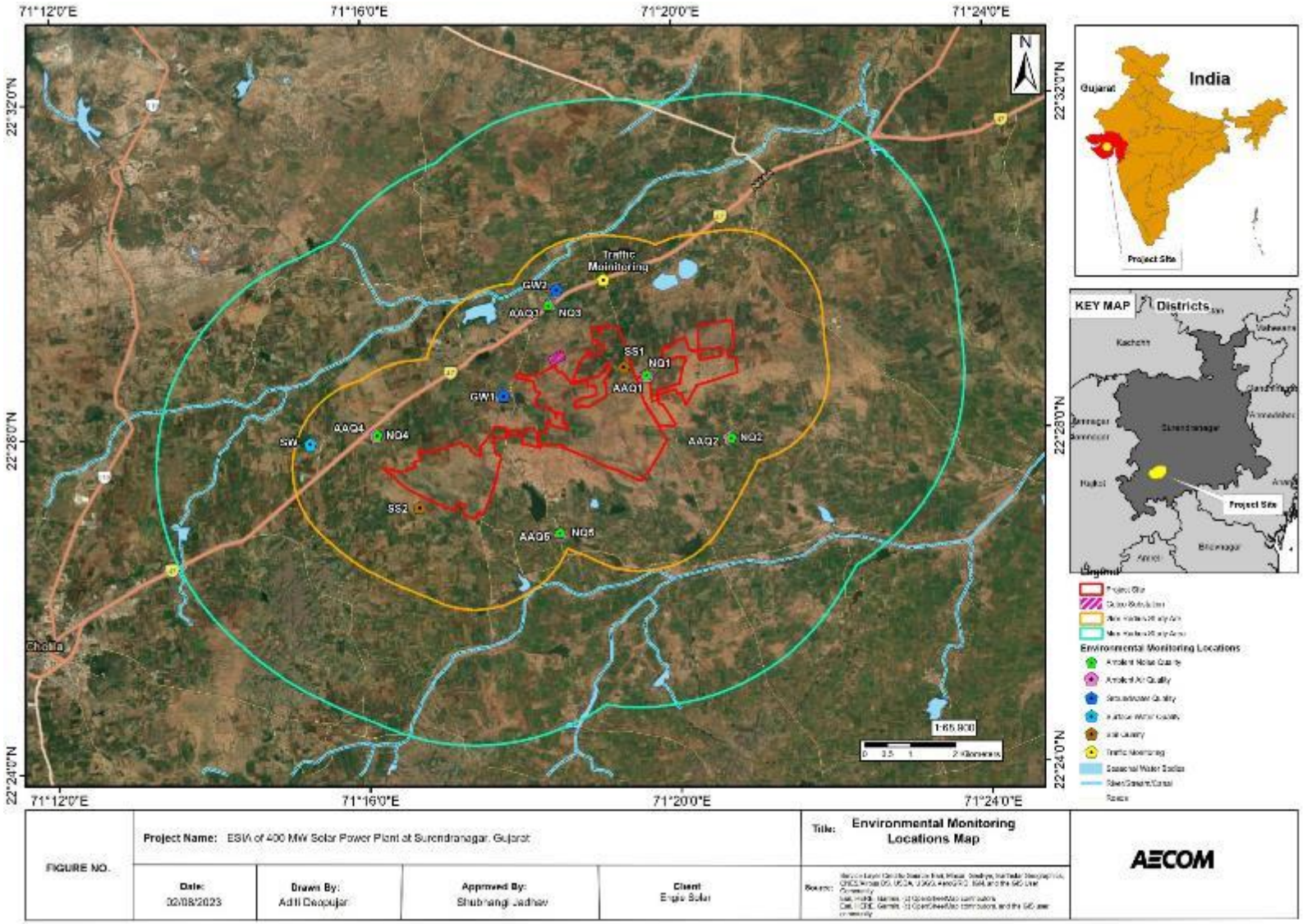


Figure 4-1: Environmental Monitoring Locations in the Study Area

Table 4-2 below includes the proposed locations where the monitoring will be done which is subject to condition that all the essential requirements for conducting the sampling are met. It may change accordingly.

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	AAQ1	22.47796911° 71.32713756°	Dhankaniya Road, Sayla	East of the project site	Downwind to the project site
		AAQ2	22.46535668° 71.34471884°	Dhankaniya	East of the project site	Downwind to the project site
		AAQ3	22.49225451° 71.30630837°	Shapar village	North of the project site	Crosswind to the project site
		AAQ4	22.46687468° 71.26893371°	Lords Resort, Magharikhada, Chotila	West of the project site	Upwind to the project site
		AAQ5	22.44672998° 71.30805286°	Sonpari	South of the project site	Crosswind to the project site
2)	Ground Water	GW1	22.4748352° 71.29846171°	Ratanpar village	Project site	Monitoring of ground water quality in the vicinity of the Project Area
		GW2	22.4952063° 71.30803144°	Shapar village	North of the project site	Monitoring of ground water quality in the vicinity of the Project Area
3)	Ambient Noise	NQ1	22.47796911° 71.32713756°	Dhankaniya Road, Sayla	East of the project site	
		NQ2	22.46535668° 71.34471884°	Dhankaniya village	East of the project site	
		NQ3	22.49225451° 71.30630837°	Shapar village	North of the project site	
		NQ4	22.46687468° 71.26893371°	Lords Resort, Magharikhada, Chotila	West of the project site	
		NQ5	22.44672998° 71.30805286°	Sonpari village	South of the project site	
4)	Soil Quality	SS1	22.47965976° 71.32216307°	Dhankaniya Road, Sayla	Near Project site	Soil sample collected from the Northern end of the project site
		SS2	22.4522518° 71.27397556°	Nana Kandhashar, Chotila	Near Project site	Soil sample collected from the southern end of the project site
5)	Traffic Survey	TM	22.49714038° 71.31805932°	Rajkot Highway & Dhankaniya Road, Near Indian Oil Bunk	East of the project site	Access road to be used for carrying construction equipment and material

4.1.1 Physiography

Surendranagar district is located in the north-western part of Saurashtra Peninsula of Gujarat State. The Rann of Kachchh is located towards north, the vast low lying alluvial tract plains of North Gujarat towards east and uplands of the central Saurashtra towards and south and west encircle the district. The district covers an area of 10,489 Sq.Km .A major portion of the district is drought prone. The district is essentially an underdeveloped district having diverse terrain conditions and varied but limited endowments of nature.

Surendranagar district has a geographical area of about 10,489 sq. km and falls in the Survey of India Degree sheets 41N and 41M, between North latitudes 22° 8’ and 23° 3’ and East longitudes 70° 58‘ and 72° 12‘ shown in

figure no.1.The district has 651 villages and 11 towns (populations greater than 1,00,000) spread over 10 talukas,namely Wadhwan , Limbdi, Dasada, Dhranghadhra, Chotila, Chuli, Halvad Muli, Sayla and Lakhtar.[18]

4.1.2 Geology

The general geological succession of the rock formations occurring in the Surendranagar district.

Dhrangadhra Formations: Dhrangadhra formations constitute the oldest exposed rocks in Saurashtra region, covering an area of about 3000 Sq. Km and 400 m in thickness.

Wadhwan Formations: The Wadhwan sandstone are exposed around Wadhwan Surendernagar, near Doliya and along the Wadhwan Bhogava River covering an area about 300 Sq. Km. It is considered to be younger in age than Dhargandhra formation though apparently no clear demarcation of the boundary exists.

Deccan Traps: The basaltic lava flows unconformably overlying the Wadhwan and the Dhrangadhra formations are exposed in Southeastern part of the district covering an area of about 2100 sq. km. The basalts are compact, fin grained too porphyritic and sparsely joint. The major fracture pattern in the Deccan traps is in NE—SW and NW-SE directions with high angle dips. Columnar jointing is also seen in the massive basalts. The joints are mainly cooling joints and seldom interrupt more than flow. However, a few major shear zones intersecting several flows are also encountered.

Basic Intrusive: The basic intrusive are mainly Dolerite dykes. These dykes are mostly manifested in the Dhrangadhra formation at many places. The dykes are generally compact but highly jointed/fractured dykes are also observed.

Alluvium: The eastern part of the district comprises unconsolidated to semi consolidated sediments of Recent to Pleistocene age covering an area about 5500 Sq. Km. The top few meters of the area invariably comprise blown sand deposits.

As per the geological map presented in the CGWB report project site falls in sayla region where deccan basalts rock forms and with intermediate lineaments (100-300 km) showing limits of known faults.[19] Land from areas near to project site were observed to be used for road construction activitiesDrainage

The drainage in the northern most and eastern parts comprises mostly short streams which disappear into the Little Rann of Kachchh towards north in the low-lying saline/partly marshy land and towards east in the sandy tracts .Limbdi- Bhogava I and Wadhvan- Bhogava II i.e., Bhogava II which originate from the hilly range of Chotilla about 64 km. west of Surendernagar are two east flowing rivers. These rivers have almost no tributaries in the alluvial tracts. Instead, here are several small / insignificant interdunal drains and also many west-east flowing streams which are running parallel to the Bhogava II. There are many small northerly flowing streams out of which the Brahmanani or Bhambani and Kankavati are the only major streams and are ephemeral.[20]

[18] Surendarnadar.pdf (cgwb.gov.in)
[19] Surendarnadar.pdf (cgwb.gov.in)
[20] Surendarnadar.pdf (cgwb.gov.in)

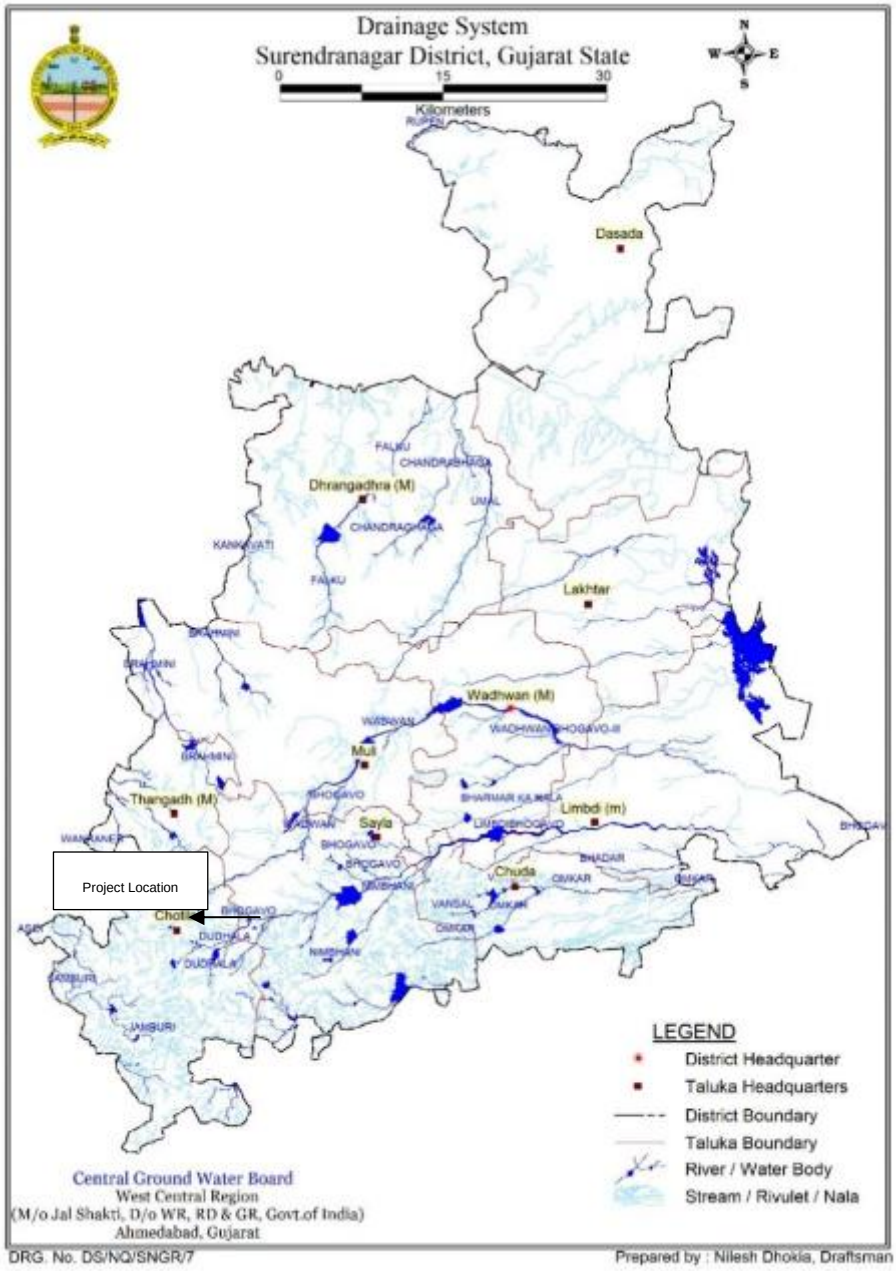


Figure 4-2: Map showing drainage pattern in the district with project location

There are two seasonal river bodies which are both the tributaries of Bhogavo river on the eastern and western side approximately 3-4 kms from the centre of the project site. Both are generally dried during the summers. There are several lakes which can be seen in the below figures are Sayla lake on the western side, pond in Nana Kandhashar and mota kandhasar on the southern side of the Project Area.

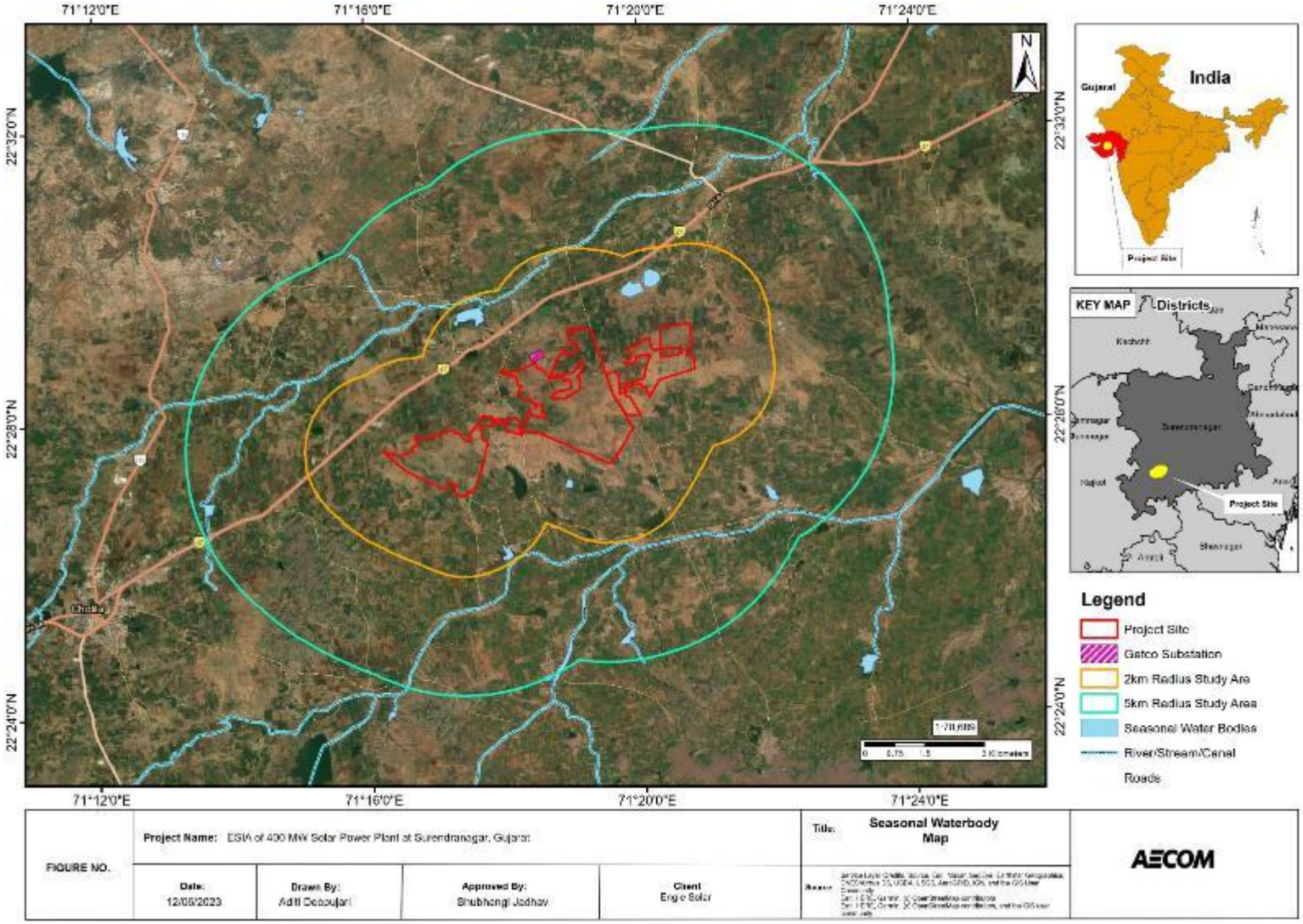


Figure 4-3: Map Showing Seasonal Waterbody Around the Proposed Project Site

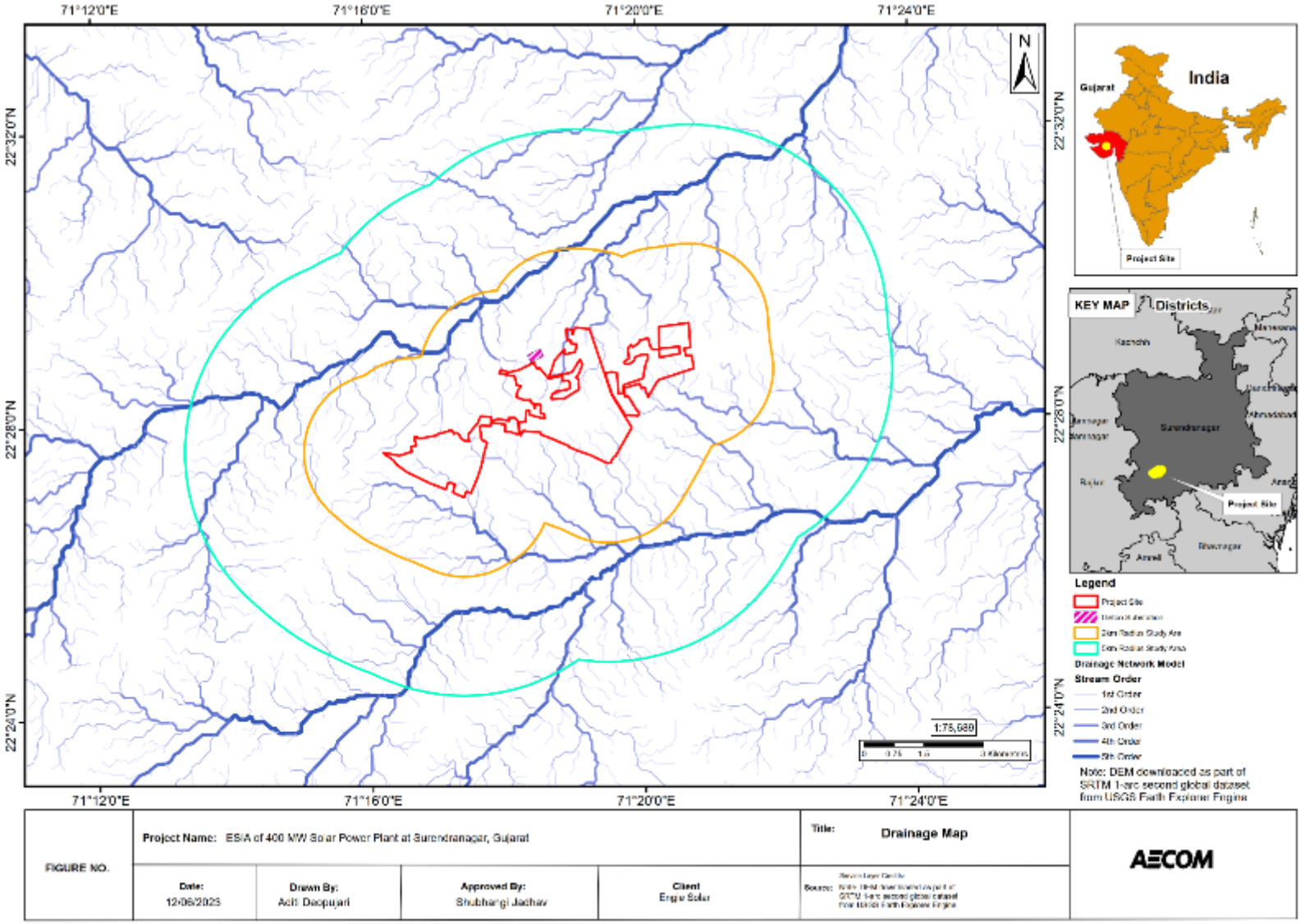


Figure 4-4: Map Showing Drainage Around the Project Area

4.1.3 Land use and Land Cover

The total geographical area of the district is 922,500 Ha out of which nearly 623,934 Ha (67.63%) is under agriculture. The land under non agriculture use is 50,855 Ha which is 5.52% of the total geographical area of the district. Out of the land under non-agricultural use Dasada block has the highest (8,821 Ha) followed by Chotila (7718 Ha) and Dhrangadhra (6,975 Ha). The forest area covers 4.86 % of the total geographical area which is 44821 Ha Source (DIP (2016-2020), Surendranagar). The land use pattern in Surendranagar district is shown in the map below.

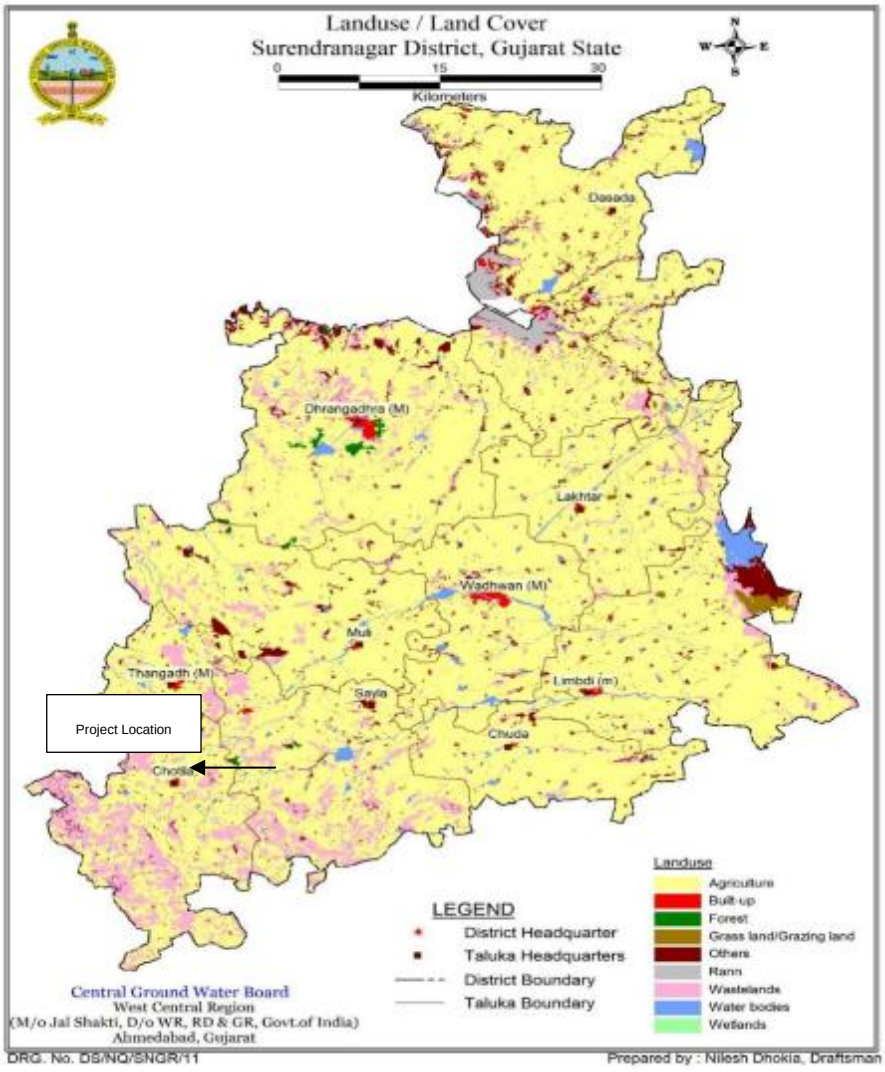


Figure 4-5: Land use and Land Cover Map With Project Location

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

Table 4-3: Land use in cropping pattern in Surendranagar district (area in hectares)

S.No.	Land Particulars	Total Area (ha)
1	Geographical area	10489
2	Forest area	526
3.	Land under non-agricultural use	547
4.	Permanent pastures	460
5.	Cultivable wasteland	157
6.	Barren and un-cultivable land	1245

S.No.	Land Particulars	Total Area (ha)
7.	Current fallows	330
8.	Net sown area	5389
9.	Area sown more than once	1011
10.	Gross cropped area	6400

Source: District Groundwater Brochure, Surendranagar

The landuse land cover details of study area is shown in table and figure below.

Table 4-4: Project Area land use and land cover details

S.No.	Land Particulars	Total Area (Sq. km.)	Total Area (hectares)	Percent are (%)
1	Agricultural Land	173.42	17342	90.16
2	Built-up land	4.47	447	2.33
3.	Open Land	14.28	1428	7.42
4.	Seasonal waterbody	0.17	17	0.09
5.	Grand Total	192.34	19234	100

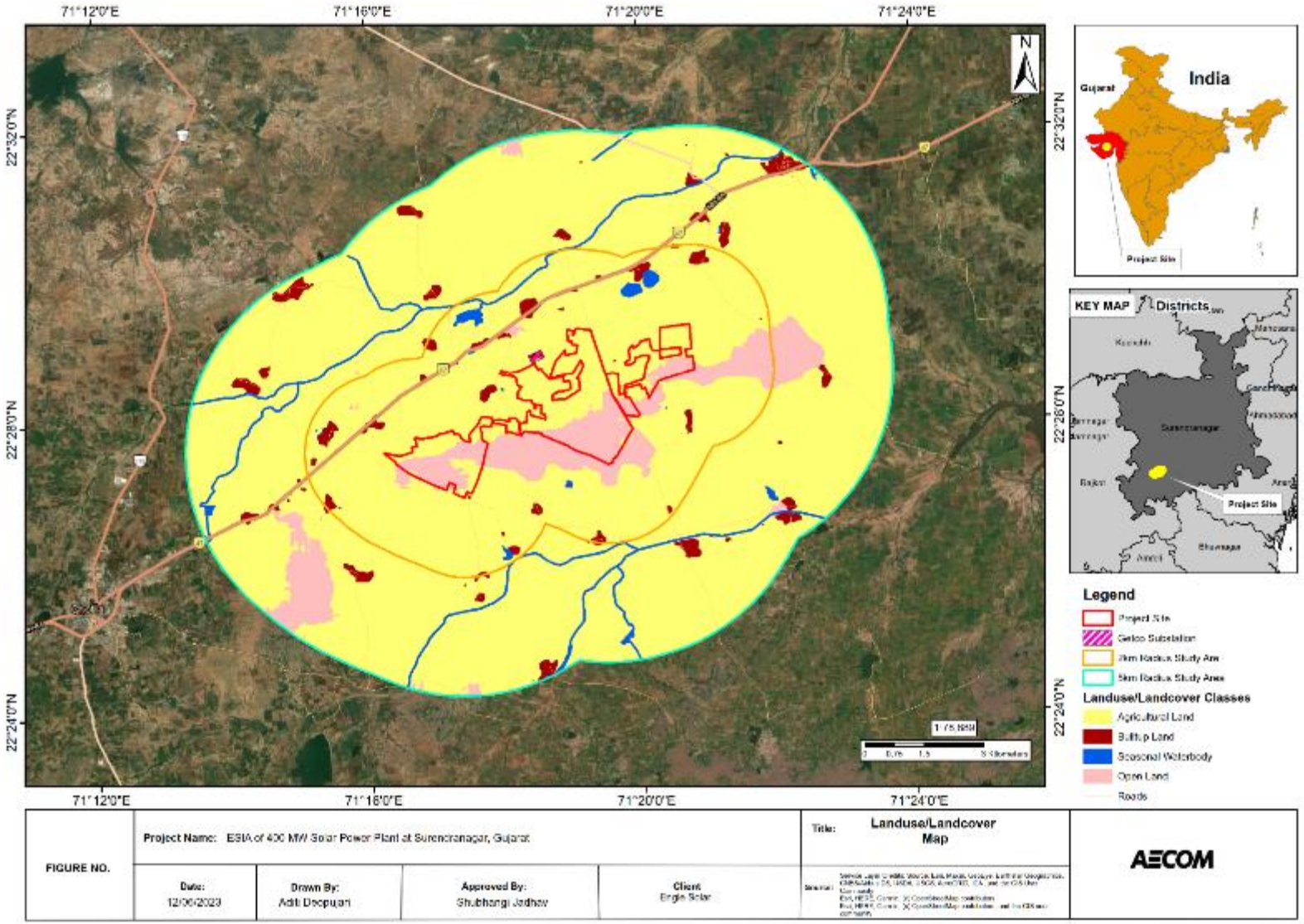


Figure 4-6: Map showing Land use and Land cover within 5 km radius of the Proposed Project site

4.1.4 Soil Types

The soils of Surendranagar district may be classified into three main categories:

a. Medium black soils

b. Red Sandy soils

c. Silty soils

Medium black soils generally occur at shallow depths (less than 5m) where basalts/shale forms the main rock unit and is exposed on the surface in the south, southwest and central part of the area. These soils are good in fertility but not suitable for heavy irrigation. The red sandy soils occur in north-east, east and south-east part of the area. The silty soils are found along a narrow strip close to the little Ran of Kachchh in the north-east and along shallow alluvial tracts and hard rock areas in central uplands has appreciable content of sand[21]. Project Area

The soil investigation report by the client shows that the soil in the Project Area consist of top thin layer of silty sand with gravels or clayey sand/silty clay having low plasticity followed by weathered sandstone upto 6.0m termination depth below Existing ground level (EGL).

4.1.5 Hydrogeology

The groundwater in the area occurs phreatic, semi-confined and confined conditions. The ground water occurrence is controlled by topography, drainage, lithology and disposition of fractures and joints. The medium to coarse grained sandstone act as good repository of ground water. The main water bearing formations identified with in the area as follows

Ground Water in alluvium

Most of the northern and eastern parts of the district, covering an area of about 5375 Sq. Km, comprise semi and unconsolidated formations. The ground water occurs under unconfined to confined conditions. The depth of the wells in this formation ranges between 2.00 and 30.00 m bgl. The depth of water levels ranges from 0.20 to 20.0 m bgl. The yield of shallow dug wells varies from 40 to 60 m3/day. The depth of the tube wells ranges from 60 to 300 m. The free flow discharge of these well ranges from 5 to 60 m3/day.

Ground Water in Dhrangadhra Sandstone

The Dhrangadhra sandstone are the most important water bearing formations in the district. it occupies about 2700 Sq.Km. area and situated in the central and north-western parts of the district. The shallow dug wells in the depth range between 5 and 28m, tapping Upper Dhrangadhra sandstone have water yielding capacity of 20 to 60 m3/day. The general range of water level in this aquifer is around 4 to 22 m. A number of tube wells sited, in Middle Dhrangadhra formations, down to depths ranging between 90 and 157 m are in operation. The yield of tube wells varies from 25 to 80 m3/day. The piezometric head in this aquifer vary from 10 to 30 mbgl.

Ground Water in Deccan Traps

The Deccan basalts, unconformably overlying the Dhrangadhra formation form aquifers in southern part of the district, covering an area of 2100 Sq.Km. The movement of ground water is controlled by weathered zone, joints and fissures. The groundwater occurs under both water table and semi-confined conditions. The depth of the dug wells in the traps range from 6.0 to 28.0 m and depth to water level rests between 1.0 and 20 m bgl. The yield of shallow dug wells ranges from 20.0 to 50.0 m3/day. The depth of the boreholes tapping interflow zones range from 80 to 110 m, where in the piezometric head rests between 18 and 25 m bgl. As such the yield of the shallow/deep boreholes in the traps are ranging from 35 to 70 m3/day.[22]

As per the soil investigation carried out in March 2023 by the project team, The Ground water table was not encountered in the boreholes upto 6.0m termination depth below EGL and the figure below shows that sayla region where the project is proposed to be built has moderate yield 5 to 20 m^3/hr.

[21] Surendranagar Gujarat.pdf (cgwb.gov.in)
[22] Surendranagar Gujarat.pdf (cgwb.gov.in)

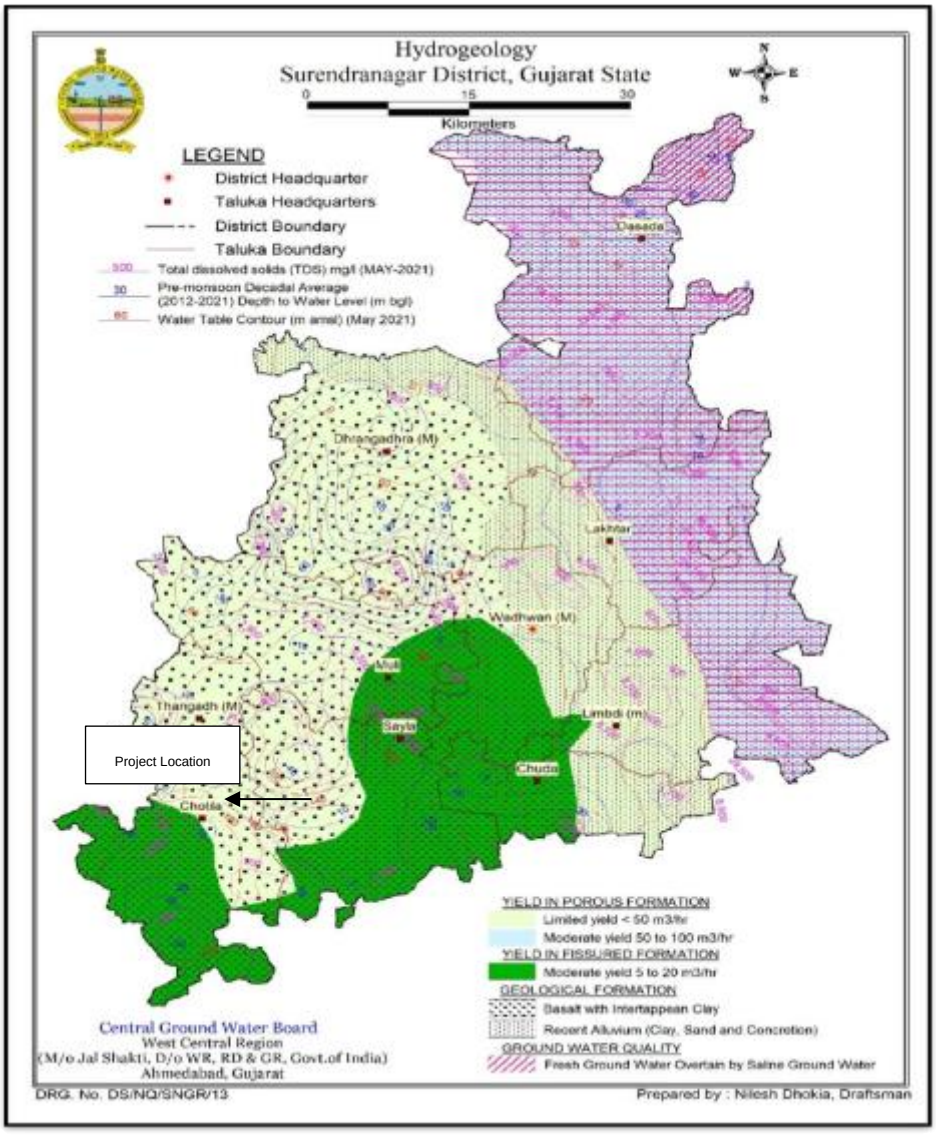


Figure 4-7: Hydrogeology of the area

4.1.6 Climate and Meteorology

Surendranagar district is located in the north-western part of Saurashtra Peninsula of Gujarat State. The Rann of Kachchh towards north, the vast low-lying alluvial tract plains of North Gujarat towards east and uplands of the central Saurashtra towards south and west encircle the district.[23]

4.1.6.1 Temperature

The period from March to May records gradual increase in temperature and May being the hottest month. The maximum temperature in summer reaches 46° Celsius with an average of 41.9° Celsius. With the onset of the south-west monsoon, by about June, there is an appreciable drop in the day temperatures. From the beginning of November month onwards, both day and night temperatures drop rapidly (even up to 5°C) till January which is being the coldest month. The mean daily maximum and minimum temperatures works out to be 28.3° C and 12.9° C respectively for period of observation.

4.1.6.2 Rainfall

The rainfall data of Surendranagar, Chotila, Dasada, Dhrangadhra, Sayla, Lakhtar, Limbdi, Thangadh and Muli Rain gauge stations published by the Water Resources Investigation Circle, Department of Irrigation, Gujarat

[23] Surendranagar Gujarat.pdf (cgwb.gov.in)

have been utilized for this writ up. More than 90% of the rainfall occurs during the monsoon. Rainfall during the winter and summer months is negligible. The average rainfall (1987 to 2021) of the district is 578.1 mm and in the 2021 it is 497 mm only which is 16 % lesser than of the average rainfall.

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

Year	Jan	Feb	March	April	May	June	July	August	Sept	Oct	Nov	Dec
2017	0	0	0	0	0	93.2	584.5	141.7	18.6	0	0	1.6
2018	0	0	0	0	0	14.4	96.4	122.3	4.3	0.4	0	0
2019	0	0	0	0.7	0	47.2	127.7	338.5	322.1	85.9	39.3	0
2020	0	0	1	0	0	107.6	142.3	516.5	75.3	4.9	0	0.8
2021	0	0	0	0.8	52.2	80.9	56.3	12	279.1	26.1	0.2	1.3

Source: IMD (http://hydro.imd.gov.in/hydrometweb/(S(awukl145hdrzez45y0yrex45))/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 Natural Hazards

4.1.7.1 Wind Hazard

As per the Gujarat's wind hazard map in the below figure, Project Area falls under moderate damage risk zone-B (V_b=39m/sec) area

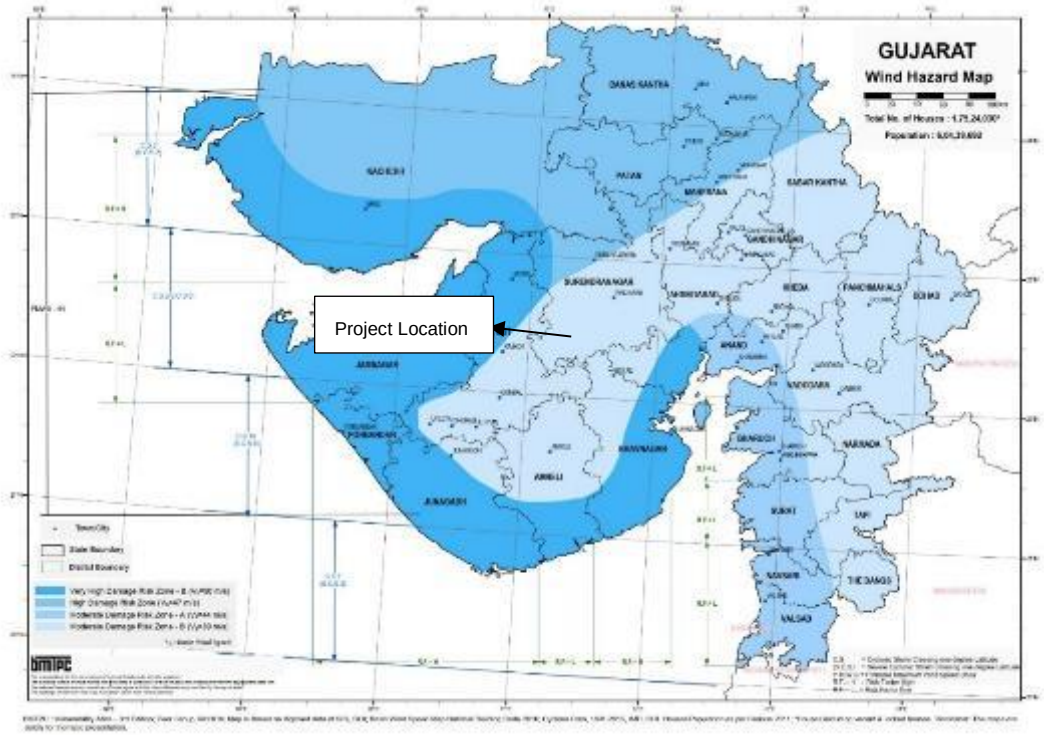


Figure 4-8: Wind Hazard map of Gujarat state

Source: Building materials and technology promotion council (BMTPC) BMTPC

4.1.7.2 Seismicity

Some parts of the Surendranagar district fall under Zone -III and others fall under Zone -IV. The proposed project site in the district falls under Seismic Zone –III i.e., Project falls in the Moderate damage risk zone and can be seen in the figure below:

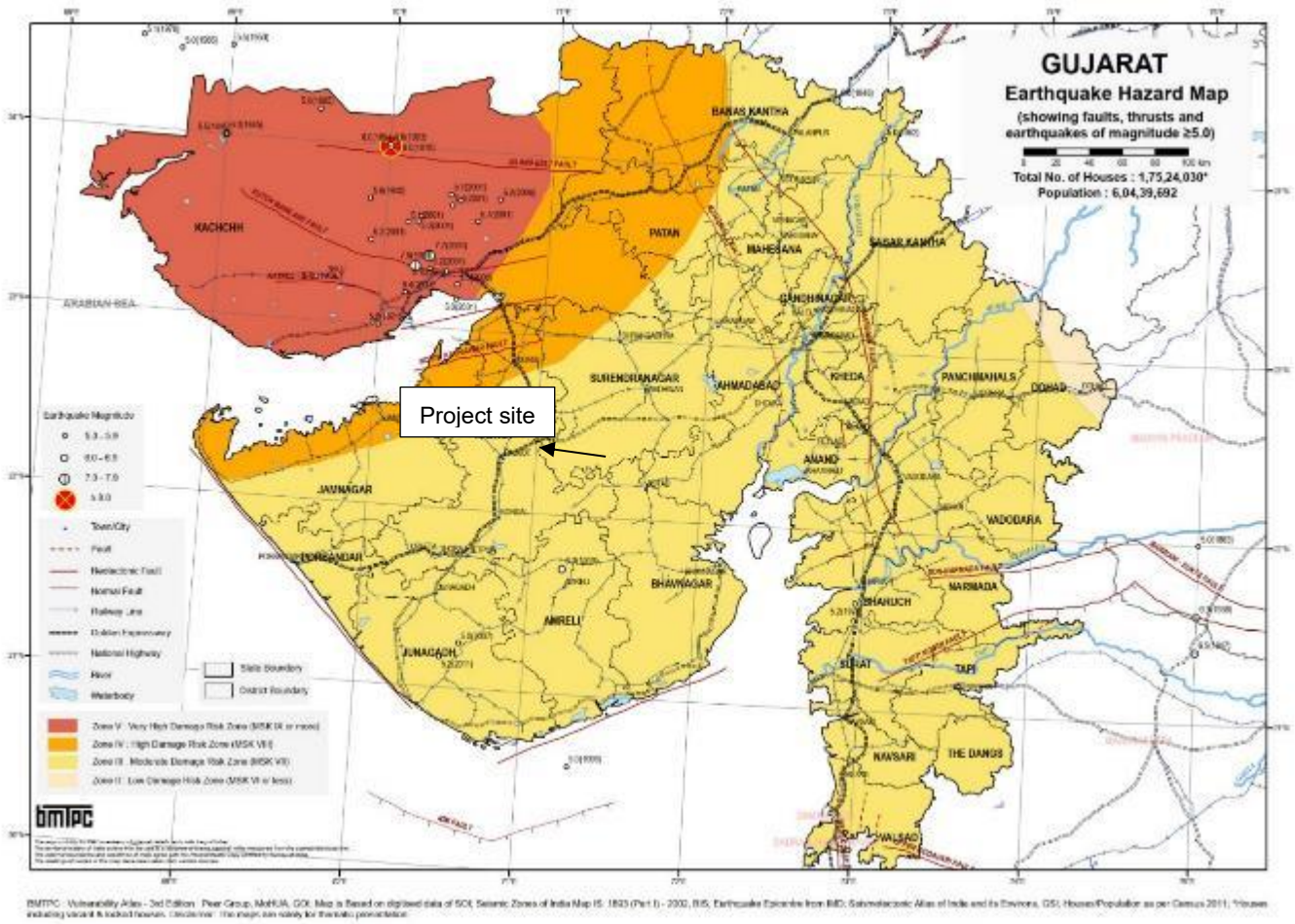


Figure 4-9: Earthquake Hazard Map of Gujarat state

Source: Building materials and technology promotion council (BMTPC) https://vai.bmtpc.org/eq-tn.html

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 8th June to 14th June 2023 at all the identified locations during site survey by an external laboratory, M/s Chennai Testing Laboratory Private Limited, which is accredited to National Accreditation Board for Testing and Calibration Laboratories (NABL).

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.

Ambient air was monitored in the Project Area to estimate the quality of ambient air around the project site. 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 4-6: Results of Ambient Air Monitoring

Pollutant	Time Weighted Average	Concentration in Ambient Air (Industrial, Residential, Rural and Other Areas)	Dhankaniya Road, Sayla (AAQ1)	Dhankaniya (AAQ2)	Shapar (AAQ3)	Lords Resort, Magharikhada, Chotila (AAQ4)	Sonpari (AAQ5)
Particulate Matter (size less than 2.5 µm) or $PM_{2.5}$, µg/m^3	24 Hours	60	30.35	17.85	38.4	34.9	21.8
Particulate Matter (size less than 10 µm) or PM_{10}, µg/m^3	24 Hours	100	65.95	44.6	80.45	77.85	52
Sulphur Dioxide (SO_2), µg/m3	24 Hours	80	7.55	3.4	15.6	12.95	4.95
Nitrogen Dioxide (NO_2), µg/m^3	24 Hours	80	15.7	7.75	30.25	26	11.75
Ozone (O_3), µg/m^3	8 Hours	180	27	11.2	43.25	38	21.6
Lead (Pb), µg/m^3	24 Hours	1	BDL	BDL	BDL	BDL	BDL
Carbon Monoxide (CO), mg/m^3	8 Hours	4	BDL	BDL	BDL	BDL	BDL
Ammonia (NH_3), µg/m^3	24 Hours	400	10.7	BDL	31.9	23.75	13.1
Arsenic (As), ng/m^3	Annual	6	BDL	BDL	BDL	BDL	BDL
Nickel (Ni), ng/m^3	Annual	20	BDL	BDL	BDL	BDL	BDL
Benzene (C_6H_6), µg/m^3	Annual	5	BDL	BDL	BDL	BDL	BDL
Benzo(a)pyrene		1	BDL	BDL	BDL	BDL	BDL

Source: Laboratory Results, June 2023

BDL: Below Detectable Limit

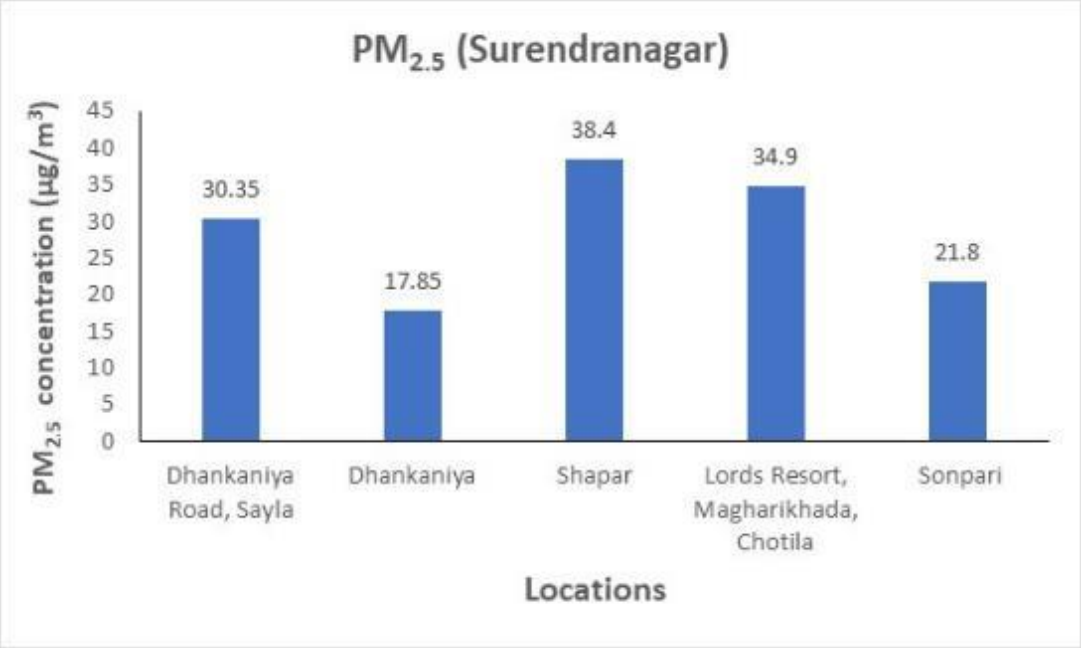


Figure 4-10: $PM_{2.5}$ concentration comparison for different locations

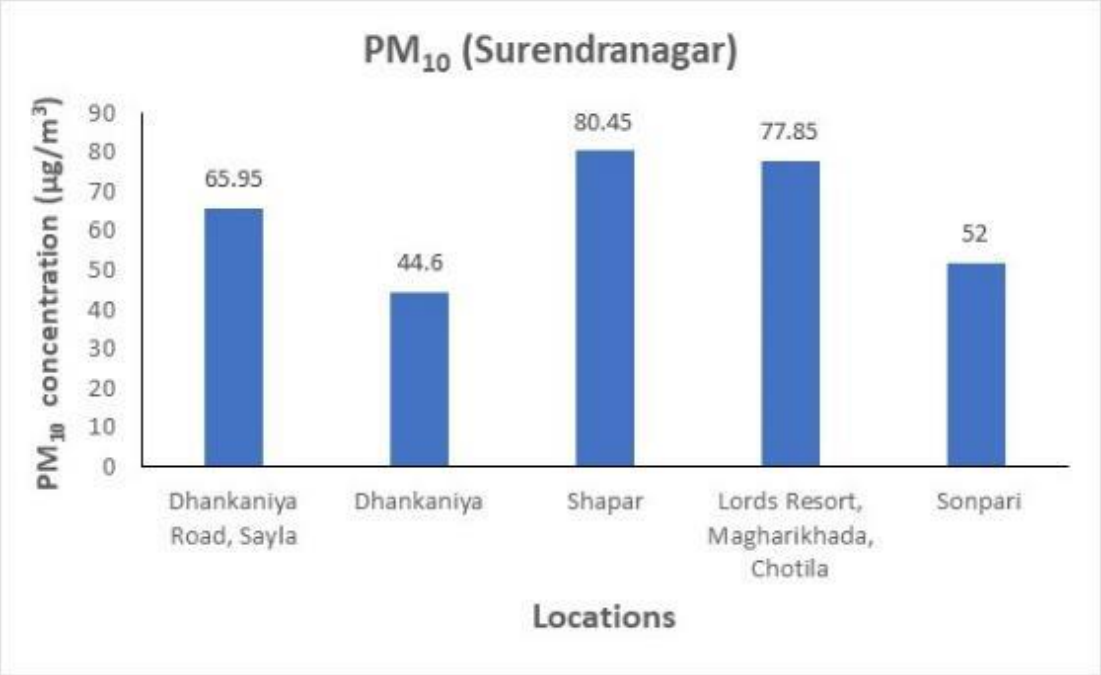


Figure 4-11: PM_{10} concentration comparison for different locations

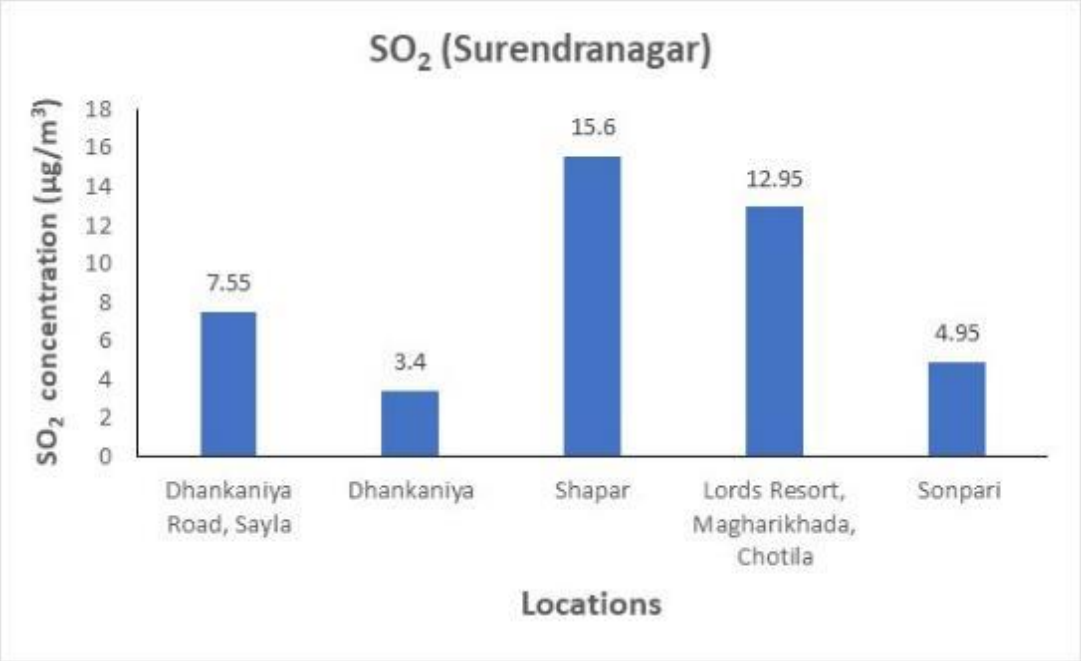


Figure 4-12: SO_2 concentration comparison for different locations

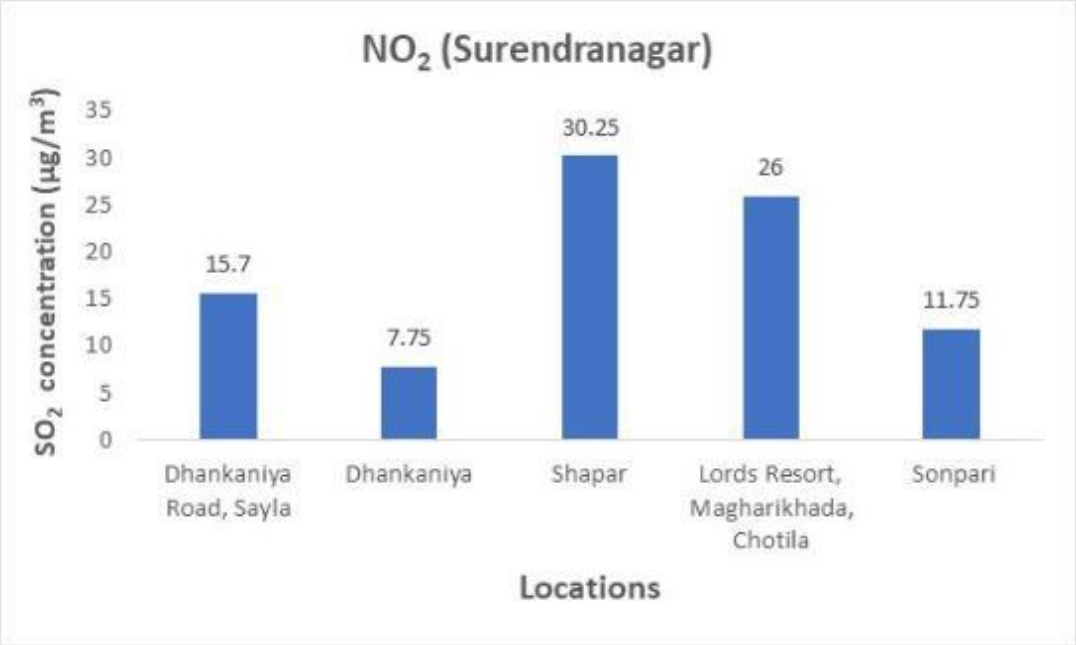


Figure 4-13: NO_2 concentration comparison for different locations

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 are $PM_{2.5}$, PM_{10}, SO_2, NO_2, CO, NH_3, Lead, Ozone, As, Ni, Benzene and Benzo(a)pyrene. $PM_{2.5}$, PM_{10}, SO_2, NO_2, O_3 and NH_3 were detected in all the samples and were noted to be well within the permissible limits of the National Ambient Air Quality Standards (NAAQS), as defined by MoEF&CC and other parameters such as CO, Pb, As etc., were found below detection limit. From figure 4.10 and figure 4.13 shows the concentrations levels at different areas.

4.2.2 Ambient Noise Quality

Ambient Noise level was monitored continuously for 24 hours at six (06) locations around the Project Area using Sound Level Meter at the identified receptor locations mentioned in table below. 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 4-7: Results of Ambient Noise level Monitoring on weekday

Location Code	*Noise Standard (Residential Area)*	Dhankaniya Road, Sayla (NQ1)	Dhankaniya (NQ2)	Shapar (NQ3)	Lords Resort, Magharikhada, Chotila (NQ4)	Sonpari (NQ5)
L_{min}	35.5	34.6	37.2	38.8	34.8	35.5
L_{max}	44.7	47.2	58.5	64.5	52.5	44.7
L_{90}	44.35	47.02	57.16	63.76	51	44.35
L_{eq} Day dB (A)	42.64	40.55	49.20	54.76	42.08	42.64
L_{eq} Night dB (A)	38.13	38.64	44.97	42.40	37.06	38.13
Leq	41.5	41.5	50.8	55.6	43.7	41.5

Source: Laboratory Results, June 2023

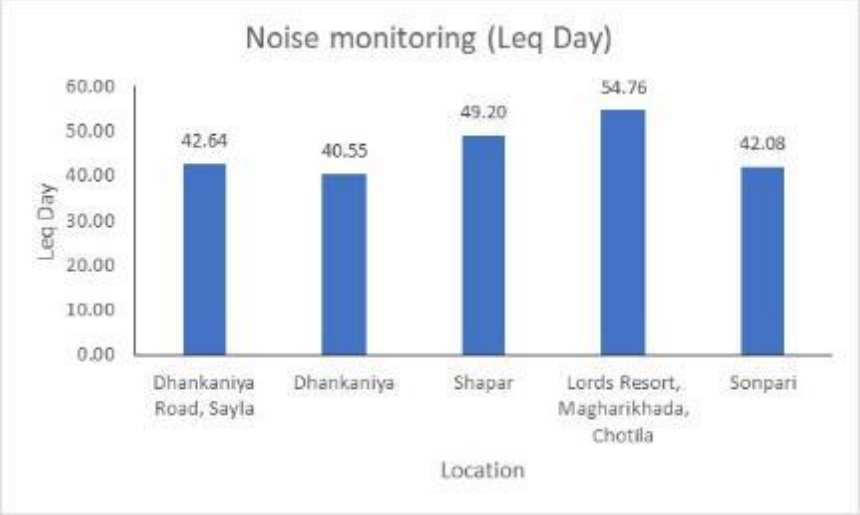


Figure 4-14: Noise level (Leq) Day comparison at different locations

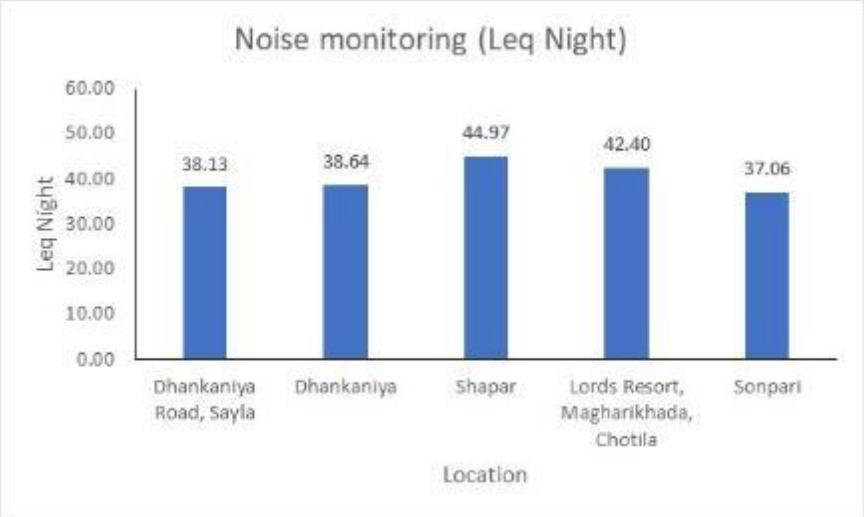


Figure 4-15: Noise level (Leq) Night comparison at different locations

Inference

The ambient noise level during day time at the monitoring locations were noted to be within permissible standards of noise levels prescribed by CPCB. The noise level during night time at the monitoring locations were noted to be within permissible standards of noise levels.

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.

Two (02) ground water sample were collected to assess the water quality at site and around the Project Area. Samples 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: Results of Ground Water Quality

S. No.	Parameters	Unit	Limits As per IS 10500:2012		Ratanpar (GW1)	Shapar (GW2)
			Acceptable Limit	Permissible Limit		
1.	Colour	HU	Max. 5	Max.15	2	2
2.	Odour	-	Agreeable	Agreeable	Agreeable	Agreeable
3.	Taste	-	Agreeable	Agreeable	Disagreeable	Disagreeable
4.	Turbidity	NTU	Max. 1	Max. 5	< 1	< 1
5.	pH @ 25°C	-	6.5 - 8.5	No relaxation	7.8	7.6
6.	Total Hardness as CaCO3	mg/l	Max. 200	Max. 600	597	212
7.	Iron as Fe	mg/l	Max. 0.3	No relaxation	0.04	0.03
8.	Chloride as Cl-	mg/l	Max. 250	Max. 1000	765	57
9.	Chloramines as Cl2	mg/l	Max. 4.0	No relaxation	BDL(DL:0.1)	BDL(DL:0.1)
10.	Residual Free Chlorine	mg/l	Min. 0.2	Min. 1	BDL(DL:0.1)	BDL(DL:0.1)
11.	Fluoride as F	mg/l	Max. 1.0	Max. 1.5	0.22	0.10

S. No.	Parameters	Unit	Limits As per IS 10500:2012		Ratanpar (GW1)	Shapar (GW2)
			Acceptable Limit	Permissible Limit		
12.	Total Dissolved Solids	mg/l	Max. 500	Max. 2000	1920	340
13.	Calcium as Ca	mg/l	Max. 75	Max. 200	152	67
14.	Magnesium as Mg	mg/l	Max. 30	Max. 100	53	11
15.	Sulphate as SO4	mg/l	Max. 200	Max. 400	166	21
16.	Nitrate as NO3	mg/l	Max. 45	No relaxation	24	3.4
17.	Cyanide as CN	mg/l	Max. 0.05	No relaxation	BDL(DL:0.01)	BDL(DL:0.01)
18.	Anionic detergent as MBAS	mg/l	Max. 0.2	Max. 1.0	BDL(DL:0.1)	BDL(DL:0.1)
19.	Total Alkalinity as CaCO3	mg/l	Max. 200	Max. 600	298	165
20.	Boron as B	mg/l	Max. 0.5	Max. 1.0	BDL(DL:0.1)	BDL(DL:0.1)
21.	Ammonia (as Total Ammonia –N)	mg/l	Max. 0.5	No relaxation	BDL(DL:0.1)	BDL(DL:0.1)
22.	Barium as Ba	mg/l	Max. 0.7	No relaxation	BDL(DL:0.5)	BDL(DL:0.5)
23.	Sulphide as H2S	mg/l	Max. 0.05	No relaxation	BDL(DL:0.01)	BDL(DL:0.01)
24.	Copper as Cu	mg/l	Max. 0.05	Max. 1.5	BDL (DL:0.02)	BDL (DL:0.02)
25.	Manganese as Mn	mg/l	Max.0.1	Max. 0.3	0.05	BDL (DL:0.01)
26.	Mercury as Hg	mg/l	Max. 0.001	No relaxation	BDL(DL:0.001)	BDL(DL:0.001)
27.	Cadmium as Cd	mg/l	Max. 0.003	No relaxation	BDL(DL:0.002)	BDL(DL:0.002)
28.	Selenium as Se	mg/l	Max. 0.01	No relaxation	BDL(DL:0.005)	BDL(DL:0.005)
29.	Total Arsenic as As	mg/l	Max.0.01	Max.0.05	BDL(DL:0.001)	BDL(DL:0.001)
30.	Lead as Pb	mg/l	Max. 0.01	No relaxation	BDL(DL:0.005)	BDL(DL:0.005)
31.	Zinc as Zn	mg/l	Max. 5	Max. 15	0.10	BDL(DL:0.08)
32.	Aluminium as Al	mg/l	Max. 0.03	Max. 0.2	BDL(DL:0.02)	BDL(DL:0.02)
33.	Total Chromium as Cr	mg/l	Max. 0.05	No relaxation	BDL(DL:0.01)	BDL(DL:0.01)
34.	Silver as Ag	mg/l	Max. 0.1	No relaxation	BDL(DL:0.004)	BDL(DL:0.004)
35.	Molybdenum as Mo	mg/l	Max. 0.07	No relaxation	BDL(DL:0.05)	BDL(DL:0.05)
36.	Nickel as Ni	mg/l	Max. 0.02	No relaxation	BDL(DL:0.01)	BDL(DL:0.01)
37.	Poly Chlorinated Biphenyls (as PCB)	µg/l	0.005	No relaxation	BDL(DL:0.05)	BDL(DL:0.05)
38.	Pesticide Residues	µg/l	-	-	BDL(DL:0.01)	BDL(DL:0.01)
39.	DDT	µg/l	1	NR	BDL(DL:0.01)	BDL(DL:0.01)
40.	Endosulfan	µg/l	0.4	NR	BDL(DL:0.01)	BDL(DL:0.01)
41.	"Biochemical Oxygen Demand (BOD) 3 days @ 27°C"	mg/l	-	-	< 2	< 2
42.	Chemical Oxygen Demand (COD)	mg/l	-	-	< 4	< 4
43.	Phosphorus as P	mg/l	-	-	BDL(DL:0.1)	BDL(DL:0.1)
44.	Conductivity @ 25°C	µS/cm	-	-	3200	584
45.	Sodium Absorption Ratio	-	-	-	8.34	0.61
46.	Dissolved Oxygen	mg/l	-	-	7	6.9
	Microbiology:					
47.	Total Coliform	Per 100ml	Shall not be detectable in any 100 ml sample		Absent	Absent

S. No.	Parameters	Unit	Limits As per IS 10500:2012		Ratanpar (GW1)	Shapar (GW2)
			Acceptable Limit	Permissible Limit		
48.	E.coli	Per 100ml	Shall not be detectable in any 100 ml sample		Absent	Absent

Source: Laboratory Results, November 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 ground water testing and the pH, colour, taste of the water sample was observed to be within the permissible limit IS 10500:2012.

4.2.4 Soil Environment

Soil samples from two (02) locations within the project site as mentioned in table below. 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 4-9: 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 4.10: Standard Soil Classification

Sr. No.	Parameters	Unit	MDL*	Dhankaniya Road, Sayla (SS1)	Nana Kandhashar, Chotila (SS2)
				Concentration	Concentration
1	pH	---	2-12	8.5	8.8
2	Conductivity	µmho s/cm	0.1	0.153	0.149
3	Total Nitrate as NO_3	mg/kg	<0.01	12.5	17.5
4	Cation Exchange Capacity	meq/100 g	1	5.9	7.6
5	Total Organic Matter	%	0.01	0.29	0.74
6	Arsenic as As	mg/kg	0.01	BDL(DL:0.1)	BDL(DL:0.1)
7	Mercury as Hg	mg/kg	0.01	BDL(DL:0.2)	BDL(DL:0.2)

8	Lead as Pb	mg/kg	10	17.36		7.05	
9	Cadmium as Cd	mg/kg	5	BDL(DL:2.0)		BDL(DL:2.0)	
10	Manganese as Mn	mg/kg		52.45		118.06	
11	Copper as Cu	mg/kg	5	29.02		8.12	
12	Zinc as Zn	mg/kg	10	91.72		38.24	
13	Nickel as Ni	mg/kg	5	23.4		16.37	
14	Iron as Fe	%	0.01	1.36		0.718	
15	Chromium as Cr	mg/kg	10	47.3		BDL(DL:5.0)	
16	Total Nitrite as NO_2	mg/kg	<0.01	1.4		1.8	
17	Permeability	cm/hr	0.01	1.3		1.1	
18	Barium as Ba	mg/kg	10	BDL(DL:5.0)		BDL(DL:5.0)	
19	Porosity	%	5	38		42	
20	Phosphate as PO_4	mg/kg	1	170		210	
21	Texture	-	-	Silty clay loam		Silty clay loam	
22	Sand	%		14.79		11.29	
23	Silt	%		59.45		61.25	
24	Clay	%		25.76		27.46	
25	**Particle Size Distribution:**		0.1				
	1.70 mm	%		74.24	25.76	10.04	89.96
	0.850 mm	%		11.42	14.34	9.46	80.5
	0.710 mm	%		1.42	12.92	3.46	77.04
	0.600 mm	%		1.46	11.46	4.37	72.67
	0.355 mm	%		5.17	6.29	37.27	35.4
	0.180 mm	%		2.67	3.62	25.97	9.43

** Based on manual of Soil testing in India, ministry of Agriculture, GOI:2011*

Source: Laboratory Results, June 2023 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 are 8.5 & 8.8 indicating the soil to be saline in nature. Electrical conductivity of soil samples is found to be higher indicating its saline nature.

As per the Soil texture diagram (shown below in the ***Figure 4-16***) prescribed by the United States Department of Agriculture (USDA), it can be deciphered that the texture of soil sample (around the Project site) is “silt loam soil”.

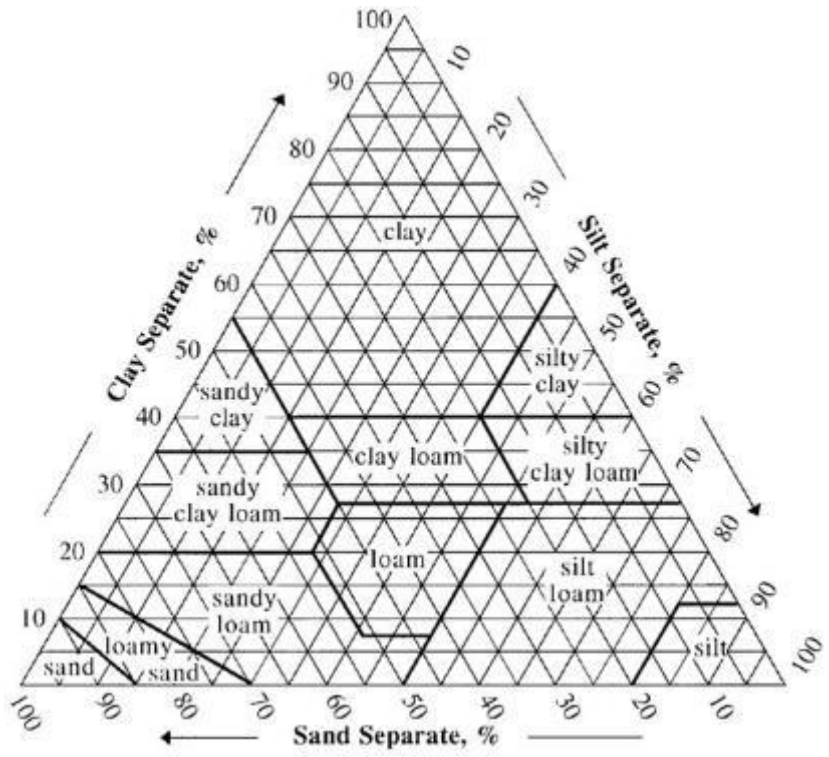


Figure 4-16: Soil Texture Diagram

(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 limited to the movement of project vehicles and materials for maintenance. The proposed Solar Project is connected through National highway (NH-47).

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 road connecting the project site with Rajkot Highway & Dhankaniya Road, Near Indian Oil Bunk.

These roads will be used for transportation of the construction materials during construction phase and is the main connecting road for the site. The one-way traffic volume counts were recorded for twenty-four hours (6:00 am to 6:00 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 (motorcycle, scooters);
- Three-wheeler (auto-rickshaw+ tractor)
- Four wheelers;
- High commercial vehicle (HCV);

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.

Table 4.11: 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 4.17

Table 4.12: Hourly Traffic Volumes

Time	PCUs			
	Two-wheelers	Three-wheeler (auto-rickshaw+ tractor)	Four-wheelers	HCV's
6:00 AM to 7:00 AM	21	20.4	96	192.4
7:00 AM to 8:00 AM	26.25	25.2	122	133.2
8:00 AM to 9:00 AM	33	24	154	148
9:00 AM to 10:00 AM	36	21.6	130	140.6
10:00 AM to 11:00 AM	29.25	15.6	131	92.5
11:00 AM to 12:00 AM	33.75	9.6	118	99.9
12:00 AM to 1:00 PM	39	8.4	112	70.3
1:00 PM to 2:00 PM	33	16.8	102	103.6
2:00 PM to 3:00 PM	30	10.8	123	114.7
3:00 PM to 4:00 PM	34.5	21.6	176	159.1
4:00 PM to 5:00 PM	28.5	25.2	137	129.5
5:00 PM to 6:00 PM	30	30	150	148
6:00 PM to 7:00 PM	16.5	14.4	113	92.5
7:00 PM to 8:00 PM	12	9.6	114	133.2
8:00 PM to 9:00 PM	7.5	12	84	118.4
9:00 PM to 10:00 PM	11.25	7.2	54	66.6
10:00 PM to 11:00 PM	4.5	3.6	32	85.1
11:00 PM to 12:00 PM	2.25	0	31	107.3
12:00 PM to 1:00 AM	1.5	0	41	129.5
1:00 AM to 2:00 AM	0	1.2	26	111
2:00 AM to 3:00 AM	0	0	31	96.2
3:00 AM to 4:00 AM	4.5	4.8	49	62.9
4:00 AM to 5:00 AM	10.5	8.4	68	81.4
5:00 AM to 6:00 AM	15.75	15.6	87	148

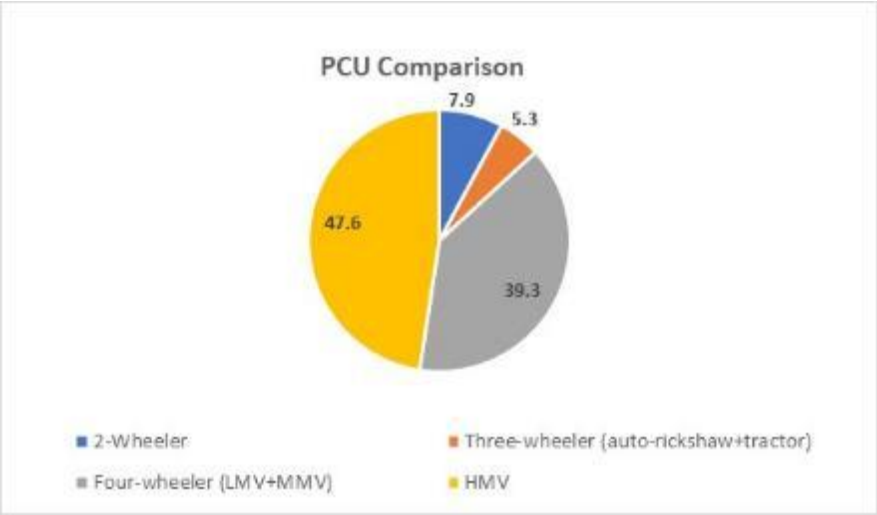


Figure 4-17: Traffic comparison chart

Inference
Tables above give the hourly recorded data at the locations mentioned. Figure above shows the comparison of the proportion of vehicles in each category, and it was found that 47.6% of the vehicles are heavy vehicle, 4-wheelers share 39.3%, while 2-wheelers and Three-wheeler share 7.9 & 5.3% each.

4.3 Biodiversity Profile

This section presents the baseline data generated through the biodiversity assessment conducted as part of the ESIA. It delineates the area subjected to the biodiversity impact assessment (hereinafter referred to as the 'Study Area'), describes the methodology used for the assessment and establishes a biodiversity baseline covering species, habitats, ecosystem services, invasive alien species and designated areas. This biodiversity baseline forms the basis for predicting the potential impacts of the project on biodiversity and suggesting mitigation measures to manage the predicted impacts.

4.3.1 Details of the Study Area and area chosen for Critical Habitat Assessment

Delineation of the Study Area

The Study Area for identifying biodiversity aspects that can potentially be impacted by the Project was limited to the overall area of influence (AoI) of the Project. The Project AoI would include the foreseeable areas of direct and indirect Project impacts. These have been delineated as follows:

a) Area of Direct Influence: The area coinciding with the collective footprint of the solar power plant site and the transmission line alignment (hereinafter collectively referred to as the 'Project Site'). Biodiversity aspects within the Project Site are likely to be directly impacted by the Project.
b) Area of Indirect Influence: The area within a 5 km buffer of the Project Site (hereinafter referred to as the 'Buffer Area'). Biodiversity aspects within the Buffer Area are likely to be indirectly impacted by the Project.

Note: The solar panelling of the 400 MW Project is expected to convert approximately 2400 acres of contiguous land, consisting of mainly arable land & savanna. The Project Site is situated in the catchments, & 2-5 km upgradient, of 2 significantly large tributaries of the regionally important Bhogavo River. The savanna in the Project Site appears to be contiguous with savannas extending 3-4 km beyond the Project Site boundaries. Hence, it is estimated that Project-induced indirect impacts could extend approximately 5 km from the Project Site.

Thus, the Project Site, Area of Direct Influence and Area of Indirect Influence together represent the Project AoI, hereinafter referred to as Study Area. This was the area used to collect biodiversity baseline and assess impacts.

The Study Area contains a significant number of patches of savanna or forest habitats, situated within or in proximity to the Project Site, as well as large ranges of modified habitats. Species associated with these habitats are likely to be occupying these patches or moving between them.

There are several seasonal or permanent inland wetlands, representing both lentic and lotic ecosystems, situated within or in proximity to the Study Area. Waterbirds using the said wetland habitats are likely to traverse the aerial envelope of the Project Site, while fishes of the said wetlands are very likely to occur in all freshwater aquatic systems directly connected with them.

Description of the Study Area

Geographically, the Study Area is situated in the Saurashtra region of central Gujarat State, India. The climate of the region is characterized by very hot summers and cold winters, with low, irregular rainfall.

The Study Area forms a part of a tract of highlands extending northeast from the Mandav Hills of north-central Saurashtra. The said highlands form a water-divide between the catchments of two rivers, the Bhagavo flowing west-east 1-2 km north of the Project Site, and the Limdi-no-Bhogavo, flowing west-east 1-2 km south of the Project Site. The terrain of the Study Area is flat to gently undulating. It is drained by several small seasonal streams that empty into either the Bhogavo River or the Limdi-no-Bhogavo River.

The elevation of the Study Area ranges from 145 to 185 m asl. The lands of the Study Area locally slope towards the 2 rivers flowing through its northern and southern parts respectively. The overall slope of the Study Area is from northwest to southeast.

The general soil-type of the region is classified as Black Cotton Soil. The soils of the Study Area tend to be shallow except in the lowlands along the two rivers, which are occupied by arable lands, plantations and rural habitation.

The ridge-top plateaux of the intervening highlands tend to have large patches of exposed rock and gravelly substrates, which support savannas composed of grassland dotted with scattered bushes. The grass cover tends to be very dense during the monsoon season.

The savannas, locally known as *vidis*, are regularly used by the local community for grazing livestock, especially during the monsoon season. Some savannas near the Project Site are reportedly designated by the Government as pasturelands.

The southwestern part of the Study Area contains a part of an isolated hillock. The slopes of the hillock support moderately degraded forest.

The rural habitations in the Study Area contain 1 or more rainfed ponds, which reportedly tend to dry up by the end of the winter season. Rainwater also collects in disused excavations to form more short-lived pools that reportedly hold water for 2-3 months after the monsoon season.

Most of the arable lands in the Study Area are under rain-fed cultivation, with only a few served by groundwater-based irrigation during the dry season. The cultivation practised in the Study Area reportedly includes seasonal, as well as perennial crops. Most of the seasonal crops are cultivated during the monsoon season and include cereals, pulses, oilseeds, pulses and fibres. The few seasonal crops cultivated during the winter season consist of mainly cereals. The perennial crops cultivated in the Study Area consist of mainly fruit trees.

Figure 4-18 presents a map indicating the components of the Study Area.

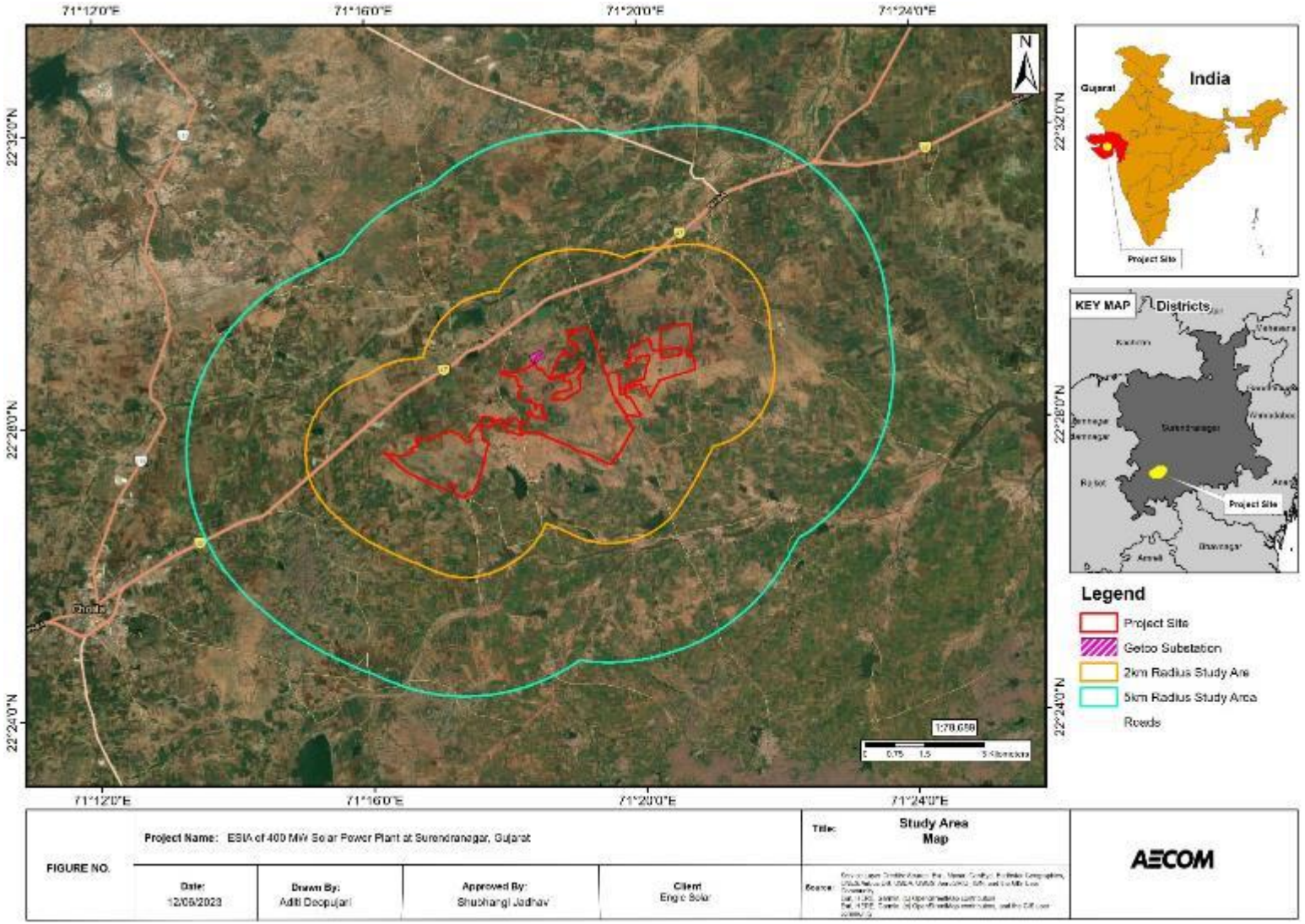


Figure 4-18: Map indicating the components of the Study Area

Delineation of the Area used for the Critical Habitat Assessment

Critical Habitat Assessment is undertaken across one or more Ecologically Appropriate Areas of Analysis (EAAAs), based on ecologically-relevant information such as habitat boundaries, watersheds, or elevation. Where habitat, elevation and other factors are relatively contiguous across and beyond a project area, a more pragmatic approach to delineating the area of analysis can be taken. This was the case for this project, which is largely situated within a contiguous agricultural area with patches of remnant wetlands or other natural habitat. As such, for this project, a simplistic approach was taken whereby the Study Area was also adopted as a single EAAA for all biodiversity.

4.3.2 Approach and Methodology

This section outlines the approach to the 2 components of the assessment, namely the Desk-based Review and the Field-based Survey, and describes the methodologies used during each.

4.3.2.1 Desk-based Review

The approach to the desk-based review involved reliance on a detailed report generated using the Integrated Biodiversity Assessment Tool (IBAT), along with appropriate public domain data, to collate a biodiversity baseline, consisting of species, habitats, ecosystems, ecosystem services and designated areas potentially occurring in or overlapping the Study Area.

The methodology for collating a tentative biodiversity baseline for the Study Area involved the following steps:

a) Referring to a detailed report generated using the Integrated Biodiversity Assessment Tool (IBAT) to obtain a list of IUCN Red List-assessed species potentially occurring within a 50 km buffer of the Project Site, as also, a list of areas internationally designated for biodiversity value that potentially overlap the Study Area.

b) Referring to Google Earth imagery to identify habitat-types, as listed in the IUCN Habitat Classification Scheme, potentially occurring in the Study Area.

c) Referring to governmental websites to identify areas nationally designated for biodiversity value.

d) Referring to biodiversity-related portals, such as eBird, iNature and GBIF, to identify the most recent and nearest records of CH candidate species with respect to the Study Area.

e) Referring to public domain data to identify any significant provisioning and/or cultural ecosystem services reported from the Study Area.

The methodology for screening the EAAA for presence of critical habitat (CH) involved the following steps:

f) Screening in of any species classified by the IUCN Red List as globally threatened, migratory, congregatory or endemic/restricted range potentially occurring in the EAAA as CH Candidate species.

g) Identifying the CH criteria as per which each screened in species qualifies as a CH Candidate.

h) Evaluating the extent of occurrence (EOO), global population, suitable habitat types and elevation range of each CH Candidate species to assess the likelihood of the EAAA containing CH with respect to the said species.

i) Screening out of CH Candidate species for which the EAAA is unlikely to contain CH as per any of the applicable CH criteria.

j) Screening in of any areas, designated nationally or internationally for biodiversity value and potentially overlapping the EAAA, as CH Candidate habitats.

k) Screening out of CH Candidate habitats for which the EAAA is unlikely to contain CH as per any of the applicable CH criteria.

l) Consulting an appropriate Subject Matter Expert (SME) and/or referring to relevant published research to determine presence of CH in the EAAA with respect to any species or habitats identified as likely CH triggers.

4.3.2.2 Field-based Survey

The field-based survey was conducted through a visit to the Study Area during 29 May-2 June 2023.

The approach to the field-based survey involved verification of secondary data collated through the desk-based review, collection of primary data on species and habitat-types, and collection of secondary data on species and ecosystem services through consultations with governmental officials and the local community.

The methodology for the field-based survey consisted of the following steps:

a) Conducting walk-through and/or drive-through surveys of the Study Area to collect primary data on species.

b) Verification of the habitat-types identified in the Study Area during the desk-based review.

c) Identification of any significant natural habitat in the Study Area.

d) Consulting local Forest Department officials to collect secondary data on species potentially occurring in the Study Area and areas nationally designated for biodiversity value.

e) Conducting opportunistic, informal interviews with local community members to collect secondary data on species, habitats and ecosystem services of the Study Area.

The primary data on species was recorded at 22 sites in the Study Area between early morning and late evening through qualitative sampling using the visual encounter method. The sites were selected using stratified random sampling, subject to considerations of safety and accessibility.

Table 4-13 presents details of the biodiversity sampling sites, including location coordinates, elevation above mean sea level (amsl) and associated habitat type(s).

Table 4-13: Details of the Biodiversity Sampling Sites

Sampling Site ID	Location Coordinates	Elevation (in m)	Habitat Type(s)
Within the Project Site			
BD1	22.458034°, 71.290033°	180	Arable Land
BD2	22.459510°, 71.294714°	180	Excavation Site
BD3	22.458113°, 71.303354°	178	Savanna
BD4	22.468682°, 71.324925°	180	Savanna
BD5	22.467901°, 71.318597°	187	Savanna
BD6	22.479600°, 71.308951°	183	Arable Land
BD7	22.477238°, 71.306708°	183	Arable Land
Within the Buffer Area			
BD8	22.495606°, 71.300787°	172	Wetland
BD9	22.516965°, 71.330642°	169	Wetland
BD10	22.446952°, 71.364779°	151	Wetland
BD11	22.434154°, 71.298589°	168	Wetland
BD12	22.446673°, 71.248617°	226	Forest
BD13	22.431184°, 71.244064°	228	Forest
BD14	22.466063°, 71.255482°	191	Wetland
BD15	22.493611°, 71.242313°	198	Arable Land
BD16	22.521080°, 71.349659°	162	Wetland
BD17	22.483251°, 71.370258°	176	Savanna
BD18	22.440034°, 71.339632°	157	Wetland
BD19	22.459113°, 71.334406°	172	Savanna

BD20	22.475504°, 71.324729°	181	Savanna
BD21	22.510822°, 71.351662°	169	Wetland
BD22	22.530759°, 71.302286°	185	Savanna

Source: AECOM's Field-based Survey

Figure 4-19 presents a map depicting the locations of the biodiversity sampling sites vis-à-vis the Study Area boundaries.

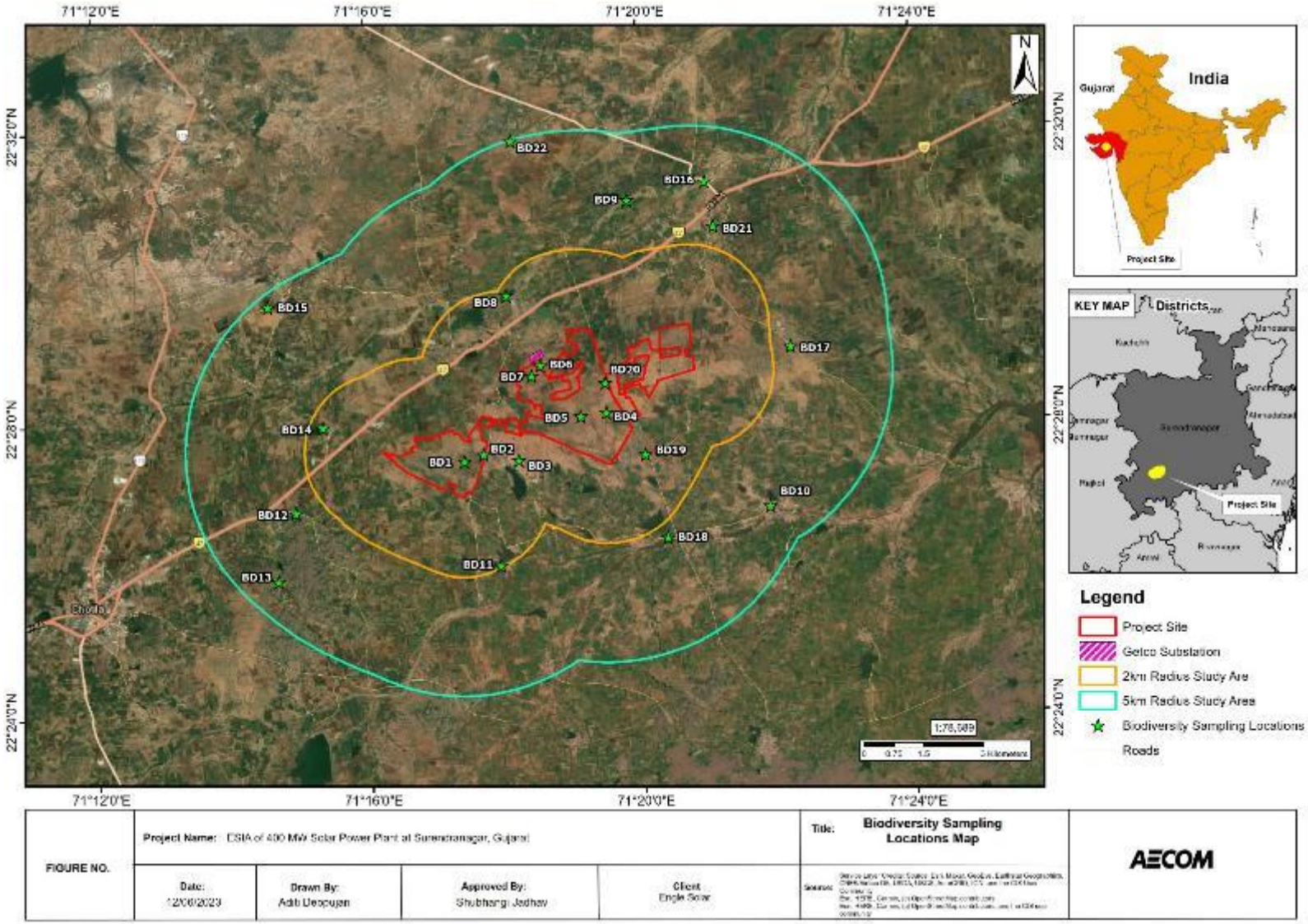


Figure 4-19: Map indicating the Biodiversity Sampling Sites vis-à-vis the Study Area.

4.3.3 Findings of the Study

This section presents the findings of the Study with respect to species, habitat types, designated areas and ecosystem services reported from or recorded in the Study Area.

4.3.3.1 Findings on Species

The detailed IBAT report provided by the Client indicates that at least 645 IUCN Red List assessed species potentially occur within 50 km of the Project Site.

Appendix B presents the said IBAT Report.

Floral Species

This section of the report presents the higher floral species, namely angiosperms, reported to occur in the Study Area or recorded therein during the field-based survey.

As per the Champion and Seth Classification of the Forest Types of India, the natural climax vegetation of the Study Area represents a forest type referred to as Northern Tropical Thorn Forest. The said forest type is known to occur in semi-arid regions of India. The nearest protected forests with respect to the Study Area from which this forest type is reported are Hindolgadh Wildlife Sanctuary and Rampara Wildlife Sanctuary. As per the IUCN Habitat Classification Scheme, the said forest type qualifies as Tropical Dry Forest.

The vegetation associated with the said forest type is very sparse and characterized by short-boled, shrubby trees, with irregular crowns that do not meet each other to form a canopy. Thorny plants are quite numerous. The dominant tree species of the said forest type are *Acacia catechu, Acacia leucophloea, Azadirachta indica* and *Prosopis juliflora*.

At least 27 species of angiosperms were recorded in the Study Area during the primary survey. None of these are listed as globally threatened in the IUCN Red List.

Appendix C presents a table giving details of each angiosperm species recorded in the Study Area, including its scientific name, common name and IUCN Red List status.

Faunal Species

This section of the report presents the higher faunal species, namely vertebrates, comprising mammals, birds, reptiles, amphibians and fishes, potentially occurring in the Project Site as per the IBAT Report or recorded in the Study Area during the field-based survey.

As per the IBAT Report, at least 504 species of vertebrates potentially occur in the Study Area. Of these, 35 species were recorded in the Study Area during the field-based survey.

Mammals

As per the IBAT Report, at least 60 species of mammals potentially occur in the Study Area. Of these, 1 species was recorded in the Study Area during the field-based survey.

Significant species with respect to the IUCN Red List include 1 Endangered (EN) species and 3 Vulnerable (VU) species.

Appendix D presents a table giving details of each mammal species potentially occurring or recorded in the Study Area, including its scientific name, common name and IUCN Red List status. Names of any species recorded during the field-based survey appear in bold font. Any invasive alien species (IAS) is indicated with an asterisk mark (*), while any species deemed extinct or possibly extinct in the Study Area is indicated with a hash mark (#).

Birds

At least 321 species of birds potentially occur in the Study Area. Of these, 33 species were recorded in the Study Area during the field-based survey.

Significant species with respect to the IUCN Red List include 6 Critically Endangered (CR) species, 5 Endangered (EN) species and 11 Vulnerable (VU) species.

Appendix E presents a table giving details of each bird species potentially occurring or recorded in the Study Area, including its scientific name, common name and IUCN Red List status. Names of any species recorded during the field-based survey appear in bold font. Any invasive alien species (IAS) is indicated with an asterisk mark (*), while any species deemed extinct or possibly extinct in the Study Area is indicated with a hash mark (#).

Reptiles

At least 55 species of reptiles potentially occur in the Study Area. Of these, 1 species was recorded in the Study Area during the field-based survey.

Significant species with respect to the IUCN Red List include 1 Endangered (EN) and 3 Vulnerable (VU) species.

Appendix F presents a table giving details of each reptile species potentially occurring or recorded in the Study Area, including its scientific name, common name and IUCN Red List status. Names of any species recorded during the field-based survey appear in bold font. Any invasive alien species (IAS) is indicated with an asterisk mark (*), while any species deemed extinct or possibly extinct in the Study Area is indicated with a hash mark (#).

Amphibians

At least 7 species of amphibians potentially occur in the Study Area. None of these are listed as globally threatened in the IUCN Red List.

Appendix G presents a table giving details of each amphibian species potentially occurring or recorded in the Study Area, including its scientific name, common name and IUCN Red List status. Names of any species recorded during the field-based survey appear in bold font. Any invasive alien species (IAS) is indicated with an asterisk mark (*), while any species deemed extinct or possibly extinct in the Study Area is indicated with a hash mark (#).

Fishes

At least 61 species of fishes potentially occur in the Study Area.

Significant species with respect to the IUCN Red List include 3 Vulnerable (VU) species.

Appendix H presents a table giving details of each amphibian species potentially occurring or recorded in the Study Area, including its scientific name, common name and IUCN Red List status. Names of any species recorded during the field-based survey appear in bold font. Any invasive alien species (IAS) is indicated with an asterisk mark (*), while any species deemed extinct or possibly extinct in the Study Area is indicated with a hash mark (#).

4.3.3.2 Findings on Habitats

The habitats of the Study Area include both, terrestrial and aquatic habitats.

The terrestrial habitats include natural habitats, mainly comprising moderately degraded forest and savanna habitat-types, as well as modified habitats, mainly comprising arable land, plantation, excavation sites and rural habitation. The aquatic habitats include natural habitats, mainly comprising rivers and streams, as well as artificial aquatic habitats, mainly comprising ponds. Most of the said aquatic habitats are reportedly seasonal.

The habitat profile of the Study Area is dominated by modified habitats, which constitute approximately 82% of the Study Area, while the natural habitats constitute approximately 18% of it.

The terrestrial habitats of the Study Area are fragmented mainly by roads, including a few major paved roads and many minor unpaved roads. The lotic aquatic habitats of the Study Area are fragmented mainly by bunds or small dams. The aerial envelope of the study area is interrupted mainly by power transmission lines and towers.

Table 4-14 presents the quantitative habitat profile of the Study Area, in terms of the relative proportions of terrestrial and aquatic, as well as natural and modified or artificial habitats in the Study Area.

Table 4-14: Quantitative Habitat Profile of the Study Area

Habitat Group	Habitat Class	Habitat Type	Proportion of Study Area (%)
Terrestrial	Natural	Forest	2.95
		Savanna	9.87
	Modified	Arable Land	77.38
		Plantation	1.3
		Excavation Sites	0.79
		Rural Habitation	2.3
Aquatic	Natural	Inland Wetland	4.9
	Artificial	Aquatic Bodies	0.51

Figure 4-20 presents a map indicating the habitat profile of the Study Area.

The photo-plate that follows indicates some of the natural and modified habitat types observed in the Study Area

Arable Land in the Buffer Area

Artificial Aquatic body in the Buffer Area

Forest in the Buffer Area

Savanna in the Buffer Area

Plantation adjacent to the Project Site

Inland Wetland (Bhogavo River) in the Buffer Area

Source: AECOM's Field-based survey

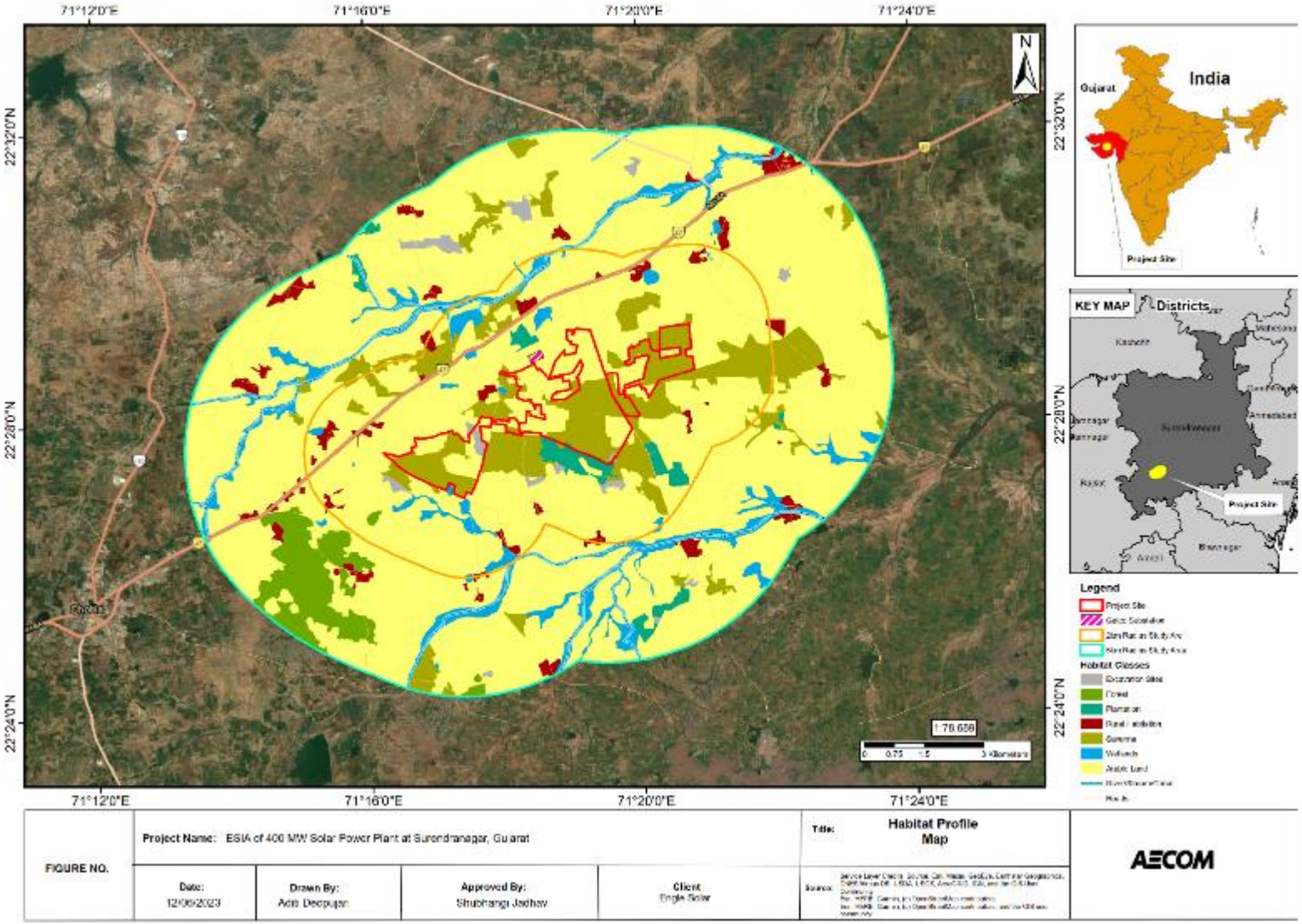


Figure 4-20: Habitat Profile of the Study Area

4.3.3.3 Findings on Ecosystem Services

This section presents an overview of ecosystem services reportedly received from the Study Area by the local community.

As per inputs received from the local community, the chief ecosystem services provided by the Study Area to the local community include provisioning services in terms of surface water & groundwater water for domestic use, soil for crop cultivation and naturally occurring plants that provide fodder.

Most arable lands in the Study Area are reportedly rain-dependant and cultivated only during the monsoon season, roughly coinciding with the annual period between June and September. The monsoon crops of the Study Area include *Arachis hypogaea* (Groundnut), *Cajanus cajan* (Pigeon Pea), *Gossypium herbaceum* (Cotton), *Eleusine coracana* (Finger Millet), Cu*minum cyminum* (Cumin), *Pennisetum glaucum* (Pearl Millet) and *Ricinus communis* (Castor). The relatively few patches that have access to groundwater-based irrigation are reportedly cultivated in the monsoon, as well as the winter season. The winter crops of the Study Ara include mainly *Sorghum bicolor* (Great Millet) and *Triticum aestivum* (Wheat). The perennial crops cultivated in the Study Area mainly consist of fruit trees, such as *Mangifera indica* (Mango) *Citrus limon* (Lemon), Mo*ringa oleifera* (Drumstick), *Psidium guajava* (Guava) and *Syzygium cumini* (Jamun).

The natural vegetation of the Study Area, particularly that regenerating in fallow arable lands or on the dry beds of seasonal lakes and ponds, is used for grazing livestock, mainly cattle and goats.

Source: AECOM's Field-based survey

4.3.3.4 Findings on Critical Habitat

As defined by ADB SPS guidance, the term 'critical habitat' refers to areas with high biodiversity value and necessarily includes the following [hereinafter referred to as the 'ADB CH Criteria (i) through (vii)']:

i) habitat required for the survival of critically endangered or endangered species.

ii) areas having special significance for endemic or restricted-range species.

iii) sites that are critical for the survival of migratory species.

iv) areas supporting globally significant concentrations or numbers of individuals of congregatory species.

v) areas with unique assemblages of species or that are associated with key evolutionary processes or provide key ecosystem services.

vi) areas having biodiversity of significant social, economic, or cultural importance to local communities.

vii) areas either legally protected or officially proposed for protection, such as areas that meet the criteria of the World Conservation Union classification, the Ramsar List of Wetlands of International Importance, and the United Nations Educational, Scientific, and Cultural Organization's World Natural Heritage Sites.

As per ADB SPS guidance, critical habitat is a subset of both natural and modified habitat that deserves particular attention.

ADB CH Criterion (i) – Critically Endangered or Endangered Species

Species listed as Critically Endangered (CR) or Endangered (EN) or Vulnerable (VU) on the IUCN Red List have been evaluated against CH Criterion 1. Owing to the IUCN National Red Lists for mammals, birds, reptiles, and amphibians being currently out-dated, only the global conservation status of species has been considered in this assessment. CR, EN and VU species are deemed to face an extremely high, very high and high risk of extinction in the wild, respectively.

Thresholds stipulated for triggering CH Criterion 1 are:

(a) Areas that support globally important concentrations of an IUCN Red-listed CR or EN species (0.5% of the global population containing 5 reproductive units of a CR or EN species);

(b) Areas that support globally important concentrations of an IUCN Red-listed VU species, the loss of which would result in the change of the IUCN Red List status to EN or CR and meet the thresholds specified in (a);

(c) As appropriate, areas containing nationally/regionally important concentrations of an IUCN Red-listed CR or EN species.

As per the IUCN Red List database, 34 IUCN-assessed CR, EN or VU species potentially occur within 25 km of the Project Site.

As per other public domain data, 2 of the said 34 species, namely *Schizothorax plagiostomus* and *Oryza malampuzhaensis,* are reported only from limited areas of the Trans-Himalayan region and Kerala, respectively, both of which areas are situated over 1000 km from the EAAA. Therefore, the said 2 species were screened out as CH Candidates.

As per IUCN Red List data, 3 other species out of the said 34 species are deemed Extinct in the EAAA. Hence, the said 3 species were also screened out as CH Candidates.

Thus, only 29 of the said 34 species qualify as CH candidates as per ADB CH Criterion (i).

ADB CH Criterion (ii) – Endemic or Range-restricted Species

As per ADB SPS guidance, IFC PS6 guidance (2019) must be referred to for definitions of Endemic or Restricted Range species, which are as follows:

(a) For terrestrial vertebrates and plants, restricted-range species are defined as those having an EOO less than 50,000 km^2

(b) For marine systems, restricted-range species are provisionally being considered as those having an EOO of less than 100,000 $km^{2.}$

(c) 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).

The IBAT Report lists 3 species as Endemic or Restricted Range (RR) species. Although the precise extent of occurrence of the said 3 species is unknown, all the said species reportedly have a widespread geographical distribution and are unlikely to meet the applicable definition of RR. Hence, they have been screened out as CH Candidates.

However, based on the IBAT Report and IUCN Red List data, 2 other species potentially occurring in the EAAA qualify as RR as per the applicable definitions.

Hence, the said 2 species were screened in as CH candidates as per ADB CH Criterion (ii).

ADB CH Criterion (iii) – Migratory Species

As per ADB SPS guidance, sites that are critical for the survival of migratory species qualify as CH. 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. As per the ADB Methodology, IUCN Red List data must be referred to, in conjunction with internet searches, to identify migratory species potentially occurring in the EAAA.

The EAAA is likely to be critical to the survival of a given migratory species only if a significant proportion of its global population occurs cyclically therein during the applicable migratory season. This is likely to be the case only for IUCN Red List assessed threatened migratory species potentially occurring in the EAAA or non-threatened migratory species otherwise known to occur cyclically in significant numbers in the EAAA.

The EAAA is situated within the Central Asian Flyway (CAF), which includes the entire Indian sub-continent. Owing to the presence of a few seasonal wetlands in the EAAA during the annual September to March period, which coincides with the chief migratory season with respect to the Indian sub-continent, it is likely that migratory waterbirds associated with CAF occur in the said wetlands or the aerial envelope of the EAAA, that during the

said period. However, considering the relatively small size of the said wetlands and lack of adequate suitable roosting or nesting areas in their vicinity, as also, inputs received from the local community, the said wetlands appear unlikely to support any congregations of the concerned non-threatened species to meet the corresponding thresholds required to trigger CH.

The nearest IBA or KBA designated for migratory and/or congregatory waterbirds as a species-group is the Bhal Area, which is situated approximately 60 km east of the EAAA and is thus, a significant distance away. The next nearest IBA or KBA designated for migratory and/or congregatory waterbirds is Bhashkarpara, which is situated approximately 75 km northeast of the Project Site. The nearest LPA, which is a known congregation site for migratory birds, namely Nalsarovar Bird Sanctuary, is situated approximately 70 km northeast of the Project Site. Thus, no significant migratory and/or congregatory habitat is reported from the EAAA applicable to the concerned migratory species.

Despite the low likelihood of the EAAA being CH for migratory species (as discussed above), on a precautionary basis 11 migratory species with potential to meet the applicable thresholds with respect to the EAAA were screened in as CH candidates as per ADB CH Criterion (iii). These are assessed in Appendix K. Appendix L presents a list of the migratory and/or congregatory species screened out of the Critical Habitat Assessment.

ADB CH Criterion (iv) – Congregatory Species

As per ADB SPS guidance, areas supporting globally significant concentrations or numbers of individuals of congregatory species qualify as CH. Congregatory Species are defined as species whose individuals gather in large groups on a cyclical or otherwise regular and/or predictable basis.

The EAAA is likely to support a globally significant concentration of a congregatory species only if a significant proportion of its global population occurs regularly or cyclically therein. This is likely to be the case only for globally threatened congregatory species known to occur in significant numbers in or near the EAAA.

No significant congregatory habitat is reported in or around the EAAA. The nearest IBA or KBA designated for migratory and/or congregatory waterbirds as a species-group is the Bhal Area, which is situated approximately 60 km east of the EAAA and is thus, a significant distance away. The next nearest IBA or KBA designated for migratory and/or congregatory waterbirds is Bhashkarpara, which is situated approximately 75 km northeast of the Project Site. The nearest LPA, which is a known congregation site for migratory birds, Nalsarovar Bird Sanctuary, is situated approximately 70 km northeast of the Project Site.

Despite the low likelihood of the EAAA being CH for congregatory species (as discussed above), on a precautionary basis, 12 congregatory species with potential to meet the applicable thresholds with respect to the EAAA were screened in as CH candidates as per ADB CH Criterion (iv). These are assessed in Appendix K. Appendix L presents a list of the migratory and/or congregatory species screened out of the Critical Habitat Assessment.

ADB CH Criterion (v) – Key Evolutionary Processes or Ecosystem Services

As per ADB SPS guidance, areas with unique assemblages of species that are associated with key evolutionary processes, or provide key ecosystem services, qualify as CH.

Assessment of the EAAA for ADB CH Criterion (v) is based on structural attributes such as topography, geology, soil, temperature and vegetation, or combinations of these variables, which can influence key evolutionary processes or give rise to ecological properties that provide key ecosystem services.

Features typically associated with key evolutionary processes include landscapes with high spatial heterogeneity, ecotones associated with high species and genetic diversity, edaphic interfaces associated with unique or rare plant communities and corridors that maintain meta-populations in otherwise fragmented habitats. No such features are reported from or were observed in the EAAA. Nor is the EAAA known to contain isolated sub-populations of any species nor any wildlife corridors that might drive speciation.

Features typically associated with key ecosystem services include significant direct dependence of local communities on water resources, wild food or fodder sources or natural features having religious, recreational or

aesthetic value. While the local community does reportedly utilize wild food or fodder sources, they are not significantly dependent on the same.

Thus, no key evolutionary processes or ecosystem services associated with the EAAA are likely to qualify as potential CH triggers with respect to ADB CH Criterion (v).

ADB CH Criterion (vi) – Biodiversity of Social, Economic, or Cultural Importance

As per ADB SPS guidance, areas having biodiversity of significant social, economic, or cultural importance to local communities, qualify as CH.

Assessment of the EAAA on towards ADB CH Criterion (vi) is based on site-specific observations recorded by the social experts on the AECOM team, inputs received from the local community, as also, national/regional level assessments carried out by governmental bodies, recognized academic institutions and/or internationally recognized NGOs.

The EAAA consists largely of unirrigated, moderately fertile, seasonally cultivated arable land with relatively low economic value. The few scattered patches of relic natural vegetation occurring therein represents a common forest type of semi-arid regions of India. As per data collated through the desk-based review, as well as inputs received from the local community, there is no significant social, economic or cultural value associated with the species or natural habitats of the EAAA.

Hence, the biodiversity of the EAAA is unlikely to qualify as a potential CH trigger as per ADB CH Criterion (vi).

ADB CH Criterion (vii) – Legally Protected Areas or areas officially proposed for protection

As per ADB SPS guidance, areas that are legally protected or are proposed for such protection, may qualify as CH. These include areas that meet the criteria of the World Conservation Union classification, the Ramsar List of Wetlands of International Importance, and the United Nations Educational, Scientific, and Cultural Organization's (UNESCO's) World Natural Heritage Sites.

As per the data collated through the desk-based review, the EAAA does not contain or overlap any areas that are legally protected or proposed for such protection, including areas that meet the criteria of the World Conservation Union classification, the Ramsar List of Wetlands of International Importance, or the UNESCO's World Natural Heritage Sites. As per inputs received from the Deputy Conservator of Forest, Surendranagar Division, who was consulted during the site visit, no Forest Land, a term denoting major or minor areas legally protected for biodiversity value, is situated within or near the Project Site.

*Note: A map depicting Forest Areas in Surendranagar District available on the Gujarat Forest Department's website (*https://forests.gujarat.gov.in/gis-eng.htm*) indicates that a few parts of the land marked as Option F in the KMZ of the Project Site boundary received from the Client overlaps a few Forest Areas marked in the said map. As per inputs received from the IT Cell of the Office of the Principal Chief Conservator of Forests (PCCF) & Head of Forest Force (HoFF), the said Forest Areas only represent areas appearing as forested lands in satellite imagery and do not represent legally protected areas. As per the Open Source ESRI Sentinel 2 LULC layer dated 2021, the said Option F land is designated as Rangeland. As per the Survey of India Toposheet (no. F42L7_41N7), the said Option F land is designated as Open Scrub. As per the applicable governmental terminology, neither the term 'Rangeland' nor the term 'Open Scrub' denote legally protected area.*

The major and minor legally protected areas (LPAs) nearest to the Project Site are as follows:

Rampara Wildlife Sanctuary

This is the nearest major LPA with respect to the EAAA. It is a nationally designated Wildlife Sanctuary, which qualifies as a Category IV IUCN Protected Area. It is situated 31.5 km northwest of the nearest point of the Project Site.

Thus, the EAAA does not overlap the Sanctuary and is situated a significant distance away from the nearest point on its boundary.

Hingolgadh Wildlife Sanctuary

This is the next nearest major LPA with respect to the EAAA. It is a nationally designated Wildlife Sanctuary qualifying as a Category IV IUCN Protected Area. It is situated 32.7 km south of the nearest point of the Project Site.

Thus, the EAAA does not overlap the Sanctuary and is situated a significant distance away from the nearest point on its boundary.

Bhal Area KBA

This is the nearest area with respect to the EAAA that is internationally recognized for biodiversity value. The Bhal Area is internationally designated as a KBA as it supports a large diversity of birds and other fauna. The KBA triggers include *Sypheotides indicus* (Lesser Florican or LF; IUCN Red List Status: CR). It is situated approximately 65 km southeast of the Project Site.

Thus, the EAAA does not overlap the KBA and is situated a significant distance away from the nearest point on its boundary. As per data collated through the desk-based review, as well as inputs received from the Forest Department, the said KBA is not proposed for any legal protection.

Thus, the EAAAEAAA neither overlaps, nor is situated in significant proximity to any area that is legally protected or proposed for legal protection. Hence, no part of the EAAA is likely to qualify as a CH Candidate with respect to ADB CH Criterion (vii).

Figure 4-21 presents a map indicating legally protected, as well as internationally recognized, areas of biodiversity value nearest to the EAAA.

Source: Source: IBAT PS6 & ESS6 Report. Generated under licence 35019-42818 from the Integrated Biodiversity Assessment Tool on 03 May 2023 (GMT). www.ibat-alliance.orgs; Open Street Map (https://www.openstreetmap.org/); Gujarat Forest Department (https://forests.gujarat.gov.in/index.htm); https://moef.gov.in/en/rules-and-regulations/esz-notifications/

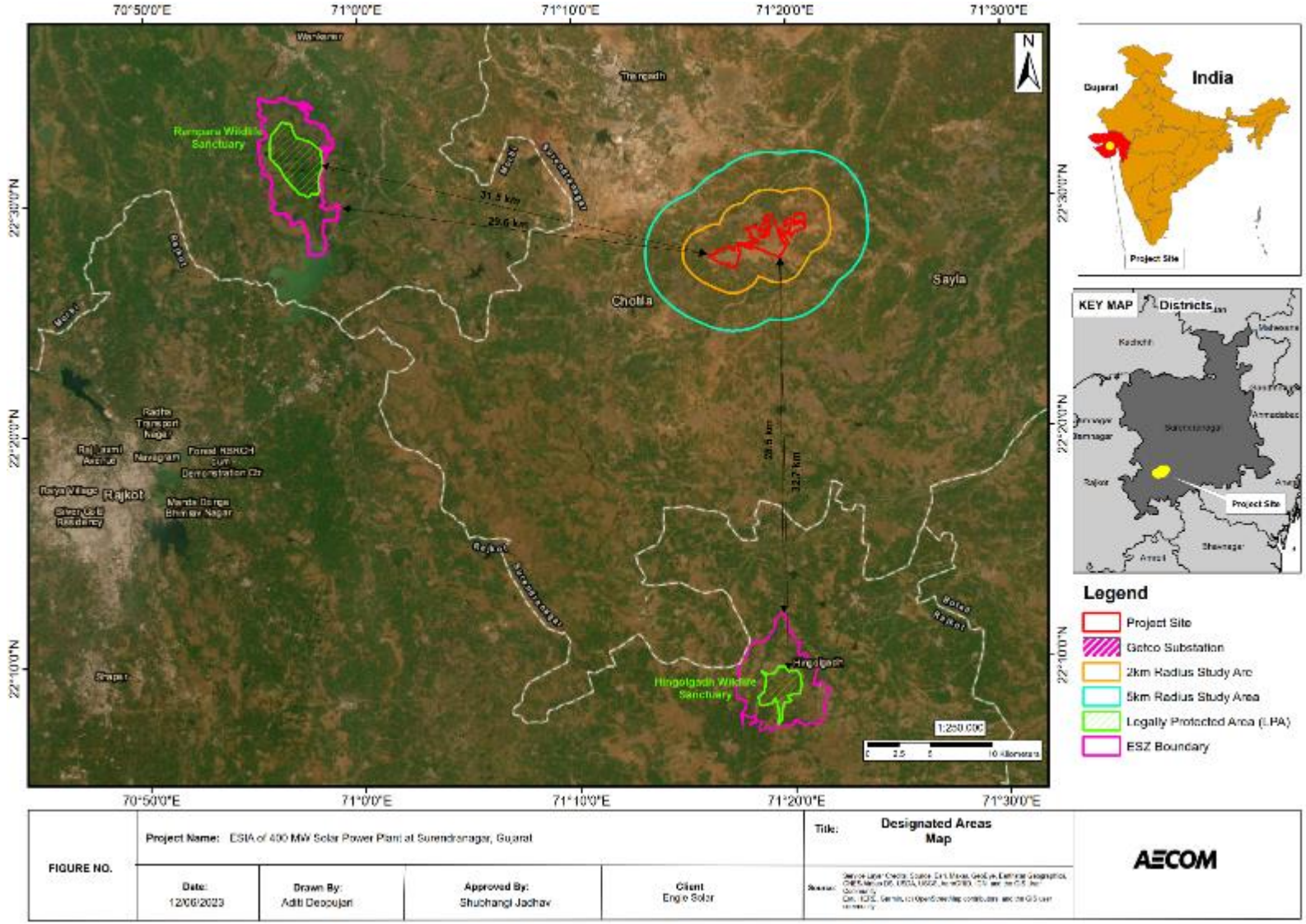


Figure 4-21: Map indicating major Legally Protected Areas nearest to the EAAA

Therefore, a total of 31 species, and no habitats, were screened in as CH Candidates with respect to the Project.

Table 4-15 presents the details of the CH Candidate species, along with the ADB CH criteria as per which each species qualifies as a CH Candidate.

Table 4-15: Details of CH Candidate Species

SN	Scientific Name	Applicable ADB CH Criteria	Global Population [Mature]	EOO	Elevation (m amsl)	Suitable Habitat Types*
Critically Endangered						
1	*Ardeotis nigriceps*	(i)	[50-249]	12500000	0-?	G, A
2	*Gyps bengalensis*	(i), (iv)	6,000-9,000	7370000	0-1500	F, S, Sh, G, U
3	*Gyps indicus*	(i), (iv)	[5000-15000]	2150000	0-2000	F, S, Sh, G, R, P, U
4	*Sarcogyps calvus*	(i), (iv)	3,500-15,000	5230000	0-2500	F, S, Sh, G, U
5	*Sypheotides indicus*	(i), (iii)	[356-1228]	520000	-	G, A
6	*Vanellus gregarius*	(i), (iii), (iv)	16,000-17,000	1620000	0-300	G, D, A, W
Endangered						
7	*Aquila nipalensis*	(i), (iii), (iv)	78,042-110,193	12600000	0-3000	F, S, G, R, D
8	*Falco cherrug*	(i), (iii), (iv)	[12200-29800]	19100000	0-4700	F, Sh, G, A, P, U, W
9	*Haliaeetus leucoryphus*	(i), (iii)	[1000-2499]	1740000	?-5000	W
10	*Manis crassicaudata*	(i)	-	-	0-1850	F, S, Sh, G, P, DF
11	*Neophron percnopterus*	(i), (iii), (iv)	18,600-54,000	50100000	0-4500	S, Sh, G, R, D, A, P, U, W
12	*Nilssonia gangetica*	(i)	-	-	20-1000	W
13	*Sterna acuticauda*	(i), (iv)	[900-1100]	4810000	0-700	W
Vulnerable						
14	*Aquila heliaca*	(i), (iii), (iv)	3,500-15,000	14900000	0-1600	
15	*Aquila rapax*	(i), (iv)	[100000-499999]	52700000	0-3000	F, S, Sh, G, A, P
16	*Aythya ferina*	(i), (iii), (iv)	1140000-1180000	548000	0-2690	W, M
17	*Bagarius bagarius*	(i)	-	3883000	-	W
18	*Chlamydotis macqueenii*	(iii)	50,000-99,999	13200000	-	G, D, P
19	*Clanga clanga*	(i), (iii), (iv)	[3900-10000]	15300000	0-1400	F, Sh, G, A, W, M
20	*Clanga hastata*	(i)	3,500-15,000	6560000	?-1000	F, A, P, W
21	*Columba eversmanni*	(iii)	15,000-29,999	3080000	0-2000	Sh, C, D, A, W

SN	Scientific Name	Applicable ADB CH Criteria	Global Population [Mature]	EOO	Elevation (m amsl)	Suitable Habitat Types*
22	*Crocodylus palustris*	(i)	[5700-8700]	-	?-420	W, M
23	*Grus antigone*	(i), (iii), (iv)	19,000-21,800	13800000	-	G, A, P, W
24	*Lissemys punctata*	(i)	-	-	0-500	W
25	*Rusa unicolor*	(i)	-	-	0-3900	F, S, Sh, G, Pl, DF, W
26	*Saxicola macrorhynchus*	(i)	3,500-15,000	97400		Sh, G, D
27	*Schoenicola striatus*	(iii)	3,500-15,000	1270000	?-460	Sh, G, W
28	*Sterna aurantia*	(i), (iv)	30,000-100,000	9330000	?-600	W, M
29	*Wallago attu*	(i)	-	10446620	-	W
Least Concern						
30	*Oenanthe javanica*	(ii)	-	4000	600-?	W
31	*Ophisops kutchensis*	(ii)	-	31981.96	55-195	Sh, G

**A - Arable Land, C – Caves & Sub-terranean Habitats, D - Desert, DF - Heavily Degraded Former Forest, F - Forest, G - Grassland, M - Marine, P - Pastureland, Pl - Plantation, R - Rocky Areas, S - Savanna, Sh - Shrubland, U - Urban Areas and W - Inland Wetland.*

Source: IBAT PS6 & ESS6 Report. Generated under licence 35019-42818 from the Integrated Biodiversity Assessment Tool on 03 May 2023 (GMT). www.ibat-alliance.orgs; The IUCN Red List of Threatened Species. Version 2022-2

Evaluation of the known attributes of each CH Candidate Species, in terms of its geographical distribution, global population, suitable habitat types and elevation range, against the attributes of the EAAA, resulted in 29 of the 31 CH Candidate Species being screened out as Potential CH Triggers with respect to the EAAA (Appendix K).

The 2 CH Candidate Species screened in through the CH Screening as Likely CH Triggers are *Sypheotides indicus* (Lesser Florican, CR) and *Ophisops kutchensis* (Kutch Small-scaled Snake-eye, LC). These are discussed in more detail below:

Ophisops kutchensis (Kutch Small-scaled Snake-eye, or 'KSS')

This species is restricted-range and resident in the EAAA. Described as a new species in the year 2018, it is one of the few endemic reptiles of the semi-arid landscapes of India. The extent of occurrence of the species is estimated to be 31982 sq km, occurring in several localities in Kutch, Gujarat, within an elevation range of 55-195 m asl. Information on the global population estimate of the species is not available.

It is a diurnal species recorded in open scrub and grassy habitats in semi-arid landscapes. It is known to be active in April and August, when subadults and adults have been recorded, respectively. It is collected from Banni Grasslands and Lakhpat Fort in Kutch, with historic records from Bhuj, Okha, Rajkot and Nal Sarovar Dam.

The EAAA forms approximately 0.4% of the total distribution range of the species, containing 9.8% suitable habitat-type which forms only ~0.04% of the total distribution range.

Mr Akshay Khandekar, one of the authors who described the species, was identified as the Subject Matter Expert and contacted via email on 7th June 2023. As reported by the SME, open scrub areas with gravelly substrate and dispersed shrubs are suitable habitat for the species. Modified or disturbed shrublands and savannas are less preferred by the species as it is extremely sensitive to disturbance.

Although the species is endemic, it is commonly found and widespread across its range owing to the homogenous habitat present throughout most of its range. It is active during the early morning hours, as during

the day the temperature is too high. The species is abundantly found, especially during its breeding season which is during the summer. After summer season, juveniles and sub-adults are observed. Although the global population of the species is not known, there may be at least hundred individuals in 1 sq km during the breeding season. This number is much less during the non-breeding season.

The species is highly sensitive to human presence and moves very quickly to seek shelter from any disturbance. Habitat loss is perceived to be the most significant impact to the species, as per the SME.

Based on the available information and SME inputs, it is apparent that the species is abundantly found as suitable habitat of the species is plentiful in its distribution range. Given that the suitable habitat within the EAAA forms only ~0.04% of its geographic range, the species is listed as Least Concern by the IUCN Red List, and the species is common across its geographic range, it is unlikely that the minimum number of individuals that meet the required threshold for the applicable CH criterion would occur in the EAAA. Hence, the species can be ruled out as a CH trigger with respect to the EAAA.

However, considering the endemic nature of the species and sensitive to disturbance, suitable mitigation measures may be undertaken by the project. Such mitigations measures are provided in the ESMP.

Sypheotides indicus (Lesser Florican, or 'LF')

This species is migratory. As per the IUCN Distribution Range map, the EAAA is situated within the breeding range of the species. The species breeds in Gujarat, Rajasthan, Madhya Pradesh, Maharashtra and Andhra Pradesh. The global population is estimated to be 356-1228 mature individuals, with a best estimate of 730 mature individuals. Its suitable habitat-types are grassland and arable land. The remaining strongholds of the species are thought to be Velavadar (Gujarat), with 96-115 displaying males where the population is concentrated in few sites at high density, and and Shokalyia-Bhinai (Rajasthan).

The species breeds during the southwest monsoon season, between May to September. It occurs in productive rain-fed grasslands greater than two hectares, in lowland areas (below 250 m), particularly dominated by *Sehima nervosum* and *Chrysopogon fulvus*, with scattered bushes and scrub such as *Zizyphus sp.* and *Acacia sp.* (Dutta et al. 2018). Such areas with grass cover and scattered bushes, categorized as savanna, form 9.8% of the EAAA. LF has also been recorded breeding in cultivated field of *Glycine max* (Soybean), *Arachis hypogea* (Groundnut) and less frequently in *Sorghum vulgare* (Sorghum), *Zea mays* (Maize), *Saccharum* (Sugarcane) and *Triticum vulgare* (Wheat), as well as grassland in forest plantations. During the non-breeding season, LF is found in a range of grassland habitats and crop fields. Arable land habitat-type forms 77% of the EAAA. Therefore, although the EAAA does not contain grasslands, the EAAA contains approximately 87% suitable habitat.

The EAAA constitutes approximately 0.1% of the breeding range of LF. Approximately 87% of the EAAA contains habitat-types deemed suitable to LF.

Dutta et al. (2018) conducted a status survey during July-September 2017 throughout the breeding range of the LF and presented a breeding status survey report. As per the report, LF was only detected from Velavadar in the Saurashtra region. However, a location near Chobari Village, situated approximately 22 km south of the Project Site, was reported to have relatively high model-predicted breeding occupancy probability. Similarly, other high breeding occupancy probability locations, predicted by the model, in proximity to the Project Site, are near Surendranagar (45 km northeast), Velavadar (86 km southeast) and Amreli (100 km South). The location of the Project Site with respect to these high breeding occupancy probability regions is presented in the Figure 5-1. As per a preliminary breeding conservation priority map presented in the report, the EAAA is situated in low breeding conservation priority region, with high breeding conservation priority areas approximately 86km from the Project Site in the Blackbuck National Park, Velavadar and its adjoining area in Bhavnagar District.

As per received inputs from the Rajkot Forest Department for a previous assignment, a breeding population of LF occurs regularly during June, July and August each year, in Padawla Vidi, Valadhari Vidi and Karvanthali Vidi, all community-designated grasslands situated approximately 57, 72 and 84 km southwest of the Project Site.

As per records on the citizen-science portal, eBird, the nearest records of the species are from Lakhatar (60 km northeast), Gondal (80 km southwest), Nal Sarovar (80 km east) and Bagodara (90 km east). As per Sureja et. al. (2022), and Mori et al (2017), the bird is reported to be either absent or locally very rare in Rajkot district but recorded in Surendranagar. Breeding records in Surendranagar are reported from Kherva and Gediya, approximately 70 km northeast of the Project Site.

As per the discussion with the Deputy Conservator of Forest (DCF), Surendranagar Division, it was noted that LF has been recorded from Dhrangadhra and Lakhtar ranges, but not reported from Sayla Range, wherein the EAAA is located. In Dhrangadhra, the species is reported from Patdi, which is situated approximately 90 km north of the Project Site. No historic records from the EAAA were reported by the DCF. While the range does have presence of *vidis*, which are grassland habitats used for grazing, there are no reserved or protected *vidis* in the Sayla Range. One of the large *vidis* near the Project Site is located in Chorvira, Thangadh which is approximately 10 km north of the Project Site.

Dr Devesh Gadhavi, Deputy Director, The Corbett Foundation (Kutch Division) and IUCN SSC Bustard Specialist Group Member was identified as a Subject Matter Expert with respect to LF. He was contacted via email on 8th June 2023. The SME confirmed that the EAAA contains habitats suitable to LF. However, no recent reports or published literature reporting presence of LF in the vicinity of the EAAA is available. The historic records as old as 1999 (Sankaran 2000), as referenced by the SME, mention four grasslands in Surendranagar District, Anandapur in Chotila, Chorwira and Sangadra in Thanghad and Chikasar in Zainabad. Out of these, LF has been last recorded from Sangadra in the year 1994. Dr Gadhavi informed that making any assumptions about presence and/or number of individuals of LF occurring in the EAAA would be difficult without LF-focused primary surveys. According to Dr. Gadhavi, at least 2 LF-focused surveys of 3 months each from July-September (breeding season) and October to December (non-breeding season) would need to be conducted by highly experienced and skilled observers to identify LF presence, if any, in the EAAA. These surveys would need to be complemented with habitat surveys involving vegetation sampling, as also, social surveys. According to Dr. Gadhavi, transmission lines having a capacity of 33 kV or less present major risk to the species, while an underground 220 kV line is unlikely to have a major impact on the species.

A Subject Matter Expert (SME), Dr. Sujit Narwade, Principal 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, though there are no recent records of the species from the EAAA, the said area is considered under-observed with respect to LF.

Recent satellite telemetry-based evidence indicates that LF traverses vast distances annually, ranging to over a thousand kilometres across its non-breeding range during its non-breeding season, but it shows considerable site fidelity with respect to breeding sites during its breeding season which is known to coincide with the annual regional monsoon season from approximately late June to early October.

Given the significantly low estimated population and significantly large apparent home-range of the species, any LF-focused monitoring in the EAAA is deemed unlikely to generate conclusive evidence of cyclical presence regarding presence or absence of the species therein.

Under CH Criterion 1, the applicable CH trigger threshold consists of 2 components. The first component is regular or cyclical occurrence of 0.5% of the global population of the species within the EAAA. For LF, 0.5 % of its global population is technically equivalent to only 1 individual. The EAAA fully overlaps the geographical range of the LF. Approximately 87% of the EAAA is composed of habitat types deemed suitable to LF. The EAAA is situated well within the known ranging distance of LF from its nearest documented sightings. LF is also the trigger species of the nearest KBA with respect to the EAAA. Thus, it is not unlikely for 1 individual of LF to occur in the EAAA. The second component is regular or cyclical occurrence of at least 5 reproductive units of the species within the EAAA. As per available data, it is unlikely that the minimum number of individuals of the species, required to meet the second component of the applicable CH trigger threshold, would occur in the EAAA. Hence, LF is unlikely to fully qualify as a CH trigger under Criterion 1 with respect to the EAAA.

Under CH Criterion 3, the applicable threshold is 1% of the global population or distribution (etc.) of a species within an EAAA. For Lesser Florican, this equates to two individuals. It is clear there are insufficient data to confirm whether two individuals are likely to regularly use the EAAA. However, the proximity to breeding habitats, the migration route of the species southwards from breeding grounds (in many cases therefore across the latitude of this project), and the suitability of habitats in the EAAA to this species, all combine to suggest that it is not unlikely that two Lesser Florican may regularly use the EAAA during migration or post-breeding dispersal.

As per international good practice guidance, considering the highly globally threatened status of the species and its migratory nature, it would be appropriate to take a precautionary approach and assume that the regular use of the EAAA by at least two Lesser Florican is likely. For these reasons, the EAAA is precautionarily considered to be CH with respect to LF.

A precautionary measure recommended to reasonably ensure mitigation of Project-induced risk with respect to LF could consist of institution of a Chance Find Procedure (CFP) at the Project Site. The said CFP would need to be designed to ensure appropriate action by Project personnel in the event of an LF individual being detected in or around the Project Site during the life of the Project.

Note: Please refer to the Critical Habitat Screening Report for details on the screening methodology, observations, screening rationales and conclusions.

4.4 Socio Economic Profile

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, etc.

4.4.1 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;
- Consultations with the Women Members and Agriculture Labours were undertaken; and
- Consultations with members involved in animal grazers were undertaken.

Socio-Economic Baseline from the macro (district) level to micro (village) level was developed through consultations and is supplemented through secondary data base available in the public domain. As presented 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, Gujarat.

4.4.2 Administrative Profile

4.4.2.1 State profile: Gujarat

Gujarat State lies in the western coast of India, with the longest coastline in India of 1600km. Gujarat is the fifth largest Indian state by area and ninth most populous state in India. Gujarat State is bordered by Rajasthan to the northeast, Dadra and Nagar Haveli and Daman and Diu to the south, Maharashtra to the southeast, Madhya Pradesh to the east, and the Arabian Sea and the Pakistani to the west. Gandhi Nagar is being the capital city of Gujarat State and Ahmedabad is being the largest city. Gujarat is a leading industrial state in India and has been recognised nationally and globally for offering a conducive business ecosystem. Spread across roughly about six per cent of India's geographical area and home to five percent of the national population, Gujarat accounts for almost eight per cent of India's Gross Domestic Product (GDP). As per the 2020 Export Preparedness Index report of NITI Aayog, Gujarat topped the index with a strong display in export promotion Policy, business environment as well as infrastructure. Gujarat ranks 21st among Indian states and union territories in human development index. Gujarat ranks 21st among Indian states and union territories in human development index.

The Narmada is the largest river in Gujarat followed by the Tapi. The Sardar Sarovar dam project in the Narmada valley consisting of a network of canals, has significantly increased irrigation in the region. There are three international airports (Ahmedabad and Surat, Vadodara) and nine domestic airports. Gujarat comes under the Western Railway Zone of the Indian Railways. Ahmedabad Railway Station is the most important, centrally located and biggest railway station in Gujarat which connects to all important cities of Gujarat and India.

Gujarat potentially accounts for 14% of the total Renewable Energy Power generated in India and 74.21% of the total solar energy produced by the nation. With a total of 8,887 megawatts (MW) of installed solar energy capacity and 9,925 MW of installed Wind Energy Capacity, Gujarat State ranks second among all states in India.

Gujarat Population Census Data shows that it has Total Population of 6.03 Crore which is approximately 4.99% of total Indian Population. Literacy rate in Gujarat has seen upward trend and is 79.31% as per 2011 population census. Of that, male literacy stands at 87.23% while female literacy is at 70.73%. Urban Population of the State is 42.6%, which used to be at 37.4% in 2001. Rural population in the state in 2011 fell to 57.4% from 62.6% in 2001. Ahmedabad is the most populated District in the State, with 7.20 million people, up 11.94% from 2001, followed by Surat with 6.07 million people, up 10.07%. Sex Ratio in Gujarat is 919 i.e. for each 1000 male, which is below national average of 940 as per Census 2011.

Demographic profile of the state of Gujarat has been provided in Table below.

Table 4-16: Demographic Profile of State of Gujarat

Description	2011	2001
Population	60,439,692	50,671,017
Male	31,491,260	26,385,577
Female	28,948,432	24,285,440
Population Growth	19.28%	22.48%
Percentage of total Population	4.99%	4.93%
Sex Ratio	919	920
Child Sex Ratio	890	883
Density/km2	308	258
Area (Km)	196,244	196,024
Total Child Population (0-6 Age)	7,777,262	7,532,404
Literacy	78.03 %	69.14 %
Male Literacy	85.75 %	79.66 %
Female Literacy	69.68 %	57.80 %

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

4.4.2.2 District profile: Surendranagar

The Surendranagar district mainly falls in North Saurashtra Agro-Climatic Zone. It lies between 2208' to 23038' North latitudes and 7100' to 7202' East longitudes. It is bounded on the north by the little Rann (Desert) of Kachchh and the Patan district and in south by parts of Ahmadabad and Bhavnagar districts, on the west it is bounded by the Rajkot district and on the east again by the Ahmadabad district. Area wise, the district ranks 5th among all the districts of the State. The population density of the district was only 138 persons per sq. km compared to 308 person per sq. km. density of Gujarat. The climate of this district is characterized by a hot summer and general dryness except during the south-west monsoon season. Surendranagar is a base for industrial sectors such as, textiles, chemicals, ceramics and food processing industries. Textiles and chemicals have been the major sectors of investment and employment in the district. There are 8,639 SSI and 33 large scale industries established in the district. All 651 villages in the district are electrified. The pattern of cropping is almost the same throughout the district, varying according to the local conditions and needs. The principal crops in this district are cotton, followed by bajri, jowar, wheat, barely; moong, math, gram and sesame, while among non-food crops, cotton and groundnut occupy a pride of place.

According to 2011 Census the total population of Surendranagar district is 1,75,62,68 comprising 9,09,917 males (51.8%) and 8,46,351 females (48.2%). The population of Surendranagar district is 2.9 Percent of total population of Gujarat State and it ranks 16th among 26 districts of the State. The rural population of the district is 1,25,93,52 comprising 6,49,475 males (51.6%) and 6,09,877 females (48.4%), which is distributed among 647 inhabited villages in 10 talukas[24]. There are four uninhabited villages in the district. The urban population of the district is 4,96,916 comprising 2,60,442 males (52.4%) and 2,36,474 females (47.6%) spread over nine towns.

4.4.2.3 Study Area

The proposed project site land spreads across three revenue villages namely Dhedhuki, Ratanpar and Shapar is considered to the direct impact zone. For the study, the project site is 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). Twenty revenue villages from Chotila and Sayla Tehsil falls within the 5-kilometre radius of the project site. Being a solar power project, it is expected that the area of influence of the project will be within five (05) kilometre and the socio-economic impact 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.

[24] an administrative district for taxation purposes, typically comprising a number of villages.

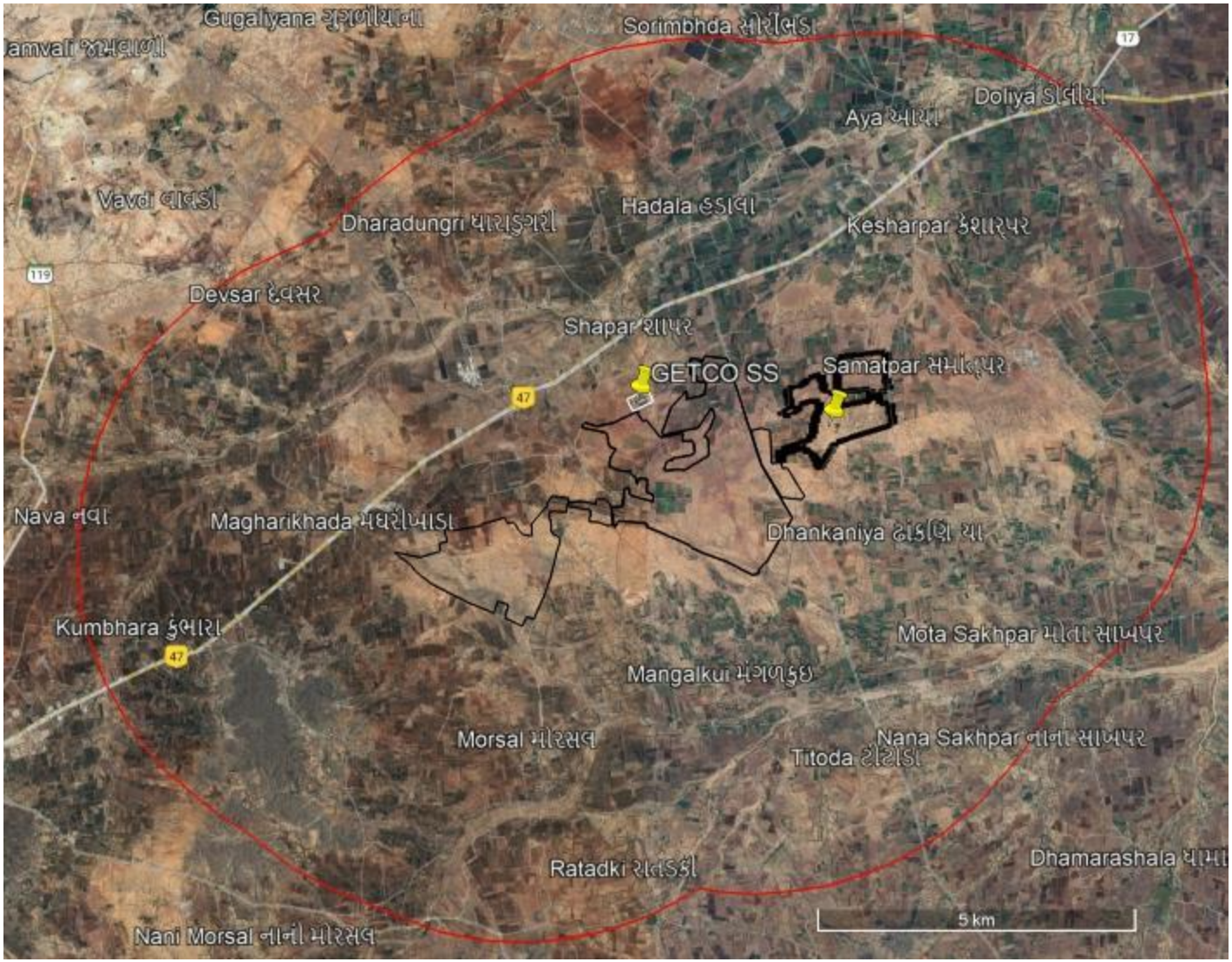


Figure 4-22: Map showing the Study Area Villages

Table 4-17: Revenue Villages falling within five (05) kilometre radii.

District	Tehsil	Revenue Villages
Buffer		
Surendranagar	Chotila	Devsar
		Magharikhada
		Mota Kandhasar
		Nana Kandhasar
		Rajavad
		Sakhpar
		Sangani
	Sayla	Aya
		Brahmapuri (Vanki)
		Dhankaniya
		Dharadungri
		Doliya
		Hadala
		Kesarpar
		Morsal
		Ratadki
		Ratanpar
		Samatpar
		Sonpari
		Titoda
Core		
Surendranagar	Sayla	Dhedhuki
		Ratanpar
		Shapar

4.4.3 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.

4.4.3.1 Population level

Table below represents the population level of the study area.

Table 4-18: Population Level

Administrative Unit	Households	Total Population	Male Population	Female Population	Sex Ratio
District					
Surendranagar	**343213**	**1756268**	**909917**	**846351**	**930**
Core Zone Villages	**547**	**2857**	**1499**	**1358**	**906**
Dhedhuki	193	1036	542	494	911

Administrative Unit	Households	Total Population	Male Population	Female Population	Sex Ratio
Ratanpar	120	624	320	304	950
Shapar	234	1197	637	560	879
Buffer Zone Villages	**3884**	**21523**	**11150**	**10373**	**930**
Aya	113	490	260	230	885
Brahmapuri (Vanki)	74	390	201	189	940
Devsar	259	1515	811	704	868
Dhankaniya	86	382	195	187	959
Dharadungri	216	1591	816	775	950
Doliya	586	3106	1589	1517	955
Hadala	193	1165	609	556	913
Kesarpar	142	885	452	433	958
Magharikhada	198	1034	544	490	901
Morsal	245	1226	616	610	990
Mota Kandhasar	187	941	493	448	909
Nana Kandhasar	244	1309	691	618	894
Rajavad	265	1530	794	736	927
Ratadki	245	1262	632	630	997
Ratanpar	120	624	320	304	950
Sakhpar	35	188	99	89	899
Samatpar	215	1309	664	645	971
Sangani	229	1179	615	564	917
Sonpari	86	400	211	189	896
Titoda	146	997	538	459	853

Source: Primary Census Abstract, Census 2011

It can be noted from the table above the direct impact villages i.e., core zone villages comprise of 0.16% (2,857) and Buffer Zone villages i.e., the indirect impact villages comprise of 1.22% (21,523) of the total population Surendranagar District. The sex ratio in the core zone villages was 906 females for 1000 males and buffer zone villages it was 930 where the district sex ratio was 930.

4.4.3.2 Vulnerable groups

Vulnerable groups are those groups of people who may find it difficult to lead a comfortable life and lack developmental opportunities due to their disadvantageous positions. Further, due to adverse socio-economical, cultural and other practices present in each society, they find it difficult many a times to exercise their human rights fully[25].

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)

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

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. Within the project site villages Scheduled Caste population are present in Dhedhuki (10.33%) and Shapar (3.34%) Villages and Scheduled Tribe Population are present in Shapar Village (0.33%). Based on consultation with the locals and village representatives it was reported that SC / ST are not socially secluded, and they live along with the mainstream people.

Table 4-19: Presence of Scheduled Caste and Scheduled Tribe population in the study area

Administrative Unit	Population	Scheduled Caste	Scheduled Tribes
District			
Surendranagar	**17,56,268**	**179,461 (10.22%)**	**21,453 (1.22%)**
Core	**2857**	**147 (5.15%)**	**4 (0.14%)**
Dhedhuki	1036	107 (10.33%)	0 (0%)
Ratanpar	624	0 (0%)	0 (0%)
Shapar	1197	40 (3.34%)	4 (0.33%)
Buffer	**21,523**	**988 (4.59%)**	**11 (0.05%)**
Aya	490	68 (13.88%)	0 (0%)
Brahmapuri (Vanki)	390	0 (0%)	0 (0%)
Devsar	1515	45 (2.97%)	5 (0.33%)
Dhankaniya	382	20 (5.24%)	0 (0%)
Dharadungri	1591	14 (0.88%)	0 (0%)
Doliya	3106	127 (4.09%)	6 (0.19%)
Hadala	1165	123 (10.56%)	0 (0%)
Kesarpar	885	0 (0%)	0 (0%)
Magharikhada	1034	8 (0.77%)	0 (0%)
Morsal	1226	24 (1.96%)	0 (0%)
Mota Kandhasar	941	64 (6.8%)	0 (0%)
Nana Kandhasar	1309	52 (3.97%)	0 (0%)
Rajavad	1530	267 (17.45%)	0 (0%)
Ratadki	1262	166 (13.15%)	0 (0%)
Ratanpar	624	0 (0%)	0 (0%)
Sakhpar	188	0 (0%)	0 (0%)
Samatpar	1309	5 (0.38%)	0 (0%)
Sangani	1179	0 (0%)	0 (0%)
Sonpari	400	0 (0%)	0 (0%)
Titoda	997	5 (0.5%)	0 (0%)

Source: Primary Census Abstract, Census 2011

With respect to the study area villages highest number of SC population were reported in Rajavad village (17.4%) and highest Scheduled Tribe population were reported to present in Shapar (0.33%) and Devsar (0.33%).

Based on the field observations and outcome of the stakeholder consultation it hereby confirmed that there is no presence of Scheduled Tribe population or no livelihood dependency of any scheduled tribe on the said project

site land and no land belonging to scheduled tribe or Assigned land is being involved in the project. The Scheduled caste population in the study area are usually involved in agriculture works.

4.4.3.3 Gender Profile

The table below represents the gender profile of the study area.

Table 4-20: Gender Profile

Administrative Unit	Sex Ratio	Child Sex Ratio	Male Literates	Female Literates	Male Workers	Female Workers
District						
Surendranagar	**930**	**896**	**82.1%**	**61.5%**	**55.4%**	**25.9%**
Core	**906**	**1000**	**74.8%**	**49.0%**	**55.2%**	**18.9%**
Dhedhuki	911	840	70.2%	49.9%	51.5%	1.8%
Ratanpar	950	1015	69.3%	43.5%	57.8%	9.9%
Shapar	879	1176	81.0%	51.2%	57.0%	38.8%
Buffer	930	906	71.4%	47.3%	54.5%	42.1%
Aya	885	694	84.8%	61.7%	58.5%	60.4%
Brahmapuri (Vanki)	940	786	81.1%	57.1%	53.7%	56.1%
Devsar	868	938	74.8%	45.0%	51.9%	48.4%
Dhankaniya	959	893	83.2%	58.0%	54.9%	5.9%
Dharadungri	950	950	51.2%	33.4%	59.4%	60.0%
Doliya	955	1013	75.4%	56.9%	56.2%	32.2%
Hadala	913	990	68.6%	46.4%	57.1%	48.2%
Kesarpar	958	819	70.6%	45.5%	53.1%	18.0%
Magharikhada	901	870	86.5%	56.1%	53.3%	55.9%
Morsal	990	950	63.2%	41.2%	53.6%	52.3%
Mota Kandhasar	909	860	74.2%	43.6%	52.9%	20.8%
Nana Kandhasar	894	719	67.1%	36.9%	51.5%	7.9%
Rajavad	927	954	78.8%	59.2%	52.6%	55.3%
Ratadki	997	900	63.8%	49.2%	51.4%	51.6%
Ratanpar	950	1015	69.3%	43.5%	57.8%	9.9%
Sakhpar	899	563	81.9%	57.5%	56.6%	64.0%
Samatpar	971	1016	69.2%	42.3%	53.9%	39.2%
Sangani	917	908	78.7%	44.8%	52.8%	56.4%
Sonpari	896	763	68.2%	36.9%	59.2%	58.7%
Titoda	853	817	62.2%	37.1%	53.7%	50.3%

Source: Primary Census Abstract, Census 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 906 and 930 females per 1000 males respectively, with respect district it was 930. Based on review of the above data, the sex ratio among all administrative units are reported to be fair when compared to the State and national rate. The lowest sex ratio was reported in Titoda village (853), whereas the lowest children sex ratio in the Sakhpar village (563) compared to the district rate (896).

Education Level of Women

Literacy level amongst the women in the core and buffer zone of the study area was 49.0% and 47.3% respectively, Dharadungri village in the buffer zone seems to have lowest women literacy rate of 33.4%. On review of the literacy rate among all the administrative units presented in table above, it was observed that the female literacy rates in all administrative units were seems to less when compared to the male literacy level. However, it was reported during consultation with the women groups, that girl children are encouraged to take up higher education in the recent past. Various initiatives were taken by the Government in order to improve and promote inclusive education. Few notable schemes are Beti Bachao Beti Padhao, Sukanya Samriddhi Yojana, Bal Pravesh | Mid Day Meal Schemes, Nirogi Bal, Vidhyalaxmi Bonds, Vidhya Deep Yojna, Kanya Kelavani, National Scheme of Incentive for the Girls of Secondary Education, etc. which have been launched and implemented with the primary objective to empower the girl child and ensure her education, essentially addressing the pre and post birth discrimination against the girl child.

Women Participation in Workforce

Overall, the women participation in the workforce in the region is less than that of male workforce participation. With respect to the study area, 18.9% for the core zone villages and 42.1% for the buffer zone villages are involved in economic activity. The lowest female workforce participation was observed in Dhedhuki village (1.8%). It was reported during the consultation with the opinion leaders and women groups, generally the people in the region encourages the girl children to pursue higher education and in general the average age for marriage for girl is around 20-22 years. Women are usually reported to be involved in agriculture labour work.

Political participation, decision-making and agency

As per Article 243D of the Constitution of India provides for not less than one-third reservation for women out of total number of seats to be filled by direct election and number of offices of chairpersons of Panchayats. However, as per the information available with the Ministry, 23 States including Gujarat made provision of 50% reservation for women in Panchayati Raj Institutions.

Crime and Domestic Violence Against Women

As per NCRB Report 2020, in total 111 crimes were registered under Indian Penal Code (IPC) and Special and Local Laws (SLL). Of which 15 cases have been reported to be Cruelty by Husband or his relatives, no cases were registered on Kidnapping & Abduction of Women, 10 reported cases of Rape, about 51 cases were reported under Child Rape and there were no reported cases on domestic violence. Based on the outcome of the consultation with the women groups in the study area villages, it was reported that there are no reported such case in the recent past and women and girls are free to move without fear and have been reported to be equally treated, girl children are encouraged to pursue higher education, given property rights, etc.

4.4.4 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 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 below:

Table 4-21: Literacy profile of Study Area

Administrative Unit	Total Population	Literate Population	Literate Male Population	Literate Female Population
District	**17,56,268**	**10,93,626 (72.1%)**	**643,221 (82.1%)**	**450,405 (61.5%)**
Surendranagar	**17,56,268**	**10,93,626 (72.1%)**	**643,221 (82.1%)**	**450,405 (61.5%)**
Core	**2857**	**1461 (62.7%)**	**924 (74.8%)**	**537 (49%)**
Dhedhuki	1036	508 (60.4%)	306 (70.2%)	202 (49.9%)

Administrative Unit	Total Population	Literate Population	Literate Male Population	Literate Female Population
Ratanpar	624	279 (56.8%)	176 (69.3%)	103 (43.5%)
Shapar	1197	674 (67.5%)	442 (81%)	232 (51.2%)
Buffer	**21523**	**10527 (59.8%)**	**6498 (71.4%)**	**4029 (47.3%)**
Aya	490	300 (73.7%)	179 (84.8%)	121 (61.7%)
Brahmapuri (Vanki)	390	218 (69.2%)	129 (81.1%)	89 (57.1%)
Devsar	1515	735 (61.1%)	486 (74.8%)	249 (45%)
Dhankaniya	382	233 (70.8%)	139 (83.2%)	94 (58%)
Dharadungri	1591	528 (42.5%)	326 (51.2%)	202 (33.4%)
Doliya	3106	1762 (66.4%)	1029 (75.4%)	733 (56.9%)
Hadala	1165	559 (58.1%)	348 (68.6%)	211 (46.4%)
Kesarpar	885	403 (58.1%)	245 (70.6%)	158 (45.5%)
Magharikhada	1034	621 (72%)	391 (86.5%)	230 (56.1%)
Morsal	1226	517 (52.2%)	313 (63.2%)	204 (41.2%)
Mota Kandhasar	941	465 (59.5%)	302 (74.2%)	163 (43.6%)
Nana Kandhasar	1309	565 (52.5%)	373 (67.1%)	192 (36.9%)
Rajavad	1530	854 (69.4%)	505 (78.8%)	349 (59.2%)
Ratadki	1262	594 (56.4%)	333 (63.8%)	261 (49.2%)
Ratanpar	624	279 (56.8%)	176 (69.3%)	103 (43.5%)
Sakhpar	188	114 (69.9%)	68 (81.9%)	46 (57.5%)
Samatpar	1309	589 (56%)	371 (69.2%)	218 (42.3%)
Sangani	1179	620 (62.5%)	407 (78.7%)	213 (44.8%)
Sonpari	400	177 (53.2%)	118 (68.2%)	59 (36.9%)
Titoda	997	394 (50.6%)	260 (62.2%)	134 (37.1%)

Source: Primary Census Abstract, Census 2011

Table above represents the literacy level in the study area. It can be noted that the literacy level in the core and buffer zone was 67.2% and 59.8% 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. At the village level, the lowest literacy rate (42.5%) was at Dharadungri Village and highest literacy rate (73.7%) was at Aya Village. During consultations with the revenue officials and village representatives, it was stated that the people are encouraging their children to pursue higher education. With respect to educational facilities primary schools are located in all project villages and the nearest Hr. Secondary school is located at Dhedhuki Village are accessed to the schools up to Higher

Secondary (12th Std.) and the nearest higher education facilities such as colleges and skill development institutes are accessible from the nearby towns Surendranagar, Rajkot, etc.

4.4.5 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[26].

Table below denotes that majority of the population in all administrative units are engaged in agricultural activities as their main occupation. Within the study area, about 80.5% (35.4% Cultivators and 45.1% Agriculture Labours) of the workers from core zone villages and 88.8% (44.6% Cultivators and 44.2% 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 and the agriculture activities are dependent on monsoon, majorly only one crop is being cultivated and few with borewell irrigation facility are cropping 2nd crop and few patches of plantations like Guava, Lemon, etc, were observed during the field study. There are no major industries in the region and no renewable energy projects within the study area. The educated youths from the study area villages have mostly migrated to the nearby towns and cities in search of decent jobs. Grazing activities were observed within the vicinity of the project villages, and it was reported Rabari Community involved in cattle rearing as primary source of livelihood. Based on the consultation with the shepherds, revenue officials, and few neighbouring landowners reveals that the proposed project site land does not involve any Gaucher Lands (Grazing Land) and they expressed that there would not be any adverse impact or loss of livelihood due to the proposed project.

[26] The type of workers that come under this category of 'Other Workers' 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 4-22: 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
District	**723500 (41.2%)**	**504038 (55.4%)**	**219462 (25.9%)**	**81.0%**	**185235 (25.6%)**	**142740 (28.3%)**	**42495 (19.4%)**	**270861 (37.4%)**	**143498 (28.5%)**	**127363 (58%)**	**9518 (1.3%)**	**6193 (1.2%)**	**3325 (1.5%)**	**257886 (35.6%)**	**211607 (42%)**	**46279 (21.1%)**
Surendranagar	723500 (41.2%)	504038 (55.4%)	219462 (25.9%)	81.0%	185235 (25.6%)	142740 (28.3%)	42495 (19.4%)	270861 (37.4%)	143498 (28.5%)	127363 (58%)	9518 (1.3%)	6193 (1.2%)	3325 (1.5%)	257886 (35.6%)	211607 (42%)	46279 (21.1%)
Core	**1083 (37.9%)**	**827 (55.2%)**	**256 (18.9%)**	**91.2%**	**383 (35.4%)**	**293 (35.4%)**	**90 (35.2%)**	**488 (45.1%)**	**341 (41.2%)**	**147 (57.4%)**	**0 (0%)**	**0 (0%)**	**0 (0%)**	**212 (19.6%)**	**193 (23.3%)**	**19 (7.4%)**
Dhedhuki	288 (27.8%)	279 (51.5%)	9 (1.8%)	91.3%	84 (29.2%)	83 (29.7%)	1 (11.1%)	112 (38.9%)	106 (38%)	6 (66.7%)	0 (0%)	0 (0%)	0 (0%)	92 (31.9%)	90 (32.3%)	2 (22.2%)
Ratanpar	215 (34.5%)	185 (57.8%)	30 (9.9%)	100.0%	79 (36.7%)	74 (40%)	5 (16.7%)	128 (59.5%)	104 (56.2%)	24 (80%)	0 (0%)	0 (0%)	0 (0%)	8 (3.7%)	7 (3.8%)	1 (3.3%)
Shapar	580 (48.5%)	363 (57%)	217 (38.8%)	87.9%	220 (37.9%)	136 (37.5%)	84 (38.7%)	248 (42.8%)	131 (36.1%)	117 (53.9%)	0 (0%)	0 (0%)	0 (0%)	112 (19.3%)	96 (26.4%)	16 (7.4%)
Buffer	**10435 (48.5%)**	**6072 (54.5%)**	**4363 (42.1%)**	**77.8%**	**4659 (44.6%)**	**3263 (53.7%)**	**1396 (32%)**	**4406 (42.2%)**	**1895 (31.2%)**	**2511 (57.6%)**	**18 (0.2%)**	**9 (0.1%)**	**9 (0.2%)**	**1352 (13%)**	**905 (14.9%)**	**447 (10.2%)**
Aya	291 (59.4%)	152 (58.5%)	139 (60.4%)	61.9%	121 (41.6%)	101 (66.4%)	20 (14.4%)	160 (55%)	43 (28.3%)	117 (84.2%)	3 (1%)	2 (1.3%)	1 (0.7%)	7 (2.4%)	6 (3.9%)	1 (0.7%)
Brahmapuri (Vanki)	214 (54.9%)	108 (53.7%)	106 (56.1%)	34.1%	51 (23.8%)	49 (45.4%)	2 (1.9%)	147 (68.7%)	48 (44.4%)	99 (93.4%)	1 (0.5%)	1 (0.9%)	0 (0%)	15 (7%)	10 (9.3%)	5 (4.7%)
Devsar	762 (50.3%)	421 (51.9%)	341 (48.4%)	55.4%	253 (33.2%)	167 (39.7%)	86 (25.2%)	290 (38.1%)	58 (13.8%)	232 (68%)	3 (0.4%)	1 (0.2%)	2 (0.6%)	216 (28.3%)	195 (46.3%)	21 (6.2%)
Dhankaniya	118 (30.9%)	107 (54.9%)	11 (5.9%)	98.3%	42 (35.6%)	37 (34.6%)	5 (45.5%)	47 (39.8%)	42 (39.3%)	5 (45.5%)	0 (0%)	0 (0%)	0 (0%)	29 (24.6%)	28 (26.2%)	1 (9.1%)
Dharadungri	950 (59.7%)	485 (59.4%)	465 (60%)	99.4%	265 (27.9%)	130 (26.8%)	135 (29%)	682 (71.8%)	353 (72.8%)	329 (70.8%)	0 (0%)	0 (0%)	0 (0%)	3 (0.3%)	2 (0.4%)	1 (0.2%)
Doliya	1381 (44.5%)	893 (56.2%)	488 (32.2%)	87.5%	611 (44.2%)	430 (48.2%)	181 (37.1%)	524 (37.9%)	257 (28.8%)	267 (54.7%)	1 (0.1%)	1 (0.1%)	0 (0%)	245 (17.7%)	205 (23%)	40 (8.2%)
Hadala	616 (52.9%)	348 (57.1%)	268 (48.2%)	87.7%	347 (56.3%)	219 (62.9%)	128 (47.8%)	215 (34.9%)	98 (28.2%)	117 (43.7%)	0 (0%)	0 (0%)	0 (0%)	54 (8.8%)	31 (8.9%)	23 (8.6%)
Kesarpar	318 (35.9%)	240 (53.1%)	78 (18%)	99.7%	114 (35.8%)	110 (45.8%)	4 (5.1%)	168 (52.8%)	99 (41.3%)	69 (88.5%)	0 (0%)	0 (0%)	0 (0%)	36 (11.3%)	31 (12.9%)	5 (6.4%)
Magharikhada	564 (54.5%)	290 (53.3%)	274 (55.9%)	98.6%	67 (11.9%)	64 (22.1%)	3 (1.1%)	455 (80.7%)	194 (66.9%)	261 (95.3%)	4 (0.7%)	3 (1%)	1 (0.4%)	38 (6.7%)	29 (10%)	9 (3.3%)
Morsal	649 (52.9%)	330 (53.6%)	319 (52.3%)	97.8%	636 (98%)	321 (97.3%)	315 (98.7%)	3 (0.5%)	0 (0%)	3 (0.9%)	0 (0%)	0 (0%)	0 (0%)	10 (1.5%)	9 (2.7%)	1 (0.3%)
Mota Kandhasar	354 (37.6%)	261 (52.9%)	93 (20.8%)	91.0%	236 (66.7%)	189 (72.4%)	47 (50.5%)	82 (23.2%)	41 (15.7%)	41 (44.1%)	0 (0%)	0 (0%)	0 (0%)	36 (10.2%)	31 (11.9%)	5 (5.4%)

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
Nana Kandhasar	405 (30.9%)	356 (51.5%)	49 (7.9%)	98.0%	261 (64.4%)	233 (65.4%)	28 (57.1%)	81 (20%)	67 (18.8%)	14 (28.6%)	3 (0.7%)	0 (0%)	3 (6.1%)	60 (14.8%)	56 (15.7%)	4 (8.2%)
Rajavad	825 (53.9%)	418 (52.6%)	407 (55.3%)	49.7%	369 (44.7%)	299 (71.5%)	70 (17.2%)	396 (48%)	78 (18.7%)	318 (78.1%)	1 (0.1%)	1 (0.2%)	0 (0%)	59 (7.2%)	40 (9.6%)	19 (4.7%)
Ratadki	650 (51.5%)	325 (51.4%)	325 (51.6%)	44.8%	229 (35.2%)	216 (66.5%)	13 (4%)	314 (48.3%)	78 (24%)	236 (72.6%)	0 (0%)	0 (0%)	0 (0%)	107 (16.5%)	31 (9.5%)	76 (23.4%)
Ratanpar	215 (34.5%)	185 (57.8%)	30 (9.9%)	100.0%	79 (36.7%)	74 (40%)	5 (16.7%)	128 (59.5%)	104 (56.2%)	24 (80%)	0 (0%)	0 (0%)	0 (0%)	8 (3.7%)	7 (3.8%)	1 (3.3%)
Sakhpar	113 (60.1%)	56 (56.6%)	57 (64%)	99.1%	111 (98.2%)	55 (98.2%)	56 (98.2%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	2 (1.8%)	1 (1.8%)	1 (1.8%)
Samatpar	611 (46.7%)	358 (53.9%)	253 (39.2%)	44.7%	133 (21.8%)	81 (22.6%)	52 (20.6%)	433 (70.9%)	241 (67.3%)	192 (75.9%)	0 (0%)	0 (0%)	0 (0%)	45 (7.4%)	36 (10.1%)	9 (3.6%)
Sangani	643 (54.5%)	325 (52.8%)	318 (56.4%)	67.7%	360 (56%)	216 (66.5%)	144 (45.3%)	23 (3.6%)	13 (4%)	10 (3.1%)	0 (0%)	0 (0%)	0 (0%)	260 (40.4%)	96 (29.5%)	164 (51.6%)
Sonpari	236 (59%)	125 (59.2%)	111 (58.7%)	98.3%	78 (33.1%)	77 (61.6%)	1 (0.9%)	154 (65.3%)	45 (36%)	109 (98.2%)	0 (0%)	0 (0%)	0 (0%)	4 (1.7%)	3 (2.4%)	1 (0.9%)
Titoda	520 (52.2%)	289 (53.7%)	231 (50.3%)	83.8%	296 (56.9%)	195 (67.5%)	101 (43.7%)	104 (20%)	36 (12.5%)	68 (29.4%)	2 (0.4%)	0 (0%)	2 (0.9%)	118 (22.7%)	58 (20.1%)	60 (26%)

Source: Primary Census Abstract, Census 2011

4.4.5.1 Agriculture and Irrigation Sources

As discussed in the earlier section Agriculture and allied activities are the major sources of livelihood in the region. Based on the outcome of the consultation, it was reported that the study area villages are of mostly rainfed region and agriculture is dependent on monsoon and does not have any perennial source of irrigation facility. Hence only single crop is usually cultivated. At the time of site visit, no major cultivation / standing crops were observed within project site land, except for a few patches of land observed to have Guava plantations, and fodder crops. Major portions of the project site land are barren and the soil type seems to be gravel in nature. Due to poor soil quality & lack of irrigation facilities, no crops were cultivated in majority portion of the project site land. With respect to the study area villages Groundnut, Pigeon Pea, Cotton, Ragi, Jeera, Castor Bean, Bajra, etc. are being rainfed crops and Jowar and Wheat are being cultivated during the monsoon season. In addition, orchids of Mango, Lemon, Guava, were observed within the study area.

4.4.6 Physical Infrastructure and Civic Amenities

4.4.6.1 Health Profile and Infrastructure

During the consultations with the village representatives and revenue officials, it was stated that there is no Primary Health Centre within the project site villages. The nearest government hospital is at Ukkarakundi Community Health Centre (CHC), with respect to nearest private allopathic hospitals and clinics are present at Manur and Devarkulam villages. Most people prefer to go to government hospital in case of ailment.

The nearest medical facility to the project site is at Doliya PHC and Community Health Centre at Chotila. The Chotila CHC is the referral hospital for the PHCs under Chotila Tehsil and covering entire taluk and Chotila Town. The facility has 50 beds capacity with emergency services, maternity care, operation theatre, standby ambulance, and outpatient services covering majority of service. The facility also maintains and administer antivenom, childhood immunization. Based on consultation with the Health Officer, it was reported that 100% of the childbirth in the tehsil are institutionalized and 100% of the newborns are being vaccinated. For major ailments the patients are referred to General Hospital Surendranagar and further private multi-speciality hospitals at Surendranagar and Rajkot. As reported, there are no existing common illness or disease endemic to the region.

4.4.6.2 Drinking Water

The primary source of drinking water supply is the panchayat, which is distributed through shared overhead tanks. The water is sourced from the Narmada Water Canals. Groundwater is not considered suitable for drinking, and people primarily depend on the Narmada Water Canal for their drinking needs. Sanitation

Swachh Bharat Abhiyan scheme was stated to be implemented in study area villages. As per Swatch Bharat Abhiyan portal, 100% of households in Dhedukhi Village are with household level sanitation facilities, whereas the Ratanpar and Shapar villages were at 30%.

4.4.6.3 Religious and Archaeological Important Sites

The proposed project site is to be developed within private land and few Government land parcels, there are no presence of any religious or cultural important places within the project site and along the proposed TL connecting the Plant and PSS. The nearest Archaeological Survey of India (ASI) Notified Archaeological Important sites are Navlakha Temple located at 7.5km from the project site.

Figure 4-23 ASI Notified Navlakha Temple, Sejakpur

5. Stakeholder Engagement and Consultation

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 13th to 16th March 2023 and in XX XXX. The team was able to conduct consultations with stakeholders from the project village and few buffer zone villages as well. 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 of each stakeholder group;
- 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.

5.1 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 below.

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.
ADB	ADB Safeguard Requirements-2	• The borrower/client will conduct meaningful consultation with affected persons, their host communities, and civil society for every project identified as having environmental and involuntary resettlement impacts. Meaningful consultation is a process that (i) begins early in the project preparation stage and is carried out on an ongoing basis; (ii) provides timely disclosure of relevant and adequate information; (iii) is undertaken in an atmosphere free of intimidation or coercion;

Institution/ Regulatory Body	Reference Regulation/ Standard	Requirements
		(iv) is gender inclusive and responsive, and tailored to the needs of disadvantaged and vulnerable groups; and (v) enables the incorporation of all relevant views of affected people and other stakeholders into decision making, such as project design, mitigation measures, the sharing of development benefits and opportunities, and implementation issues. • SPS 2 principle: Pay particular attention to the needs of vulnerable groups, especially those below the poverty line, the landless, the elderly, women and children, and Indigenous Peoples, and those without legal title to land, and ensure their participation in consultations. • Disclose ESIA and RLRP in an accessible place and in a form and language(s) (Gujarati and English) understandable to affected people and other stakeholders

5.2 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"[27]. Stakeholders thus vary in terms of degree of interest, influence and control they have over the project.

Stakeholder Identification

Identification of all affected communities and stakeholder groups according to the degree of their vulnerability to the impacts of the project should be undertaken. They can be classified as "Primary" and "Secondary Stakeholders" according to their degree of influence of the project and vice versa. While those stakeholders who have a direct impact on or are directly impacted by the project are known as **Primary Stakeholders** and those who have an indirect impact or are indirectly impacted are known as **Secondary Stakeholders**.

Stakeholder Analysis

Stakeholder analysis takes into consideration a more comprehensive view of the stakeholder's groups interest, how they would be affected and to what extent and the influence they could have on the project. These aspects would cumulatively provide the basis for constructing the stakeholder engagement strategy. The key stakeholders identified in the above section have been categorized into four major groups: inform, monitor, consult and engage deeply. The stakeholder analysis takes into consideration a more comprehensive view of the stakeholders' groups interest, how they would be affected and to what extent and the influence that they could have on the project. These aspects would cumulatively provide the basis for constructing the stakeholder engagement strategy 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 land users
Institutional Stakeholders	• Developers and Contractors • Gram Panchayats	• Civil Society/ Local NGOs
Government Bodies	• Regulatory Authorities • District Administration	
Other Groups	• Migrant Workforce	

5.3 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.

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

The magnitude of stakeholder impact/influence is assessed taking the power/responsibility[28] and proximity[29] 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. As part of the stakeholder engagement process tools like personal interviews, consultation and focused group discussions were used. The overall significance of the stakeholder group is assessed as per the matrix provided below.

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

5.4 Stakeholder Analysis

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

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

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

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

28. 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.
29. 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.

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 / Informal Landusers / GETCO	• The proposed project involves sourcing of both Private and Government Land. It was reported that private land is to be sourced through executing long term lease agreement on willing lessor and willing lessee basis and government land on basis of allotment from the district administration. • During field visit, the government land which were proposed to be acquired were observed to be under cultivation by informal land users. • As observed during the site visit except for a few patches of land, majority of the project site land is barren and not utilized for any cultivation and there was no livelihood dependency on the land. • The plant boundary is adjacent to the GSS. PSS and GSS are proposed to be connected through underground cables. Hence the issue of RoW clearance will not be applicable for the project. • GETCO 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 for solar project site is envisaged to be negligible as majority of the land is barren and the determined lease rate is reported to two to three times the average yield value from the land • Due to procession of government land, the informal users may lose their livelihood, who used the land for cultivation.	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 GETCO 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, the Client is the developer for the proposed solar power project. The EPC contract for the project is in the process of being finalised.	• Hassle-free lease deed execution of the identified plots of land for the project; and • Smooth operation of the construction activity and to complete the work within	• 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	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
			the scheduled time and cost.		stipulated budgetary provisions.	
	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 skilled category is limited; and • Skilled laborers and educated youths are reported to have migrated to the nearby towns and 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 • Wages, leaves, etc. 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; • Community development 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. • Gujarat Energy Transmission Corporation Limited (GETCO) for	The project will comply with the applicable regulatory framework comprising of the guidelines and policies of the State Government such as Gujarat Solar Power Policy	-	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
		power evacuation/ grid connectivity etc.	2021 and coordination with the District Industries Centre, Surendranagar 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 negotiation 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 Community Development interventions. • Informal land users were involved in using government land, district / Tehsil administration will involve in clearing of land free from encroachments / encumbrance	Medium
	Migrant Workforce	• As on date no project related activities were carried out in the project site. An estimated workforce comprising of 1000-1500 workers will be employed for a duration of 6 months of skilled and highly skilled categories of about 200 skilled workers are expected to be migrant workers and will be engaged in the	• 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	• 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	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
		project-specific construction activities	deployment of migrant workers.		completion of construction work. • Health and Safety issues at work. • Holidays and leaves as per labour laws applicable etc.; and • 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 km inhabit 23 villages • The community in the study area is dependent on agriculture and allied activities.	• The Community Development 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 free 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 4.65% of Scheduled Caste Population and 0.06% of Schedule Tribe population. These Scheduled Caste / Tribe population are not socially secluded, and they live along with the mainstream people.	• In view of the poor social and economic conditions of the Vulnerable Communities as identified as part of Stakeholder Engagement Activity, 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 been sourced for the project. As on date, project activities do not have influence or impact on the project.	• 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. Due to lack of perennial irrigation sources and	• The project villages are of mostly rainfed agriculture lands and does not have any perennial source of irrigation.	• 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
		cultivation based on the dependency of monsoon only single crop is cultivated. During the agriculture lean season, the agriculture laboures mostly move to neighbouring villages in search of agriculture labour work	• The local community will be benefitted by means of the local employment opportunities that will be generated.			
	Civil Society/Local NGOs	• The local NGOs, mostly based out Surendranagar and Rajkot 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 Community Development 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 below.

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	Landowners	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

5.5 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**As part of the assessment primary stakeholders such as landowners, panchayat representatives, regulatory authorities, etc were being consulted by using questioners.

Consultation with Negigbouring Landowners

Consulation with Agriculture workers

	
Consultation with Landowner	Consultation with Shepherd, Dhedhuki Village
	
Consultation with Revenue Officials Dy. Thasildar, Chotila	Consultation with Medical Officer, Chotila CHC

5.5.1 Consultation with Village Representatives, Landowners and Revenue Officials

Summary of consultations undertaken with the Village Representatives, Landowners and Revenue Officials of on 31st May 2023 has been presented in the table below.

Basic details	
Location: Dhedhuki Village, Sayla Taluk	District: Surendranagar
Project Title: ESIA of 400 MW Solar Power Project, Surendranagar, Gujarat, India	Date: 31st May 2023
Stakeholder Group Title: Village Representatives, Landowners and Revenue Officials	
Objective of the Interview/Consultation	
To understand the socio-economic baseline of Core Zone villages and an assessment of the perception of the upcoming project amongst the community members.	
Key discussion points	
1	**What is the demographic of the Dhedhuki village?** Dhedhuki village has approximately ~1200 population residing from 210 houses (as on date). Most of the houses are observed to be pakka and semi-pakka.
2	**Communities present in the village and their primary occupational activity.** • Among the total population about 4.65% of Scheduled Caste Population and 0.06% of Schedule Tribe population. Notable caste people in the villages are Koli Chamat, Kodi Patel, Rabari, Barwad, etc.
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. • There are no industries located in the region.

Basic details	
4	**Agricultural Crops Grown in the area** • The primary agricultural crops grown in the village are Bajra, Seasame, Moong dal, etc. Most of the crops harvested are sold to the local market or dealers in Surendranagar. Cultivation is carried out mostly during monsoon season. There is no permanent source of irrigation and most of the cultivations are rainfed. **Livestock Population** • It was stated that 200+ cows, 150 buffalos and 15 goats are there in Dhedhuki village. Majority of the milk produced are self-consumed or sold locally. Majority of the Rabari Community engaged in cattle rearing. It was stated that 300 acres of dedicated Gaucher land is present within Dhedhuki village
5	**Migration Trend in the Village** • It was stated that the educated youth population of the village have migrated to nearby towns in search of skilled and decent jobs.
6	**Educational Profile** • With respect to education facilities, primary schools are located in all project villages and the nearest Hr. Secondary school is located at Dhedhuki Village are accessed to the schools up to Higher Secondary (12th Std.) and the nearest higher education facilities such as colleges and skill development institutes are accessible from the nearby towns Surendranagar, Rajkot, etc. The people in the village encourage the girl children to take higher studies.
7	**Health Profile** • Within Dheduki village there are no medical facilities. The nearest medical facility to the project site is at Doliya PHC and Community Health Centre at Chotila.The Chotila CHC is the referral hospital for the PHCs under Chotila Tehsil and covering entire taluk and Chotila Town. • The village is covered by 108 Ambulance service under National health Mission. • In case of ailment people mostly prefer to visit government CHC at Chotila. • The Anti-venom stabilization and Anti-rabis stocks and Covid-19 screening is done and has 50 beds for in-patient care.
8	**Women Profile** • All girl children in village were enrolled in school. The literacy rate among the women is less compared to national and state averages. • Women of the village are primarily engaged as agricultural labours.
9	**Youth Profile** • The youth of village were primarily engaged as agricultural labourers, move to nearby towns in search of unskilled labour works and educated youths have migrated to the nearby towns, cities in search of job opportunities.
10	**Social Perception of Project:** • The landowners and the opinion leaders welcome the project and the project being developed in unproductive land will not adversely impact the livelihood, moreover the project will create job opportunities within the village and induced development in the region.
11	**Perception among the Landowners** • The farmers expressed their willingness to give their land for the project, as majority of the proposed project site land is barren, and they were paid higher than the market price. • They do not have any grievance related to the land leasing and it was based on negotiations.
12	**Benefits/ Expectations from the Project** • Induced Development benefits due to project development such as improved road connectivity,

Basic details	
	• 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 Community Development Initiative fund i.e., Skill Development Training, Irrigation facilities, Drinking Water Facility, etc.
13	**Concerns regarding the Project** No reported grievance.

5.5.2 Consultations with Land Aggregator

Summary of consultations undertaken with the land Aggregator in regard understanding the land procurement process in the table below

Basic details	
Location: Chotila Town	District: Surendranagar
Project Title: ESIA of 400 MW Solar Power Project, Surendranagar, Gujarat, India	Date: 31st May 2023
Stakeholder Group Title: Land Aggregator involved in Land Leasing	
Objective of the Interview/Consultation	
To understand the land lease process, determination of rental value and perception about the landowners in regard to leasing 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 2260.84 Acres • As per revenue records, 100% of the land identified are rainfed agriculture land. Of the total ~2260.84 acres land, 856.43 acres of government land is being involved in the project. • The project boundary is adjacent to the GSS, hence Transmission Line connecting the PSS and GSS is not envisaged under the project. Underground cable for 70 meters is proposed to be placed for connecting the plant to the GSS. • The Client had identified land parcels belonging to three villages of Sayla Taluk namely Dhedhuki, Ratanpar, Shapar Villages Sayla Taluk, Surendranagar District.
2	**Mode of Land Sourcing** • The required land is sourced through Land Aggregator appointed by Client i.e. Systems Renewable Energy, Land is being proposed to be leased based on the willing lessor and willing lessee basis. With respect to government land, the land is being sourced based on government allotment.
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 to three times the yield value of the land and higher than the prevailing market value of the region.
4	**Involvement of SC/ST Land** • No land belonging to ST population is procured for the proposed project development. • Land belonging to SC community is reported to be procured, however no grant land, assigned land given by government to poor / vulnerable people were involved in the project.
5	**Current Status of Land Procurement** • As on the date of site visit (30th May 2023), no lease deeds were executed, and Client and Land aggregator team is in process of negotiation with the landowners and executing Agreement to Lease. • Of the 2260.84 acres, legal due diligence by Client team is completed and Client & Land aggregator is in process of obtaining Non-Agriculture certificate for the project site land.
6	**Grievance related to Land Procurement** • As on date there are no reported grievance among the landowners.

5.5.3 Consultations with Medical Officer, Chotila CHC

Summary of consultations undertaken with the Medical Officer in regard understanding the existing health facilities, health status of the people is detailed in the table below

Basic details	
Location: Chotila Town	District: Surendranagar
Project Title: ESIA of 400 MW Solar Power Project, Surendranagar, Gujarat, India	Date: 31st May 2023
Stakeholder Group Title: Medical Officer, Chotila Town	
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 Chotila CHC and PHC at Doliya Village.
2	**People – availing medical facilities** People are availing medical aids mostly from the Chotila CHC, including maternity care. For major ailments the patients are referred to Surendranagar GH and Hospital and further private multi-speciality hospitals as Surendranagar and Rajkot.
3	**Existing Medical Facility** • The Chotila CHC is having Emergency Care, OPD, maternity care centre and is of 50 bed capacity. The study area is covered by 108 Ambulance services and under National Health Mission (NHM). Delivery, Stabilization Theatre, Ambulance, Immunization, etc are being provided at this CHC. • Antivenom stocks are being maintained and administered at CHC and further referred to Surendranagar GH • Covid-19 screening is carried out in CHC and referred to the Surendranagar GH for quarantine facility and further referral treatment.
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 the Proposed Project; and
- Alternate Routes for Transmission Lines.

6.1 No Project Scenario

India is located in the equatorial sun belt of the earth, thereby receiving abundant radiant energy from the sun. In most parts of India, clear sunny weather is experienced 250 to 300 days a year. 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. With 250 to 300 sunny days each year, large parts of Rajasthan, Gujarat, Rajasthan, Andhra Pradesh, Tamil Nadu and Madhya Pradesh are ideal for solar energy and can produce 4.0-6.4 kilowatts per square metre.

Due to the fast-emerging energy demand in the country, there is a distinct necessity for strengthening and expanding the transmission networks. The state of Gujarat has significant potential of solar energy resource due to its topography and has distributed solar PV systems in large scale. The state has installed over 3200 MW of solar PV technology across all segments until 2020[30].

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. The country as a whole is likely to have an Energy surplus of 2.9% and Peak surplus of 3.4 % with the Generation Programme finalized for the year 2022-2023[31]. 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.

6.2 Alternate Location for the Proposed Project

Solar power projects are non-polluting energy generation projects and are dependent on the availability of sufficient solar irradiation. The whole of India and particularly the state of Gujarat receives good amount of solar irradiation due to its geographical and environmental advantages. Among other states for solar power plants establishments, Gujarat is one of the first states to develop solar generation capacity in India.

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 available at project site mainly comprises of open and agricultural land. As per the information gathered during consultations, it is understood that due to scarcity of water, agriculture is not extensively practiced in the project area.
- No environmentally sensitive features such as forests, archaeological sites are located in the immediate site surroundings.

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

[30] Gujarat-Solar-Power-Policy-2021.pdf (guvnl.in)
[31] LGBR_2022_23 (2).pdf

6.3 Alternate Source of Power Generation

As of 31 December 2021, the total installed capacity for renewable energy in India is 151.4 GW which constitutes 40.08 GW of wind power, 49.34 GW of solar power, 10.61 GW of Bio Power, 4.83 GW of small hydro power and 46.51 GW of large hydro[32]. The country is targeting about 450 Gigawatt (GW) of installed renewable energy capacity by 2030 – about 280 GW (over 60%) is expected from solar. 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[33].

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.

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 6-1

Table 6-1 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 proposed project site land is a dry agricultural land and did not have any habitations within the project site.

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. Assessment of alternates are carried out to select the best technology for the proposed project and is presented in the Table 6-2 below:

[32] Renewable Energy in India - Indian Power Industry Investment (investindia.gov.in)
[33] Renewable Energy Industry in India: Overview, Market Size & Growth | IBEF

Table 6-2 General comparison of technologies

Parameter	Crystalline	Thin Film	Thin Film	CPV
Types of Materials	Monocrystalline, 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 will be at site. Not Guaranteed
Power Efficiency	13-24.4%	6-19.5%	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
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 +C15	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

Source: Detailed Project Report

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.

6.5 Alternate Transmission Line Route

As per information provided by the site team, the transmission line will be connected between the project site and 400 kV Grid sub-station (GSS) at Shapar, located at approximately 70m from western end of the project site. The GSS is an existing substation under Gujarat Energy Transmission Corporation Limited (GETCO). As per the information received, the TL will be laid underground, and no section of the TL will be overhead. However, TL details are still under the designing phase.

With multiple benefits of clean energy production, employment generation and elevating the standards of rural economies, the project would prove to be advantageous to all realms of the society and nation. Hence, the project with all the chosen options such as site selection, source of power generation, selections of technology, transmissions lines etc., is appropriate alternative and is beneficial for the region.

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
	Medium 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
	Beneficial	-	Useful to Environment and Community

Criteria	Sub-Classification	Defining Limit	Remarks
Nature: Refers to whether the effect is considered beneficial or adverse	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			■	■							
Water requirements for solar panel cleaning				■	■						
Repair and Maintenance of Solar Panels											■
Inspection and maintenance of transmission lines								■			■
Decommissioning Phase											
Removal of Solar Panels								■			
Removal of Foundations								■			
Site Restoration	■	■	■	■	■	■	■	■			

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
Waste Management											
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 from both ways, one which will be used for carrying the construction material and the one which will be used for official purposes, 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. Any point source emission is not likely to happen as any batching plant will not be installed inside the site. 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

- Client team 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 shall 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 shall 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 (if installed any) 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 is 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 medium 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 and intensity coming down from high to medium.

Table 7-4: Impact Significance – Ambient Air Quality

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

7.3.1.2 Soil Quality

Anticipated Impacts

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. Use tope-soil inside the Project Area where soil filling is needed to level the area. Store in line with international good practice, so that it can be re-used after construction.
- Protect excess spoils, if any, from runoff. Excess spoil / soil, to be left in orderly piles, covered with topsoil, and re-vegetated.

- 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 can be undertaken to control the chances of soil erosion by client and its contractors.
- Store hazardous material and chemicals 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 shall be handed back only to the registered producer, refurbisher or recycler.
- Disposal of recyclable solid waste through local vendors with appropriate permission from concern authorities. Recyclable waste to be disposed to recycler.

Significance of Impact

Considering the distribution of impact within the project boundary and short duration of construction phase with medium intensity makes impact of minor 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	Medium	Moderate
	With Mitigation	Local	Short	Medium	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 a mix of flat and mild undulations. During consultations in the nearby area, it was observed that villages are dependent on rainwater and nearly every village has a pond facility which is used for 4 months (inclusive of 3 months of monsoon period) of the year. Furthermore, the primary source of drinking water supply is facilitated by the panchayat, which is distributed through shared overhead tanks. which gets sourced from the Narmada Water Canals. Drinking water requirements for the project will be met through the canned bottles which will not have an impact on the quantity getting supplied in the village.

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 the aquifer mapping and management of ground water resources report for the Surendranagar District by the central ground water board, groundwater in the Sayla Taluka is categorized as safe[34]. During the construction phase, labour camp and portable cabins will be set up near and not inside the project site (location of this is yet to be identified and finalised) 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 deep around 180-200 ft. (as informed by the people in the neighbourhood villages).

Ground water monitoring reports shows that the TDS, total hardness, calcium and magnesium levels exceeds the maximum allowable limits as per IS 10500:2012. .

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 to natural flow and the levelling of the ground needs to be done in a manner to align with the natural elevation.
- Detailed storm water management plan will be worked for site along with aspects of flood management at site.
- For any changes in flow, direction of natural drains on site, prior approval of relevant government bodies will be obtained.
- All the permissions need to be obtained before using the canal water for the construction purpose.
- 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);
- All the domestic wastewater getting generated at the site level to be diverted to the septic tank so that it doesn't finds its way into surface and groundwater and the same to be ensured by the project team;
- 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 shall 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 wastewater to protect the shallow ground water level.

Significance of Impact

Considering the distribution of impact within project boundary and medium duration which will result in an overall moderate impact without mitigation. However, with proper implementation of suggested mitigation the overall impact can be brought down to minor level.

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

Aspect	Scenario	Spread	Duration	Intensity	Overall
Impacts on Water Availability	Without Mitigation	High	Medium	Medium	Moderate
	With Mitigation	Medium	short	Low	Minor

7.3.1.4 Impact on Water Availability

Anticipated Impacts

[34] Surendranagar Gujarat.pdf (cgwb.gov.in)

In the construction phase, water will be required for civil work for concrete preparation, construction of the foundation and building structure of all facilities, as well as for worker needs water for their daily use. Exact quantity of water requirement for domestic purpose will depend on the number of staffs/contract labours which will be deployed but approximately 5-6Ltrs per person will suffice the requirement whereas for construction activities 4000ltrs of water will be required. 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 like no perineal surface waterbody, very deep ground water levels. As per the information provided by site personnel, the main water supply will be provided by the nearby local suppliers in water tankers. Domestic water requirement will be limited to drinking and official purposes only, which can be met by packaged drinking water sourced from the local vendors. It is known that though there are borewells present inside the Project Area, they will not be used. All the water requirements will be met by the EPC contractors as per the contract agreement which will be signed between the client and the EPC.

Mitigation Measures

Water for construction activities, flushing and washing purpose will be met through water supplied from tankers. The other mitigation measures to be implemented are:

- The water for construction shall only be sourced from authorized sources/vendors.
- 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 shall only 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 for project or domestic usage. 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 shall be located more than 500 m away from surface or ground water source.
- All the domestic wastewater getting generated at the site level to be diverted to the septic tank so that it doesn't finds its way into surface and groundwater and the same to be ensured by the project team.

Significance of Impact

The impact on water quality will have medium 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	Medium	Moderate
	With Mitigation	Local	Short	Medium	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. The nearest habitations from the proposed Project site include Sonpari, Nana Kandhashar, Ratanpar, Mangalkui, Shapar, Dhedhuki, Dhankaniya villages which are within 3 kms or less aerial distance away from the land parcel and most of the sensitive receptors which includes schools mostly falls in the north direction to the project site and the closest is in the village shapar.

Mitigation Measures

- Use DG set with acoustic enclosure
- Restrict major noise generating activities during night-time i.e. 10:00 pm to 6:00 am
- Provide personal protective equipment (e.g., earmuffs) to all workers wherever noise is generated due to machinery operation.
- Regular maintenance of project vehicles.
- Special acoustic enclosures shall 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 shall 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 shall 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 medium 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 mitigations the impact can be made insignificant.

Table 7-8: Impact Significance – Ambient Noise Quality

Aspect	Scenario	Spread	Duration	Intensity	Overall
Ambient Noise Quality	Without Mitigation	Local	Short	Medium	Minor
	With Mitigation	Local	Short	Low	Insignificant

7.3.1.6 Solid 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 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 shall 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. shall 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 shall 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, shall be sold to State Pollution Control Board 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 shall 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 shall be encouraged to be recycled at the site.
- Any waste/damaged part of solar panel(s), broken solar panels will be only to the registered producer, refurbisher or recycler

Significance of Impact

The impact due to waste disposal will have medium 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 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	Medium	Moderate
	With Mitigation	Local	Short	Medium	Minor

7.3.1.7 Traffic and Transport

Anticipated Impacts

The construction phase involves transportation of construction materials, solar modules and mounting structures.. The project site can be accessed via Rajkot airport (50 kms from the project site and 40 kms from Surendranagar city). As informed various roads based on which is closest and feasible to the site will be used for transporting the construction material which can also be accessed from the same state highway. 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 National Highway is high with all kinds of vehicles using it and this being the main road connecting Rajkot and Ahmedabad Cities has adequate carrying capacity to accommodate the additional traffic which will happen due to the construction activities. However, the village road is 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

Additional traffic on the village road connecting to Project site can be managed by the following mitigation measures:

- A Traffic Management Plan is required for the management of traffic due to movement of vehicles for transport of manpower, equipment, and material
- 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 shall 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

The impact due to traffic activities will have medium 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 measures the overall impact will be minor.

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	Medium	Moderate
	With Mitigation	Local	Short	Medium	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, foundation laying, 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 start date of the construction work is yet to be decided, if it is 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 shall 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 shall 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 shall 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	Local	Short	High	Moderate
	With Mitigation	Local	Short	Medium	Minor

7.3.2 Impacts during Operation Phase

7.3.2.1 Visual Impacts and Aesthetics

Anticipated Impacts

Visual impacts are assessed 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 undulating land and is present 1 km away from the national highway. 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. Also, limited 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 closer to the ground, as feasible. 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 medium intensity with a local spread for a long 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 7-12: Impact Significance – Aesthetic and Visual Impacts

Aspect	Scenario	Spread	Duration	Intensity	Overall
Visual and Aesthetics	Without Mitigation	Local	Long	Medium	Moderate
	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.

In operation phase dry cleaning of solar panels is proposed, where in the use of chemicals (if at any stage is used) 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. 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 collected will be given to 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. However, details on the buy-back arrangements shall be checked from the extended producer responsibility plan as per the implementation guidelines for E-waste (management) rules, 2016.[35]
- 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 shall 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 Medium intensity with a Medium spread for a Medium duration which will result in an overall moderate impact without mitigation. However, with proper implementation of suggested mitigation measures the overall impact will be Minor.

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

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

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 moderate impact without mitigation. However, impact on surface and ground water quality can be brought down to minor 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	Medium	Moderate
	With Mitigation	Medium	Short	Low	Minor

7.3.2.3 Impact on Water Availability

Anticipated Impacts

In the solar power plants during the operational phase, the water requirements for the plant predominantly are in washing of solar PV modules periodically to remove bird droppings, dust and other dirt and domestic water

[35] displaypdf.php (cpcb.nic.in)

consumption but in this project dry cleaning system through robot shall be used. Whereas, for domestic water consumption for the Project will be restricted to manpower engaged at Project site which will be meet through packaged drinking water.

As informed by the project team, water from borewell will not be used for panel cleaning and domestic purpose. Since bottled drinking water will be used during operation phase, and no borewell will be made inside the plant and existing ones will be closed, depletion of ground water resources due to extraction during operation phase of the project is unlikely. 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, as feasible. The water harvested to 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.
- Conserve water at all the project locations and ancillary facilities by recycling and reusing water utilising every opportunity.
- If the solar panels are washed with chemicals, it shall be ensured that the chemicals are non-hazardous and biodegradable 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 low 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 availability by following the suggested mitigation measures, can be lowered down to minor category.

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

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

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

Client needs to 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, shall be implemented before resorting to individual fall arrest equipment. In addition, safety nets can be used to minimize the consequences of a fall should it occur.
- Loading and unloading operation of equipment shall 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. shall be provided to workers handling electricity and related components and monitored that they are used by the employees
- The transformer yard shall be provided with fire extinguishers and sand buckets at all strategic locations to deal with any incident of fire; and
- There shall 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 high 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;
- Client 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 as discussed above.

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. A PV module is generally 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.

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.

Inappropriate handling or disposal of solar panels 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 ensure that solar panels are handed over only to the registered producer, refurbisher or recycler to 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

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

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	Minor

7.4 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.

7.4.1 Anticipated Impacts

7.4.1.1 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[36]. 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.

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, urban flooding and river flood are categorized as very low and low respectively.[37]

iii. 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

[36] Sources of Greenhouse Gas Emissions | US EPA
[37] Think Hazard - Surendranagar

speed due to increased storms may also have potential to cause material loss of properties and loss of lives of the workers. Now as per the seasonal waterbody map shown in the figure 4-2 there are no streams passing within the project site and TL, waterlogging inside the plant is un-likely to happen though it is recommended to take into consideration flood protection /erosion protection measures during construction phase. Considering project construction activity span, the impact of climate change on project construction activities are not deemed significant.

iv. 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 will only be limited to the construction phase which will be of short duration and impact is not likely to be significant.

Mitigation Measures:

Mitigation measures include:

- Use of machines, DG, equipment and vehicles only with appropriate pollution fitness certificates. Also carry out periodic maintenance of equipment and vehicles.
- Avoid use of Ozone Depleting Substances during construction phase.
- Consideration of flood protection /erosion protection measures during construction phase

7.4.1.2 Operational Phase

Solar power has potential to significantly reduce green-house gases (GHG) emissions compared to a fossil fuel-based electricity generation system. However, the proposed 400 MW Solar PV Power Plant, like all other solar power plants and their components, is vulnerable to fluctuating weather conditions and climate change in a 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. Research 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[38]. 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 a solar energy project are low and scores better when compared with other forms of conventional and non-conventional sources of energy.

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**: Climate change will likely increase the ambient temperature of the region and the country resulting in warmer winter and hotter summer. As per the Think Hazard portal, district extreme heat hazard is categorized as High which means that prolonged exposure to extreme heat, resulting in heat stress, is expected to occur at least once in the next five years.[39] The increased risk of heat waves could impact the solar panels and deformation of the plant and 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.

[38] Variability of Photovoltaic Power in the State of Gujarat Using High Resolution Solar Data (nrel.gov)
[39] Think Hazard - Surendranagar - Extreme heat

- **Increase in rainfall and flood**: Climate change due to increase in rainfall and flood across the region may increase the frequency and intensity of heavy rainfall events, which are likely to increase water levels. As per Think Hazard' analysis, likelihood of river flood and urban flood are low and very low respectively.[40] However, it is recommended to take into consideration flood protection measures /erosion protection measures in design, 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 comparably lower source of GHG emissions. 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 around project or within nearby villages (as applicable);
- 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.
- Avoid use of Ozone Depleting Substances during operation phase.

7.4.1.3 Climate Transition Risk

Government of India and State Government of Gujarat's commitment towards building a sustainable and climate resilient future for its people, a Gujarat state has prepared State Action Plan on Climate Change (SAPCC) following a consultative process to address any transitional climate risk for the prevailing environmental and socio-economic system. The aim of SAPCC is to create core competencies in the State for addressing the challenge of Climate Change. Some of the areas of focus include generating strategic knowledge for informed decision making, creating public awareness and education and empowering communities for participatory and decentralized action on climate change.

The ADB's Checklist for Preliminary Climate Risk Screening was used to check on project sites climate screening and based on the below mentioned screening questions like weather events and future climate conditions etc scoring against each were given, details of the same are as follows:

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 Project Area
	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.)?	1	Likely Site located close to season water bodies
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	1	Likely Project can be established within a short time period of 12 months (approx..) therefore temporary impact of climate change on material and maintenance may occur.

[40] Think Hazard - Surendranagar

	selection of project inputs over the life of project outputs (e.g. construction material)?		
	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?	0	Not 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 7-19: Impact Significance – Climate Change

Aspect	Scenario	Overall
Climate Change	Without Mitigation	Moderate
	With Mitigation	Minor

7.5 Ecological Impacts and Mitigation Measures

The following sections present the foreseeable direct or indirect ecological impacts from the Project. The said impacts are listed as per the Project phases during which they are anticipated. Each impact is evaluated for significance and appropriate measures, based on international industrial good practices, are suggested to mitigate it as per the mitigation hierarchy.

7.5.1 Impacts during the Pre-Construction and Construction Phase

Change in land use: Change in the land use of the Project Site, from the present open savanna, pasture and low-intensity agricultural use to the proposed industrial use, shall change the existing habitat profile of the Project Site. As a result, the existing habitat types within the Project Site, mainly savanna and cultivated, fallow or disused arable land, would be replaced by a commercial/industrial area. This would lead to loss of suitable habitat for fauna currently utilizing the Project Site.

The Project Site contains habitat suitable to the endemic *Ophisops kutchensis* (Kutch Small-scale Snake-eye, IUCN Red List Cat. LC), which is found in open scrub areas with gravelly substrate and dispersed shrubs. Habitat loss is perceived to be the most significant impact to the species, as per Mr Akshay Khandekar, an SME identified

during the CH Screening Study. The habitat-types savanna and arable land, present within the Project Site, are also potential habitat for *Sypheotides indicus* (Lesser Florican or 'LF', IUCN Red List Cat. CR).

Considering that the Project Site largely represents slightly disturbed natural habitat likely to support mainly habitat-specialist species, the Project-related change in the habitat-profile of the Project Site is deemed of high significance.

Removal of vegetation: Removal of vegetation to clear the Project Site for construction shall result in loss or degradation of the habitats therein.

This impact is of major significance. However, there is limited natural vegetation at the Project Site, and this largely represents savanna (a relatively common habitat-type in these semi-arid regions), so this impact should not raise any significant concerns.

Considering that the vegetation provides provisioning ecosystem services in terms of fodder resource for the local livestock, soil erosion control, sediment regulation and facilitation of groundwater recharge, the ecosystem services value of the said vegetation is moderately high. All things considered, the impact of Project-related vegetation removal at the Project Site is not likely to be important.

Levelling of land: Levelling of land towards preparation of the Project Site for construction is likely alter the existing drainage in and around the Project Site.

Considering that the Project Site is situated in the catchments & 2-5 km upgradient of 2 significantly large tributaries of the regionally important Bhogavo River, which provides priority provisioning services in terms of water for domestic use and irrigation for a part of the year, the impact of any Project-related alteration in the existing drainage in and around the Project Site is deemed of moderate significance.

Movement of vehicles and heavy machinery: Movement of vehicles and operation of construction machinery would result in vehicular emissions and unnatural levels of dust, noise, light and vibrations in and around the Project Site.

Considering that the habitats in and around the Project Site are slightly disturbed natural habitats, the impact of any Project-related dust, noise, light and vibrations is deemed of moderate significance.

Artificial Illumination: Use of artificial lighting to illuminate the Project Site during night-time would cause unnatural illumination during the natural dark part of the day. Use of vehicles during the 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.

Considering that the habitats in and around the Project Site are slightly disturbed natural habitats, which are potential habitats of globally threatened species, this impact is deemed of moderate significance.

Installation of Solar Panels: The presence of the Project-related solar panels is likely to lead to avoidance of the Project Site by some faunal groups, particularly raptor species and mammalian species, reducing their current access to habitats. The solar panels would also obstruct the existing natural insolation, leading to alteration of the existing soil-moisture and floral profile of the Project Site.

Considering that the Project Site overlaps the reported ranges of globally threatened species, the impact of Project-related solar panels is deemed of moderate significance.

Installation of Transmission Lines: Installation of underground transmission cables would disturb the natural soil-profile and fragment sub-soil habitats. The associated construction will lead to loss of habitat of the endemic *Ophisops kutchensis*. These effects would lead to injury or death of organisms, thereby impacting ecosystems and the related ecosystem services.

Considering that the transmission line is proposed to be relatively short and underground, but that the Project Site is situated in proximity to potential habitats of globally threatened and endemic species, this impact is deemed of moderate significance.

Harvesting of Wild Species: Project-related labour may harvest wild plants, hunt or capture wild fauna and cause damage to nests, eggs or habitats of wild fauna, resulting in injury or death of wild species in and around the Project Site.

Considering the potential occurrence of globally threatened species in and around the Project Site, this impact is deemed of moderate significance.

Mitigation Measures

The Client has agreed to implement the following mitigation measures during the pre-construction and construction phases of the Project:

- The Client shall deploy a herpetofauna expert at the Project Site during the pre-construction land clearing and levelling activities, to detect, rescue and relocate any individuals of the endemic LC *Ophisops kutchensis* (Kutch Small-scale Snake-eye or KSS) inhabiting the Project Site.
- The Client shall restore any natural vegetation, particularly grasses, herbs and shrubs removed during the pre-construction land-clearing at the Project Site by planting the same or comparable native species in peripheral areas of the Project Site. The Client shall ensure that any species used for Project-related plantations are strictly native, and not alien or invasive, with respect to the region. Advice may be sought from the local Forest Department office, which could also provide saplings of local native species for plantation.
- The Client shall institute a Chance Find Procedure at the site, to ensure appropriate action by Project personnel in the event of an LF individual being detected in or around the Project Site during the life of the Project.
- The Client shall minimize the number and the width of all internal roads.
- The Client shall maintain the connectivity and integrity of existing natural water-channels while building internal roads or embankments.
- The Client shall use permeable paving for access roads to reduce obstruction of rain-water percolation.
- The Client shall restrict movement of construction-related vehicles, especially heavy vehicles or machinery, strictly to pre-designated routes.
- The Client shall avoid or damping of construction noise and vibrations to the maximum extent possible.
- The Client shall restrict construction activities requiring high levels of illumination to daylight hours to prevent disruption of the natural night period by artificial lighting.
- The Client must ensure that lights are provided with downward-facing shades to limit the dispersion of illumination into adjacent habitats.
- The Client shall install efficient systems for containment and disposal of waste or spillage.
- The Client shall prohibit harvesting of fuelwood or wild foods (including fauna) by construction labour.
- The Client shall install the solar panels in as small and discrete clusters as feasible, rather than installing them in continuous swathes.
- The Client shall use crystalline silicon type solar panels over other currently available technologies, to avoid introduction of toxic chemicals into the local ecosystems.
- The Client shall use solar panels with anti-reflective coating (ARC), preferably in conjunction with white, non-polarizing gridding, to reduce reflectiveness and light-polarization.
- The Client shall 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.

Table 7-20: Significance of impact on biodiversity during construction phase

Aspect	Scenario	Spread	Duration	Intensity	Nature	Significance
Degradation of Habitats	Without Mitigation	Local	Long	High	Adverse	Major
	With Mitigation	Local	Medium	Medium	Adverse	Minor
	Without Mitigation	Medium	Long	High	Adverse	Major

Aspect	Scenario	Spread	Duration	Intensity	Nature	Significance
Fragmentation of Habitats	With Mitigation	Local	Long	Medium	Adverse	Moderate
Loss of Ecosystem Services	Without Mitigation	Medium	Long	Medium	Adverse	Moderate
	With Mitigation	Medium	Medium	Low	Adverse	Moderate

7.5.2 Impacts during the Operation and Maintenance Phase

Physical Hindrance by On-ground Installations: Aerially moving diurnal organisms, mainly birds, are deemed especially vulnerable to the long-term impacts of solar panel reflectivity. Birds in flight are documented to mistake the reflective surface of the panels for water and may collide with the panels while attempting to drink the water. Birds that drink water on the wing, such as swallows, are at greater risk of mortality from this effect than those that drink from a perched position. Migratory birds take detours to avoid disturbances or irritants in their natural flight paths. This can cause a potentially 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 Project-induced faunal behaviour-alteration could lead to undesirable long-term impacts on food webs in which the affected species occupy critical trophic niches. On the other hand, areas under the solar panels may provide favourable conditions to herpetofauna during the dry season.

This impact is of moderate significance mainly owing to the presence of potential habitat of a terrestrial endemic species within and adjacent to the Project Site.

Reflectivity of Solar Panels (Albedo Effect): Aerially moving diurnal organisms, mainly birds, are deemed especially vulnerable to the long-term impacts of solar panel reflectivity. 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 minor significance as it is improbable that the wetland habitats in proximity to the Project Site support large congregations of 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 moderate significance mainly owing to the presence of potential habitat of a terrestrial endemic species within and adjacent to the Project Site.

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 moderate significance mainly owing to the presence of potential habitat of a terrestrial, partially fossorial, endemic species within and adjacent to the Project Site.

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 moderate significance mainly owing to the presence of potential habitat of a nocturnal species within and adjacent to the Project Site.

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 moderate significance owing to relatively low availability of comparable alternative habitats and ecosystem services around the Project Site, as well as presence of potential habitat of a nocturnal endemic species within and adjacent to the Project Site.

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 persist or bio-accumulate, contaminating the soil, surface water, groundwater and food-chains of the area.

As confirmed by client, no herbicidal chemicals will be used on site.

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 persist or bio-accumulate, contaminating the soil, surface water, groundwater and food-chains of the area.

This impact is of moderate significance owing to relatively low availability of comparable alternative habitats and ecosystem services around the Project Site, as well as presence of potential habitat of an endemic species in the Project Site.

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 moderate significance owing to relatively low availability of comparable alternative habitats and ecosystem services around the Project Site, as well as presence of potential habitat of an endemic species in the Project Site.

Mitigation Measures

The Client has agreed to implement the following mitigation measures during the operation and maintenance phase of the Project:

- The Client shall conduct awareness programmes for communities around the Project Site to create/improve awareness about LF, particularly its habitat needs, ecology and conservation significance.
- The Client shall develop community engagement programmes to promote community-based conservation measures for LF habitat conservation and/or restoration through LF-friendly agricultural practices and/or grassland restoration initiatives.
- The Client shall conduct monthly bird fatality monitoring in a 100m buffer of the Project's overhead transmission line corridor.
- The Client shall implement carcass management in a 100m buffer of the Project's overhead transmission line corridor.
- The Client shall restore the soil and natural vegetation of any construction-phase roads which are not necessary for carrying out operation or maintenance activities.
- The Client shall restrict maintenance-related activities to the daytime.
- The Client shall avoid use of artificial lighting in and around the project site to the extent possible.
- The Client shall use low-intensity artificial lighting, such as LED, to prevent insects from being attracted to the site.
- The Client shall ensure that lights are provided with downward-facing shades to limit the dispersion of the illumination into adjacent habitats.
- The Client shall 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.
- The Client shall prohibit the use of herbicides in the facility.
- The Client shall prohibit the use of dust-settling chemicals in the facility.
- The Client shall institute effective training modules and operational systems to ensure prevention of spillages of toxic substances.
- The Client shall install effective containment systems to prevent any accidental spillage from leaching into the local environment.

Table 7-21: Significance of impact on biodiversity during the Operation and Maintenance Phase

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

7.5.3 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 moderate 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 moderate significance since the Project Site is situated in slightly disturbed natural habitats.

Disturbance and Pollution: The decommissioning activities are likely to generate physical disturbance, dust, noise, vibrations and artificial illumination, which could cause disturbance or pollution for habitats in and around the Project Site.

Considering the potential occurrence of globally threatened species in and around the Project Site, this impact is deemed of moderate significance.

Harvesting of Wild Species: Project personnel may harvest wild plants, hunt or capture wild fauna and cause damage to nests, eggs or habitats of wild fauna, resulting in injury or death of wild species in and around the Project Site.

Considering the potential occurrence of globally threatened species in and around the Project Site, this impact is deemed of moderate significance.

Exposure of Site to Erosion: Removal of the Project installations would expose the Project Site to wind and water, leading to desiccation of underlying shade vegetation and erosion of loose soil.

Considering that the Project Site is situated up-gradient of arable lands and inland wetlands in its vicinity, as also, potential habitats of globally threatened species, this impact is deemed of moderate significance.

Mitigation Measures

The Client has agreed to implement the following mitigation measures during the decommissioning phase of the Project:

- The Client shall 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.
- The Client shall institute suitable training modules for project-personnel and labour contractors involved in the dismantling process to ensure adherence to appropriate safe disposal protocols.
- The Client shall ensure meticulous removal and sensitive disposal of transmission line components and other waste, following the best prescribed practices.
- The Client shall restrict decommissioning activities to daytime hours.
- The Client shall avoid artificial illumination during night-time.
- The Client shall avoid or damp dust, noise, and vibrations to the maximum extent possible.
- The Client shall prohibit harvesting of fuelwood or wild foods (including fauna) by labour.
- The Client shall restore land-use/ natural vegetation of the Project Site
- The Client shall restore land under the footprint of access roads.

Table 7-22: Significance of impact on biodiversity during decommissioning phase

Aspect	Scenario	Extent	Duration	Intensity	Type	Significance
Degradation of Habitats	Without Mitigation	Medium	Long	High	Adverse	Major
	With Mitigation	Local	Medium	Medium	Adverse	Minor

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

7.6 Socio- Economic Impacts and Mitigation Measures

7.6.1 Impacts During the Pre-Construction Phase and Construction Phase

7.6.1.1 Impact on Immovable Assets at Site

Entire project site land is reported to be rain fed and no major settlements are reported to be present within or adjacent to the proposed solar plant site. During the site visit it was reported that there were no residential structures within the project site, however there few agriculture farmhouses, pumphouses, Borewells, etc. on private agriculture land were observed to be present. Due to the proposed project development the farmers / landowners will lose structures / assets. The project site boundary is located adjacent to the GSS i.e.at 70 meters. PSS and GSS are proposed to be connected through underground cables, hence erections of transmission line towers and issues related to RoW are not envisaged under the proposed project.

Mitigations Measures

- Client to avoid any residential structures if any within the project site land
- Compensation to the Structures / assets lost due the project development to be compensated at the replacement cost.
- Client must effectively implement Stakeholder Engagement Plan (SEP) / Grievance Redressal Mechanism (GRM) to take necessary actions to record / resolve any reported grievance related to the loss of assets / structures, non-payment of compensation, etc. if any.

Significance of Impact

Impact on Immovable Assets at Site is assessed to be Moderate without any enhancement measures and Minor with enhancement measures.

Table 7-23: Impact Significance – Immovable Assets at Site

Aspect	Scenario	Spread	Duration	Intensity	Overall
Immovable Assets at Site	Without Enhancement measures	Local	Short	High	Moderate
	With Measures	Local	Short	Medium	Minor

7.6.1.2 Impact on Restriction of Access

Within the project site there are presence of Revenue village roads, however as reported by Client and review of project layout depicts that that those existing roads will not be restricted or altered for the purpose of the project development. Also, Client proposed to strengthen the connecting village roads for easy movement of materials. Based on the field observations and review of satellite imagery, within the project site boundary there are few footpaths / cart tracks were observed which were to be used by locals and neighbouring landowners. During consultation with landowners and local grazers there will not be any impact on impeded access due to the proposed project development. Existing village road connecting NH47, and Dhandhalpur Village is to be used for the proposed project and there will not be any additional land procurement for the purpose of access / road development.

Mitigations Measures

- For the purpose of the project development, Client shall not obstruct any traditional footpath or access routes used by the locals, neighbouring farmers, etc.
- Client 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.

Significance of Impact

Impact on restriction of access to the neighbouring villages is assessed to be Moderate without any enhancement measures and Minor with enhancement measures.

Table 7-24: Impact significance – Restriction of Access

Aspect	Scenario	Spread	Duration	Intensity	Overall
Restriction of Access	Without Enhancement measures	Local	Long	Medium	Moderate
	With Measures	Local	Long	Low	Minor

7.6.1.3 Impact due to 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 will be engaged. Engagement of migrant labourers might lead to a conflict with the local population in use of common property use. 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.

Mitigations Measures

- Depending on the size and the skill level of the local workforce, a considerable number of the workers required for the project may be recruited locally.
- According to the labour occupancy to ensure labour accommodation is equipped with adequate basic amenities such as drinking water, toilets, washing and cooking facilities to avoid workers from using common property resources.
- Restrict workers use of common property resources
- Set up a grievance mechanism/system to be effectively implemented at community level and to report any worker conflict or issues related to common property resources.

Significance of Impact

Impact on Labour Influx is assessed to be Moderate without any enhancement measures and minor with enhancement measures

Table 7-25: Impact significance – labour influx

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

7.6.1.4 Labour Rights and Welfare

Approximately ~2000 workers, including in the skilled and highly skilled categories to be employed during the construction. Client had confirmed that a labour accommodation facility will be provided for the migrant workers adjacent to the project village. The project will appoint an EPC contractor for construction the project and majority of the workforce will be recruited by the EPC Contractor.

Mitigations Measures

- Workers will be provided with basic amenities and timely payment complying with applicable regulations.
- Labour Camp will be equipped with adequate numbers of toilets, separate toilets and bathrooms for women workers, with adequate drinking water facility, kitchen etc. Each room will be provided with electrical power points along with lights and fans in each room.
- Conduct due diligence at the time of On-Boarding the contractors to ensure they are compliant with applicable laws and hold required licenses.
- The EPC Contract will contain provisions for providing the minimum wages to the labourers including overtime wage as per the applicable regulations and will comply with all applicable labour related regulations.
- Set up labor audit systems that identify human rights risks and regulatory compliance among the contractors.
- Internal Grievance system shall be effectively implemented including providing adequate training programs among the workers.

Significance of Impact

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

Table 7-26: Impact Significance – Labour Rights and Welfare

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

7.6.1.5 Impact On Animal Grazing

Consultations were undertaken with few shepherds engaged in grazing of animals in the vicinity of the project villages. Discussions with the shepherds 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 for grazing. They also reported that designated Gaucher Land (Grazing Land) were present in each village.

Mitigations Measures

- For the purpose of project development, Client shall not obstruct any traditional footpath or access routes for grazing / grazing lands.
- ENGIE 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.

Significance of Impact

Impact on animal grazing is assessed to be Minor without any enhancement measures and insignificant with enhancement measures.

Table 7-27: Impact Significance – Animal Grazing

Aspect	Scenario	Spread	Duration	Intensity	Overall
Animal Grazing	Without Enhancement measures	Local	Short	Medium	Minor

Aspect	Scenario	Spread	Duration	Intensity	Overall
	With Measures	Local	Short	Low	Insignificant

7.6.1.6 Impact on Agriculture

As reported in the earlier sections, no major cultivation / standing crops were observed within project site land (including Government Land), except few patches of land were observed to have Guava plantations, and fodder crops on private agriculture lands. Major portion of the project site land is barren, rainfed and soil type seems to be gravel in nature. Due to poor soil quality & lack of irrigation facilities no crops were cultivated in majority portion of the project site land and among the few cultivable land it was reported that one crop is being cultivated in a year based on monsoon. It was reported during the consultation with the landowners that the land lease rental amount would be two to three times higher than the average yield/acre and two times the average Lease rate in the region. Due to the proposed project development, there will not be significant impact on agriculture activity / production. Since the proposed project site is located adjacent to the GSS, Transmission line is not envisaged to be developed as the power is to be fed through underground cables and no standing crops were observed within underground cable route.

Mitigations Measures

- For the purpose of project development, Client shall not obstruct irrigation channels.
- Client 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.

Significance of Impact

Impact on agriculture activity in solar plant site is assessed to be Minor without any enhancement measures and insignificant with enhancement measures and insignificant without enhancement measures.

Table 7-28: Impact Significance – Agriculture

Aspect	Scenario	Spread	Duration	Intensity	Overall
In Solar Site	Without Enhancement measures	Local	Short	Medium	Minor
	With Measures	Local	Short	Low	Insignificant
Withing RoW of TL	Without Enhancement measures	Local	Short	Low	Insignificant
	With Measures	Local	Short	Low	Insignificant

7.6.1.7 Impact on Livelihood

Based on the outcome of the consultation and field observations, major source of livelihood in the region during post monsoon season is cultivation and agriculture labour, cattle rearing, etc. The lease rent for the project site land is paid at the replacement cost arrived through private negotiation between landowners and Client . The rental compensation determined for the land is two to three times the average yield/ acre.

Informal Land Users: The proposed project involves in sourcing of 300 acres of government land of which few land parcels were observed to be used for cultivation by the informal land users / encroachers. Though district administration is responsible for sourcing the land and allotting encumbrance free land to Client, the informal land users who were dependent on government land may be losing their livelihood.

Loss of Plantation / Trees: Based on the site visit observations, few project land parcels were observed be holding fruit bearing plantations and trees. Being a solar power project, all trees will be removed for developing the project.

Mitigations Measures

- Client to pay adequate compensation for the loss of standing crops, Trees, Plantations, structures (farm sheds / Pumphouse, etc) and borewells / wells. The compensation shall be based on negotiated rate or at the market

value as determined by the relevant government agency (Agriculture / Horticulture / Forest Department / Charted Engineer, etc.)

- Depending on the size and the skill level of the local workforce, a considerable number of the workers required for the project may be recruited locally and preference to be given to the informal land users affected in souring the government land.
- Small contracts and business opportunities shall be offered to the locals.
- As part of its Community Development Initiatives, Client may collaborate with the local Panchayats to improve village level infrastructure, education promotion programs, skill improvement, etc.
- Safe Drinking Water facility (Water ATMSs), Health Camps, Veterinary Health Camps, Skill Development programs among the local youths, Education promotions programs by improving school infrastructure, etc. can be taken up as part of the Community Development initiative.

Significance of Impact

Impact on livelihood is assessed to be Insignificant without any enhancement measures and Minor with enhancement measures.

Table 7-29: Impact significance – Livelihood

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

7.6.2 Impacts During Operation Phases

7.6.2.1 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.

Mitigations Measures

- Depending on the size and the skill level of the local workforce, a considerable number of the workers required for the project may be recruited locally.
- Preference to be given to the local traders, affected landowners, informal land users for small contracts related to the project.
- As part of its Community Development initiatives, Client may collaborate with the Panchayats to improve village level infrastructure, education promotion programs, skill improvement, etc

Significance of Impact

Impact on local economy is assessed to be Minor (Positive) without any enhancement measures and Moderate (Positive) with enhancement measures.

Table 7-30: Impact Significance – Local Economy

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

7.6.2.2 Employment opportunities

During the operation phase, the manpower requirement will be around maximum of 20-30 technical staffs including Client and O&M Contractor and about 100 contractual unskilled workers will be involved for cleaning and tilting the modules, grass cutting, etc. 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 workforce in the project-specific 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 Client and the EPC contractor.

Mitigations Measures

- Depending on the size and the skill level of the local workforce, a considerable number of the workers required for the project may be recruited locally prioritizing those from the project affected households.
- Preference to be given to the local traders, affected landowners for small contracts related to the project.
- As part of its Community Development programme, Client may collaborate with the Panchayats to implement skill improvement program for potential workers

Significance of Impact

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

Table 7-31: Impact Significance – Employment Opportunities

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

7.6.2.3 Impact on Community Health & Safety

Based on the site visit findings and as reported during the consultations with the land team and Client indicated that the proposed project will not involve in erection of Transmission line. There may be increased number of vehicular traffic carrying men, material and machinery which may result in increased risk of accidents in the region. As reported by Client, speed regularization and monitoring are proposed for all incoming vehicles. Client to effectively implement the SEP and GRM at community level.

Significance of Impact

Impact on Community Health and Safety to be Moderate without any enhancement measures and Minor with enhancement measures.

Mitigations Measures

- Client must effectively implement Stakeholder Engagement Plan (SEP) / Grievance Redressal Mechanism (GRM) to take necessary actions to record / resolve any reported grievance related to the speeding vehicle, community labour conflict, risk of electrocution, etc. and other community level grievances.

Table 7-32: Impact Significance – Restriction Of Access

Aspect	Scenario	Spread	Duration	Intensity	Overall
Community Health and Safety	Without Enhancement measures	Local	Long	Medium	Moderate
	With Measures	Local	Long	Low	Minor

7.6.3 Impacts During the Decommissioning Phase

7.6.3.1 Loss of Employment Opportunities

The manpower requirement during the O&M phase was reported by the project proponent to be in the range of 50 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.

Mitigation Measures for the identified social impacts

- Skill Development and observing local skill force through various education promotion and skill development programs among the local population encourages the local youth to pursue education.
- Client 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. Preference to local workforce to fulfil the manpower requirement in the unskilled and semi-skilled categories. Employment of local youths in the project-specific construction/ operation activities will positively contribute to the livelihood of the local villages.
- The site specific GRM procedures to be developed by Client , and they are yet to be communicated to the community and other stakeholders. Client to disseminate GRM procedures along adequate awareness to the stakeholders on lodging their grievances through GRM.
- Client will develop and implement the Labour retrenchment plan which will ensure

Significance of Impact

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

Table 7-33: Impact Significance – Employment opportunities

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

7.7 Overall Impact Significance Summary

The activities which will be carried out during construction and operation phase are considered for identifying impacts of the project. The activities during construction phase include clearing the ground for construction activity, establishment and of the labour camps, access control and barricading, arrangements of transportation of construction material, collection of construction material,; storage, handling and disposal of solid, hazardous and construction and demolition waste material; excavation works and foundation works, earth works, assembling and its mechanical installation of solar panels, operation and maintenance (O&M) of all machineries, electrical works as stringing of Transmission lines connecting the project site and the sub-station, etc. The operation phase would include activities like operation and maintenance of the power plant and other ancillary facilities etc.

The proposed project will have a few short-term impacts during construction phase. Minor impact due to generation of dust and fugitive emissions are expected during construction phase.

The project will have 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.

The anticipated impacts during the construction and operation phases and after mitigation have been summarized in the Table below:

Table 7-34: Key Impact Evaluation Matrix

Impact Description	Impact Nature	Significance of Impact	Overall Impact after mitigation
Construction Phase: Impact on Environment			
Ambient Air Quality	Negative	Moderate	Minor
Soil Quality	Negative	Moderate	Minor
Impact on Surface and Ground Water Quality	Negative	Major	Moderate
Ambient Noise Quality	Negative	Major	Moderate
Ambient Vibration	Negative	Moderate	Minor
Impact due to Muck	Negative	Moderate	Minor
Waste Storage and Disposal	Negative	Moderate	Minor
Impact Due to labour Camp	Negative	Moderate	Minor
Operation Phase: Impact on Environment			
Visual and Aesthetics	Negative	Minor	Minor
Ambient Air Quality	Positive	Moderate	Moderate
Impact due to Noise and Vibration	Negative	Moderate	Minor
Soil Quality	Negative	Moderate	Minor
Impacts on Water resources	Negative	Minor	Minor
Construction Phase: Impact on Ecology			
Biodiversity and ecosystem services	Negative	Moderate	Moderate
Operation Phase: Impact on Ecology			
Biodiversity and ecosystem services	Negative	Moderate	Minor
Construction Phase: Impact on Socio- Economic			
Socio-Cultural Engagement	Negative	Major	Moderate
Local Economy	Positive	Minor	Moderate
Employment Opportunities	Positive	Minor	Moderate
Impact to Occupational Health and Safety of Workers	Negative	Moderate	Minor
Impact Due to Traffic Diversion	Negative	Moderate	Minor

Impact Description	Impact Nature	Significance of Impact	Overall Impact after mitigation
Impact Due to Labour Influx	Negative	Moderate	Minor
Operation Phase: Impact on Socio- Economic			
Socio-Cultural Engagement	Positive	Minor	Moderate
Occupational Health and Safety of Workers	Negative	Moderate	Minor

7.8 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[41] 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.

It was observed that currently there are no other solar power projects or renewable energy projects which are operational and are located very near to the project boundary. There has been a substantial increase in renewable energy developments in India and Gujarat both, 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.

7.8.1 Environmental Impacts

Air Quality and Soil Characteristics

The baseline ambient air quality measured within 5 km radius of the project is captured through the monitoring exercise performed at five (5) different locations and the results are still awaited from the laboratory team. The construction activity of project will last for 12 months the cumulative impact on ambient air quality can be considered low.

Ambient Noise

The noise from existing surrounding has been captured through the monitoring exercise, the results of which are awaited from the laboratory team

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

[41] 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.

activities will be temporary in nature and will be carried out during the daytime and will not last for more than 12 months, cumulative noise impact is considered low.

Soil and Water Quality

There will not be wastewater generation from cleaning the solar panels due to the dry-cleaning technology proposed to be used. 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.

In addition to this, Minimal amount of solid and hazardous waste will be generated from the solar park during operation phase hence cumulative impact on water quality can be considered minor to moderate

7.8.2 Impacts on Biodiversity and Ecosystem Services

The chief Valued Ecological Components (VECs) with respect to the area under consideration include presence of habitats suitable to globally threatened species and other habitat-specialist species as described in the biodiversity baseline.

7.8.2.1 Impact on Biodiversity

The main cumulative impact envisaged is the loss of habitat due to change in land-use and an increased risk of collision and electrocution for migratory birds from the introduction of new transmission lines into the Study Area. Another major impact envisaged is the fragmentation or loss of suitable natural habitat of globally threatened *Sypheotides indicus* (Lesser Florican, IUCN Red List Status: CR), and/or the endemic or range-restricted *Ophisops kutchensis* (Kutch Small-scaled Snake-eye, IUCN Red List Status: LC).

The mitigation measures stipulated in this report will alleviate the impacts on biodiversity, considering that there are no existing projects in proximity to the Project Site and no information is available on proposed or upcoming projects in the vicinity.

7.8.3 Socio-economic Impacts

7.8.3.1 Impact on land

Project was proposed on about 2260.84 acres (914.929 hectares) of land, including private and government land and the ESIA study was focused on the entire land parcel. Currently, client is planning this project on roughly 1650 acres of land, including private and government land. The government land handover procedure is in process. The land is proposed to be utilized for installation of Solar modules along with site office, inverter room, and other associated facilities. The private land is being sourced through executing long term lease agreement and government land through allotment. The proposed project does not involve in developing Transmission line as the project site boundary is adjacent to the Grid Substation (GSS) and the plant is being connected through underground cables. Of the entire private land only few land parcels are under plantation / cultivation, majority of the project land was observed to be rainfed dry land and were lacking irrigation facilities and few government land parcels are being for farming by informal land users. It was reported that, the project site does not hold any designated grazing land nor does not obstruct the access to any designated grazing land. Overall, the project will not have significant adverse impact since the major portion of the land parcels are barren / not suitable for extensive cultivation.

7.8.3.2 Migrant Workers

The projects activities will not involve any unskilled migrant labor to the extent possible. Only skilled workers for erection of solar modules and operation of cranes would be sourced from neighboring districts / states based on skilled workforce availability and their numbers should be relatively less. During O&M phase, only skilled / technical personnel will be hired from outside the Project Area. Migrant workforce will be accommodated in accommodation complying with the relevant provisions of PS2 of the IFC policy on environmental and social sustainability and IFC/EBRD's Worker's Accommodation Guidance Note. Most of the civil works small in nature should be handled by the local contractors from the nearby regions. This would ensure that the workers are from local area. As a strategic principle is to adopt that all the contractors / sub-contractors 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.

7.8.3.3 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 local community nor block any access roads.

There will be no disturbance to local community as the erection activities will be undertaken at a considerable distance from human settlements.

8. Environmental 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 Client's compliance with all the mitigation measures and commitments in the ESIA report;
- Monitor Client'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 an emergency response 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 Client, 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 EHS standards for the project. Organization structure of Client with project level responsibilities is given in Figure 8-1 below.

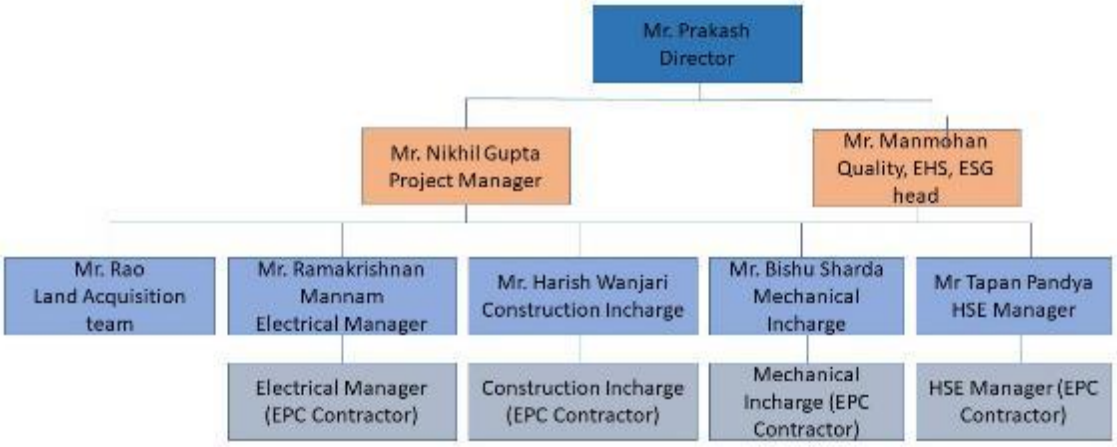


Figure 8-1: Organization structure (Construction phase)

The overall management and coordination of the project with respect to EHS will be managed through the Head, EHS and Project manager at the corporate level. Also, a designated EHS professional/EHS Project (by Client) is assigned at the site 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 team will in turn report to the Client 's corporate team. Client will be solely responsible for the O&M of the project post the contract period with the EPC

8.3 Roles and Responsibilities

This section provides the suggestions on the roles and responsibilities of the key persons responsible for management of the project activities:

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 Client ;
- ESAP and ESMP are documented, accepted, and incorporated into the action plans at the site and all offices of Client; and
- Report on progress and adherence to ESMS and items on ESAP/ESMP.

Site-in-charge

Apart from the project related aspects, Site In-charge with open access team will also have additional responsibilities of community liaison such as:

- Managing all grievances of the project and their outcomes;
- Implementing, monitoring and updating the ESMP;
- Keep record of the Community Development activities being undertaken for the project, if any;
- Keep the Project Manager informed on the progress of Community Development 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/Plant Managers

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.

I&C Contractor (during construction phase)

The HSE officer of the I&C Contractor will be responsible for management of environmental and social aspects, labour management during the construction phase. Overall responsibility will lie with the Client team for entire course of the project. The detailed roles and responsibilities of the I&C 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. • All the domestic wastewater getting generated at the site level to be diverted to the septic tank so that it doesn’t finds 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..
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. • Temporary noise barriers shall be provided surrounding the high noise generating construction equipment (wherever possible). • 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.

Aspect	Roles and responsibilities
	• 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, or handed over to CPCB/SPCB authorized vendors • 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 SPCB 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 (wherever required); • Avoid non-essential sources of hot ventilation (e.g. air conditioner outlets adjacent to working areas); • 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

Aspect	Roles and responsibilities
	• Ensure that all facilities and basic amenities as required by relevant national legislations and international best practice are provide in the Labour Camp/ Worker Accommodation facilities.

Land AquisitionTeam

The land team appointed at the site level would be expected to undertake the following roles:

- Work in coordination with Client corporate team and aggregator during pre-construction phase;
- Carry out meetings, liasioning with local community and other stakeholders of the project;
- Coordinate with corporate team and obtain applicable permits and licenses, such as NA certificate, NOC from Gram Panchayat etc.;
- Co-ordinate and evaluate the effectiveness of all program elements;
- The CLO 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) / Project 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 regional ESG 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 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 Client will monitor the completion and sufficiency status of these programs. In case of subcontractors, the training and capacity building will be done by the EHS 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 Client. 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 needed for effective implementation of ESMP. The training programme will ensure that all concerned members of the team understand the following aspects:

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

EHS head of EPC contractor and Client at site will ensure that environmental health and safety induction training and job specific trainings are identified and given to the concerned personnel for construction activities and operation of the solar project.

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

8.6 Environment and Social Management Plan and Procedures

At the project level, Client need to develop and implement following plans for management of environmental and social aspects of the project throughout the project phase (construction, operation and decommissioning):

- 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
- 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 Pre-construction & 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 pre-construction and construction phase is given in Table 8-1 & 8-2.

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 8-3.

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 8-4.

Table 8-1: ESMP during Pre-Construction Phase

S. N.	Aspects	Impacts	Impact Intensity	Mitigation/ Control Measures	Impact Intensity with Mitigation	Monitoring/ Training Requirements
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 Client	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, intimation letter to SPCB and other permits related to workers and living conditions.	Minor	• Client to ensure Periodic EHS audits 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 as per company's policy shall 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	• Client and its contractor to ensure periodic audits shall 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	Minor	• Development of ESMS management system and procedures before construction work

S. N.	Aspects	Impacts	Impact Intensity	Mitigation/ Control Measures	Impact Intensity with Mitigation	Monitoring/ Training Requirements
				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.		
4.	Biodiversity and Ecosystem Services	• Loss and/or degradation of habitat	Major	The Client shall implement the following mitigation measures: • Deploy a Herpetofauna Expert familiar with LC *Ophisops kutchensis* (Kutch Small-scale Snake-eye or KSS) at the Project Site during the pre-construction activities. • Identify the nearest safe alternative habitats as safe sites for any KSS individuals encountered at the Project Site. • Remove vegetation in a phased manner, progressing gradually from one edge of the Project Site to the opposite edge. • Have each area ear-marked for land-clearance scanned by the land-clearing team, immediately prior to removal of any vegetation, under the guidance and supervision of the Herpetofauna Expert, to detect presence of any individuals of the species. • Facilitate appropriate rescue and relocation of any KSS individuals encountered at the Project Site to the pre-identified safe sites. • Institute a Chance Find Procedure (CFP) at the site, to ensure appropriate action by Project personnel in the event of any CR *Sypheotides indicus* (Lesser Florican or LF) individual being	Moderate	• Engagement of appropriate Herpetofauna Expert • Engagement of appropriate LF expert for designing an appropriate CFP for LF. • Training of Project personnel to implement the CFP for LF.

S. N.	Aspects	Impacts	Impact Intensity	Mitigation/ Control Measures	Impact Intensity with Mitigation	Monitoring/ Training Requirements
				detected in or around the Project Site during the life of the Project. • Minimize the number and width of internal roads. • Maintain connectivity and integrity of natural seasonal streams in & around Project Site during Project Site preparation for construction.		
5.	Tree / Plantation / Crop Loss	• Within the proposed project site land, few land parcels were observed to hold Guava plantations, trees and agriculture equipment and infrastructures such as borewells, farm sheds, pump houses, etc.	Moderate	• Construction activity to commence during the agriculture lien season or post-harvest. • Client / EPC Contractor to allow the farmers to harvest their produce. Prior intimation to be given to landowners on the possession date, to recover the salvaged materials at no charge. • Client to pay adequate compensation for the loss of standing crops, Trees, Plantations, structures (farm sheds / Pumphouse, etc) and borewells / wells. The compensation to based on negotiated rate or at the market value as determined by the relevant government agency (Agriculture / Horticulture / Forest Department / Charted Engineer, etc.)	Minor	• Compensation Payment Records • Grievance Records • SEP Records
6.	Impact on Involuntary Resettlement and loss of livelihood	Proposed project site involves both private and government land. Few patches of government land were reported to be used by informal land users for cultivation. Though, the district administration is responsible for handing over the land to client free from encroachments and encumbrance. There may loss of livelihood and issue of IR may trigger if land under encroachment is being involved.	Moderate	• Client will avoid those lands which are under encroachment. • Under unavoidable circumstances, the client to pay adequate compensation for loss of crops / assets, if any being lost due to project development. • Preference to be given to the eligible PAPs/ informal land users in employment opportunities • Client to ensure fair and transparent land transactions are made and no landowners are forced to lease their land.	Minor	Client to report the status on the land transactions and impact on vulnerable PAPs in the closeout report.

S. N.	Aspects	Impacts	Impact Intensity	Mitigation/ Control Measures	Impact Intensity with Mitigation	Monitoring/ Training Requirements
				• Negotiations with the landowners to be promptly recorded and status on land transactions communicated to the ADB. • Any vulnerable landowners are being encountered in the process of land procurement to be reported to ADB immediately.		

Table 8-2: ESMP during Construction Phase

S. N.	Aspects	Impacts	Impact Intensity	Mitigation/ Control Measures	Impact Intensity with Mitigation	Monitoring/ Training Requirements
1.	Ambient Air Quality	• Fugitive Dust due to movement of project vehicles and site clearance; and • Emission from Diesel Generators.	Moderate	• The Client 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 shall 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 shall 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 to reduce fugitive dust emissions. • Cease or phase down work if excess fugitive dust is observed, or there is any community grievance related to dust. Investigate the source of dust and ensure proper dust suppression.	Minor	• Client /Contractor to ensure all vehicles used for transportation must have a PUC certificate. • Regular check on the exhaust emissions of the construction equipment’s, DG sets.
2.	Soil Quality	• Topsoil Loss	Moderate	• Provide appropriate storage of topsoil in an isolated and covered area to prevent its loss during high wind and runoff. • Allow only covered transportation of topsoil within project site. • Use the soil excavated from one place for filling activities within the site wherever needed. • Use topsoil at the time of plantation (wherever possible). • Protect excess spoils, if any, from runoff. Excess spoil / soil, to be left in orderly piles, covered with topsoil, and re-vegetated. • 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, to reduce the risk of soil erosion.	Minor	• Appropriate storage of topsoil • Excess spoils protected and covered with top-soil and revegetated with native species

S. N.	Aspects	Impacts	Impact Intensity	Mitigation/ Control Measures	Impact Intensity with Mitigation	Monitoring/ Training Requirements
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 reducing 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); • All the domestic wastewater getting generated at the site level to be diverted to the septic tank so that it doesn't finds its way into surface and groundwater and the same to be ensured by the project team; • 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 shall 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 wastewater to protect the shallow ground water level.	Low	• 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 knowing the level of ground water in the nearby areas is low and if possible, recycling and reuse of water to be taken utilising every opportunity.	Minor	• Water Consumption Records to be maintained 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 shall 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 project managers to arrange for inherently quiet construction equipment and machines to maintain the noise level to minimum (wherever required).	Minor	• Periodic monitoring (quarterly) of noise level to be conducted and compared with the ambient noise standard. It shall also be made sure that the levels do not exceeds the national ambient noise quality standards;

S. N.	Aspects	Impacts	Impact Intensity	Mitigation/ Control Measures	Impact Intensity with Mitigation	Monitoring/ Training Requirements
				• 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. • Temporary noise barriers shall be provided surrounding the high noise generating construction equipment (if used anywhere). • 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.		• 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 the authorized recyclers. • Used oil shall 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 shall be tracked and accounted for. • Hazardous wastes shall be stored in leak-proof containers and disposed as per hazardous waste regulation to facilities registered with the State Pollution Control Board.	Minor	• Periodic EHS audits to be conducted by Client; • 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; • 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;	Minor	• Traffic management plan; • Maintain records of driving licenses; • Training to drivers; • Grievance Redressal of any complaint received related to traffic

S. N.	Aspects	Impacts	Impact Intensity	Mitigation/ Control Measures	Impact Intensity with Mitigation	Monitoring/ Training Requirements
				• Regular maintenance of vehicles and use of manufacturer approved parts shall 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.		
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 I&C with supply I&C contractor 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 to be trained for temporary fall • All the workers to made aware of the possible occupational risks/hazards by the way of an OHS training/awareness program • An accident reporting, and monitoring record to 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 to be inform the labour about Emergency Preparedness Plan (EMP) and communication system to be followed during emergency situation.
9.	Biodiversity and Ecosystem Services	Loss and/or degradation and/or fragmentation of habitats	Major	The client shall implement the following measures: • Compensation of loss of any native trees at the Project Site by planting the same species in the same numbers at the nearest possible location with respect to the Project Site.	Minor	• Onboarding & regular in-service training of Project personnel on the Project's biodiversity

S. N.	Aspects	Impacts	Impact Intensity	Mitigation/ Control Measures	Impact Intensity with Mitigation	Monitoring/ Training Requirements
				• Conservation of the natural topography and drainage in and around the Project Site. • Restriction of movement of vehicles and heavy machinery to pre-designated routes. • Restriction of construction activities to daytime. • Minimization of artificial illumination during the night. • Minimization of construction noise and vibrations. • Institution of systems for appropriate containment and disposal of waste or spillage. • Prohibition of harvest of water, fuelwood or wild foods (including fauna) by Project construction personnel. • Maximization of permeable paving, subject to technical feasibility. • Organization of solar panelling into discrete clusters, to minimize contiguous reflective surface. • Implementation of the CFP for LF.		• impact mitigation measures. • Internal monitoring for compliance with Project's biodiversity impact mitigation measures.
10.	Local Economy (I&C Contractor)	• The project will lead to increase in local employment opportunities and increased demand for materials and services through local contracting.	Minor	• Efforts shall 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.
11.	Impact on Involuntary Resettlement	• Though the land is being sourced through private negotiations on willing lessor and willing lessee basis. Since the lease process is under progress, future transactions may lead to IR issue.	Moderate	• Client to ensure fair and transparent land transactions are made and no landowners are forced to lease their land. • Negotiations with the landowners to be promptly recorded and status on land transactions communicated to the ADB through closeout report. • Any vulnerable landowners are being encountered in the process of land procurement to be reported to ADB in the Compensation Close out report. • If in case any vulnerable PAPs are reported to be affected due to the project, to be compensated at the replacement cost.	Minor	• Closeout Report mentioning the status of the Land transactions and impact on vulnerable groups if any.
12.	Labour Rights and Welfare	• Skilled and highly skilled categories to be which will be sourced from locally & outside the Project Area.	Moderate	• The workers shall be aware of their rights and benefits due to them so that no issues emerge. • Labour management plan needs to be developed and effectively implemented at the site as • Adequate sanitation, drinking water and waste disposal facilities shall be provided to all workers on site as well;	Minor	• Labour management plan • Labour accommodation plan • Labour influx plan • Periodic/ surprise audits and checks

S. N.	Aspects	Impacts	Impact Intensity	Mitigation/ Control Measures	Impact Intensity with Mitigation	Monitoring/ Training Requirements
				• 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 shall 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.		
13.	Community Health and Safety	• During the construction phase, traffic movement of heavy vehicles are to be increased within the village roads, increasing the risk of accidents	Moderate	• Client must effectively implement Stakeholder Engagement Plan (SEP) / Grievance Redressal Mechanism (GRM) • Take necessary actions to record / resolve any reported grievance related to the speeding vehicle, community labour conflict, risk of electrocution, etc. and other community level grievances. • Route survey for sensitive receptors	Minor	• Grievance Records • Vehicle Log • Driver Training Records

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 an height closer to the ground so that it doesn't affect the general landscape of the area. • The panels to be arranged in a systematic manner which will give an aesthetic sense. .	Minor	• Visual inspection of solar panels
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 shall 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. • The site office shall be provided with sewage line and the collected sewage shall be channelized to a septic tank with soak pit arrangement. • 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.	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	• Water consumption due to the project water demand	Moderate	• Rooftop rainwater harvesting system will be provided within the plant premises, as feasible. The water harvested to be stored at the Site and will be used for module cleaning instead of tanker water.	Minor	• Maintaining water consumption records on daily basis; • There shall not be a leakage in the storage tankers for

S. N.	Aspects	Impacts	Impact Intensity	Mitigation/ Control Measures	Impact Intensity with Mitigation	Monitoring/ Training Requirements
				• Conserve water at all the project locations and ancillary facilities by recycling and reusing water utilising every opportunity. • It is known that the project will use robotic cleaning of solar panel modules which will reduce the project's dependence on fresh water from nearby areas. •		which regular inspections shall happen.
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, shall 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 shall 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. shall be provided to workers handling electricity and related components and monitored that they are used by the employees • The transformer yard shall be provided with fire extinguishers and sand buckets at all strategic locations to deal with any incident of fire; and • There shall 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 shall be trained for temporary fall • All the workers to be made aware of the possible occupational risks/hazards by the way of an OHS training/awareness program • An accident reporting, and monitoring record to 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 to be inform the labour about Emergency Preparedness Plan (EMP) and communication system to be followed during emergency situation.
5.	Biodiversity and Ecosystem Services	Loss and/or degradation of habitats	Major	The client shall implement the following mitigation measures: • The Client shall conduct awareness programmes for communities around the Project Site to create/improve awareness about LF, particularly its habitat needs, ecology and conservation significance.	Minor	• Onboarding & regular in-service training for Project personnel on Project's biodiversity impact mitigation measures.

S. N.	Aspects	Impacts	Impact Intensity	Mitigation/ Control Measures	Impact Intensity with Mitigation	Monitoring/ Training Requirements
				• The Client shall develop community engagement programmes to promote community-based conservation measures for LF habitat conservation and/or restoration through LF-friendly agricultural practices and/or grassland restoration initiatives. • The Client shall conduct monthly bird fatality monitoring in a 100m buffer of the Project's overhead transmission line corridor. • The Client shall implement carcass management in a 100m buffer of the Project's overhead transmission line corridor. • Allow natural regeneration of herbaceous vegetation under & around the solar panelling, subject to safety considerations with respect to Project personnel. • Plant native species of trees, shrubs & herbs in peripheral areas of the Project Site, subject to technical feasibility. • Restore the soil and natural vegetation of any construction-phase roads which are not required in the O&M phase. • Ensure that all on-ground electrical components are adequately insulated to prevent electrocution of fauna through accidental contact with Project-installations. • Minimize artificial lighting in and around the Project 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 use of herbicides or dust-settling chemicals in the Project Site. • Institute systems to minimize spillage of any toxic substances during O&M activities. • Install containment systems to prevent any accidental spillage of toxic substances from leaching into the local environment.		• Regular internal monitoring for compliance with Project's biodiversity impact mitigation measures.
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	Minor	• Specific clauses facilitating the employment of local youths can be incorporated into the EPC contract agreement between Client and the EPC contractor.	Moderate	• Employment register to be maintained covering location and skill-wise workers

S. N.	Aspects	Impacts	Impact Intensity	Mitigation/ Control Measures	Impact Intensity with Mitigation	Monitoring/ Training Requirements
		• Employment of local youths in the project-specific construction/ operation activities will positively contribute to the livelihood of the local villages.				

Table 8-4: ESMP during Decommissioning Phase

S. N.	Aspects	Impacts	Impact Intensity	Mitigation/ Control Measures	Impact Intensity with Mitigation	Monitoring/ Training Requirements
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 and cadmium telluride. If any	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; • Client 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
		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	• Topsoil 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 SPCB. • 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 and sent back only to the registered producer/refurbisher or recycler manufacture or handed over to authorized SPCB/CPCB authorized recyclers	Moderate	• The workforce to 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.
3.	Biodiversity and Ecosystem Services	Loss and/or degradation of habitats	Major	The Client shall implement the following measures: • Institute suitable training modules for project-personnel and labour contractors to ensure avoidance or minimization of solar panel damage and	Minor	• Trainings for site managers, contractors, and labour to

S. N.	Aspects	Impacts	Impact Intensity	Mitigation/ Control Measures	Impact Intensity with Mitigation	Monitoring/ Training Requirements
				adherence to appropriate decontamination protocols in the event of any unavoidable damage. • Institute suitable training modules for project-personnel and labour contractors to ensure adherence to appropriate safe disposal protocols. • Ensure meticulous removal and sensitive disposal of solar panels and other waste, following the best prescribed practices. • Restrict decommissioning activities to daytime hours. • Avoid artificial illumination during night-time. • Avoid or damp dust, noise, and vibrations to the maximum extent possible. • Prohibit harvesting of fuelwood or wild foods (including fauna) by labour. • Restore land-use/ natural vegetation of the Project Site. • Restore land under the footprint of access roads.		sensitize towards biodiversity conservation Internal monitoring for compliance with any mitigation measures adopted

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 Client, and O&M Contractor engaged by Client 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 Client.

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:

- Tie-up with SPCB/CPCB authorized recyclers to be done for E-waste disposal;
- 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 shall 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 SPCB authorized 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 needs to be diverted in the 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 Water Management plan

The purpose of Water Management Plan (WMP) is to ensure prevention and control of any adverse impact caused by un-regulated 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 water management plan:

- For any changes in flow, direction of natural drains on site, prior approval of relevant government bodies will be obtained.
- All the permissions need to be obtained before using the canal water for the construction purpose.
- 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);
- All the domestic wastewater getting generated at the site level to be diverted to the septic tank so that it doesn’t finds its way into surface and groundwater and the same to be ensured by the project team;
- 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 shall 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 wastewater to protect the shallow ground water level.
- The water for construction shall only be sourced from authorized sources/vendors.
- 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 shall only 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 for project or domestic usage. Workers will be trained for the same.
- Conserve water at all the project locations and ancillary facilities by recycling and reusing water utilising every opportunity.
- If the solar panels are washed with chemicals, it shall be ensured that the chemicals are non-hazardous and biodegradable in nature.

8.6.4 Storm Water Management Plan

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

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

- The peripheral drains will be provided outside the plant boundary during construction phase, which will prevent the silt contaminated surface run-off from site to enter into the adjoining lands.
- No surface run-off from within the solar power plant site will be directly discharged into any nallah/water body.
- 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.
- 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
- Flow, direction, quantity and quality of any of surface water streams will not be altered.
- Detailed storm water management plan will be worked for site along with aspects of flood management at site.
- For any changes in flow, direction of natural drains on site, prior approval of relevant government bodies will be obtained.
- 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;

- 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 for project or domestic usage. Workers will be trained for the same.
- 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 shall be made for temporary or permanent measures that allow for attenuation, control of velocities and capturing of sediment upstream of natural watercourses.
- Project is in the initial stage and client will undertake the necessary studies as required.

8.6.5 Occupational Health and Safety Plan

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.

8.6.5.1 Risk Assessment

Risk assessment is an important step in protecting workers. Client/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 and 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.

8.6.5.2 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.

8.6.5.3 Training Requirements

Client 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. Client 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

8.6.5.4 Documentation and Record Keeping

Client 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

Client 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.

8.6.6 Contract Worker Accommodation Plan

As indicated earlier, it was estimated that, during the peak construction phase, ~2000 workers will be employed during peak construction phase 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 district, the manpower requirement in the skilled and highly skilled categories of about 1500 workers will be sourced from outside the state based on their availability. It was reported by the Client representatives that the migrant workers will be provided accommodation in the labour camps which is to setup during the construction phase. As reported no migrant women workers or family members are to be involved for the project and labour camp would be provided for only men. However, facilities including separate toilets, restrooms, would be provided for local women workers being employed. Labour camps are to be developed adjacent to the project site area 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: -

8.6.6.1 Design / Construction standard

- The height of the rooms shall at least be 10 feet;
- The floor shall 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 shall be 22.5 square mtrs and the minimum area per person shall be 3.5 square mtrs;
- Maximum 6 numbers of people shall be provided accommodation in one room and all of them shall belong to the same gender;
- Separate room shall be provided to family members;
- There shall 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 shall be provided with at least one window for ventilation and adequate illumination;
- External lighting shall be provided in the camp area to allow persons to move safely during the night time;
- Toilets/ drains shall be connected to the septic tank and cleaning of the septic tank shall be ensured regularly;
- Electrical safety norms shall be adhered to ensure electrical safety in the Labour Camp e.g. earthing, MCBs, wiring as per electrical load etc.;
- Adequate drinking water shall be provided as per generic standards and the same shall be monitored half-yearly; and
- Sanitation and drainage shall be ensured in order to maintain proper hygiene in the Labour Camp.

8.6.6.2 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 shall 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 shall meet national/ local drinking water standards.

8.6.6.3 Toilet/ Washing/ Showering Facilities

- Adequate toilet/ washing/ showering facilities shall be provided in the Labour Camp. The number of toilets and showering facilities will depend on the shall of the Labour Camp and the number of workers being accommodated therein;
- Toilet/ Washing facilities shall be provided as required to maintain healthy and sanitary conditions in the Labour Camp. Such facilities shall 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 shall be carried out by the EPC Contractor.

8.6.6.4 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 shall 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 shall be in place to control insects and this shall include fogging and spraying during the mosquito breeding season if necessary, but only after a risk assessment plan has been developed and shared with Lenders for approval.

8.6.6.5 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.

8.6.6.6 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 Client. The proposed inspection shall 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.

8.6.7 Traffic Management Plan

Traffic of more than daily average is anticipated during overall project 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.

8.6.7.1 Management Measures

- Only trained drivers with valid license shall be recruited by Client / 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 shall 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 (20-30 km/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.

8.6.8 Environment and Social Monitoring Plan

8.6.8.1 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 below.

Table 8-5 Environmental Monitoring Plan

S. No.	Environmental Attribute	Monitoring Parameters	Frequency of Monitoring (operations and construction phase)	Responsibility
1	Ambient air quality (construction phase only)	Measurement of Ambient Air Quality (PM10, PM2.5, Nox, SO2, O3, and CO)	Every 3 months	Site Manager
1.	Ambient Noise quality	Measurement of Noise Pressure Level in dB(A)	Every Six Months	Site Manager
2.	Soil Quality	Physico-chemical parameters monitored for baseline data collection (Particle size distribution, texture, pH, permeability, porosity, EC, total nitrogen, phosphorus, sodium, potassium etc)	Every Six Months	Site Manager
3.	Water Resources	Physico-chemical parameters monitored for surface and ground water baseline data collection (physical parameters like: Colour, odour, pH, taste, TDS, EC and physical parameters like total hardness, aluminium, boron, nitorgent, alakalinity etc)	Every Six Months	Site Manager
		Water meter readings to be maintained on daily basis	Monthly	Site Manager

S. No.	Environmental Attribute	Monitoring Parameters	Frequency of Monitoring (operations and construction phase)	Responsibility
4.	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
5.	Ecological	• Visual inspection of the site area for death or injury of any faunal species, especially KSS, 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	
		• Implementation and monitoring of mitigation measures, including habitat restoration and maintenance.	Quarterly	

8.6.8.2 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

8.6.8.3 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;
- Client shall ensure that retrenchment packages are provided for all staff who stand to lose their jobs when the plant is decommissioned.

8.6.9 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

8.6.9.1 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

8.6.9.2 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.

8.6.9.3 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.

8.6.9.4 Emergency Equipment

The following points shall 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 shall include:

- Heavy-duty ABC powder type fire extinguishers kept at important electrical equipment areas;
- Portable CO2 extinguishers provided throughout the plant

Provision of Personal Protective Equipment (PPE)

Onsite workers and site staff shall 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
1.	120 seconds Continuous Whelming Sound	ON SITE EMERGENCY (ALERT) for evacuation	Plant Head/ EHS Manager

S. No.	Siren	Indicate	Authority
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.

8.6.9.5 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 GPCB, Factory Inspectorate etc.
- Local Authorities and District Administration
- District Disaster Control Room, Surendranagar

8.6.9.6 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

8.6.9.7 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.

8.6.9.8 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. Conclusion

The Environmental and Social Assessment study for the proposed 400 MW solar power project to be developed by Client in Surendranagar district, Gujarat has been undertaken in accordance with International Finance Corporation (IFC) Sustainability Framework (Policy and Performance Standards on Environmental and Social Sustainability) 2012, , ADB Safeguard Policy Statement (SPS) (2009); 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 during the operational phase. GHG emissions and other environmental pollution (stack emissions, ash management etc.) issues are also limited.

- Applying the criteria stipulated by the IFC Policy on Environmental and Social Sustainability for environmental and social categorization of projects, Client 's proposed 400 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[42].
- **ABD Safeguard Requirements 1: Environment:** The proposed project site is a solar power project which is a clean technology project using solar energy for generation of electricity and no harmful emissions are expected from the project operations, though the monitoring at the site was not done due to land procurement activities. Based on the ADB Policy on categorization of projects, the current project can be categorized as '***Category B***' with respect to environmental impacts. This is based solely on the primary data available to date. Environmental monitoring data was yet to be obtained for the project due to ongoing land purchase.
- **ADB Safeguard Requirements 2: Involuntary Resettlement:** The proposed project involves in sourcing of both Private and Government Land. It was reported that private land is to be sourced through executing long term lease agreement on willing lessor and willing lessee basis and government land on basis of allotment from the district administration. Based on the discussion with Client team and site visit observations, few government land parcels were under cultivation by illegal encroachers. Though there are no physical structures, agriculture equipment's or developments were observed within those land, use of government procedures and loss of livelihood for the encroachers is envisaged in taking procession of the Government land. Hence, considering Involuntary resettlement impacts are deemed not significant the project is **Categorized as B** for SR2-IR[43].

ADB Safeguard Requirements 3: Indigenous Peoples: The proposed solar site land including the TL route does not fall under Schedule-V areas as defined in the Indian Constitution under Article 342. The land being involved for solar plant and TL does not comprise of any tribal land/ land parcels owned by members belonging to the Indigenous Peoples (IP) or their dependency on the land for livelihood. Moreover, it is to be noted that there are no significant Scheduled Tribe population residing within the project villages. Hence the proposed project is not expected to have impacts on indigenous peoples and is **Categorized as C.** 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
- No forest land will be used for project
- Tranmission line (~70 m) will be underground
- 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.

[42] Considering that project will not use government land which has informal land users
[43] Considering that project will not use government land which has informal land users